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## Relationships between Entrepreneurial Factors and the Technical Efficiency of Eastern and Non-eastern Private Manufacturing SMEs in China

Leqi Zhao

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**Relationships between Entrepreneurial Factors and  
the Technical Efficiency of Eastern and Non-eastern  
Private Manufacturing SMEs in China**

by

**Leqi ZHAO**

This thesis is presented as part of the requirements for the award of the Degree of

**Doctor of Philosophy**

of the

University of Wollongong

School of Accounting, Economics and Finance, Faculty of Business

**April 2019**

## **Declaration**

I, **Leqi Zhao**, declare that this thesis, submitted in fulfilment of the requirements for the conferral of the degree Doctor of Philosophy, from the School of Accounting, Economics and Finance, Faculty of Business, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

**Leqi ZHAO**

April 2019

## **Thesis-related Research Outcomes**

### **Conference Paper:**

Zhao, L. Q., Harvie, C., & Arjomandi, A. (2015). *Technical efficiency of Chinese private manufacturing SMEs—A regional comparison between different development stages within China*, paper presented at the 27th Annual Conference of Chinese Economics Society Australia (CESA), Wollongong, Australia, 12-14 July, 2015.

Zhao, L. Q., Harvie, C., & Arjomandi, A. (2017). *Entrepreneurial factors and efficiency performance of private SMEs in China*, paper presented at the 16th Annual Conference of Shanghai–Hong Kong Development Institute, Hong Kong, 15-16 December, 2017.

Zhao, L. Q., Harvie, C., & Arjomandi, A. (2017). *Entrepreneurial quality and performance of private SMEs in China: Where should the ‘Mass Entrepreneurship and Innovation’ go?*, paper presented at the 30th Annual Conference of the Chinese Economics Society Australia (CESA), Sydney, Australia, 15-17 July, 2018.

## **Abstract**

The contribution of entrepreneurship to economic growth has been shown both theoretically and empirically. As in other countries, entrepreneurs and their private small and medium enterprises (SMEs) have been playing a vital role in the market-oriented economy of China. They can facilitate the spillover of new knowledge to drive an endogenous economic growth, and are thus especially important for China's transition into an innovation-driven economy. In the manufacturing sector, they are significant for moving up the position of China in the global manufacturing value chain by innovation activities. In 2015 China's government proposed the 'Mass Entrepreneurship and Innovation' program to encourage more entrepreneurial activities. But the concern of researchers has now moved from the quantity of entrepreneurs to the quality of entrepreneurs. Private SMEs built by high quality entrepreneurs with good post-entry performance can better contribute to economic growth. The performance of private SMEs should be estimated to better understand entrepreneurial activities in the manufacturing sector of China and facilitate the implementation of the 'Mass Entrepreneurship and Innovation' program. But it has not been studied in the existing literature.

The objective of this research is to evaluate the technical efficiency performance and identify the entrepreneurial factors related to this performance for private manufacturing SMEs in the eastern and non-eastern regions of China. It uses cross-sectional data for 664 private manufacturing SMEs in China from the *2012 China Private Enterprise Survey*. The parametric Stochastic Meta-Production Function (SMF) model and Tobit regression are combined in this research to estimate the scores and determinants of metafrontier technical efficiency, instead of the traditional regional frontier technical efficiency, in order to make an effective comparison of the efficiency performances between eastern and non-eastern regions. This research is not only the first to estimate the technical efficiency performance of private manufacturing SMEs in China using reliable firm-level data. It is also the first to identify the relationships between comprehensive entrepreneurial factors and a firm's technical efficiency performance, and the first to estimate the metafrontier technical efficiency scores for SMEs.

The empirical results of this research show that the regional frontier technical efficiency scores for eastern and non-eastern private manufacturing SMEs in China were 91.41 per cent and 81.11 per cent in 2012, respectively. The ratio of the technology used by eastern private manufacturing SMEs relative to the best technology available in China is estimated to be 95.56 per cent in 2012, while this ratio for non-eastern private manufacturing SMEs was 90.00 per cent. Combining the effects of regional frontier technical efficiency and the technology gap ratio, the eastern private manufacturing SMEs were found to produce 87.38 per cent technically efficiently relative to the national metafrontier. The metafrontier technical efficiency score for non-eastern private manufacturing SMEs was 73.26 per cent in the same year. These results reveal that the efficiency performance of private manufacturing SMEs in both eastern and non-eastern regions should be further promoted. Eastern private SMEs produced more efficiently and also used more advanced technology than those located in the non-eastern regions in the manufacturing sector of China. More effort should be put into improving the performance of non-eastern private SMEs to help China achieve a balanced economic growth.

This research also provides empirical evidence that, in eastern regions, an entrepreneur's university education and business connections and a firm's size, age, export density, credit access and R&D activities can have positive and significant relationship with the regional frontier technical efficiency of private manufacturing SMEs, while an entrepreneur's age and political connections with the Communist Party of China are found to have a negative relationship with it. Other factors, including an entrepreneur's start-up motivation, gender and experiences, are all shown to be insignificant for their technical efficiency relative to the regional frontier in eastern regions. The results for non-eastern private manufacturing SMEs show that an entrepreneur's opportunity-driven start-up motivation, university education, management experience, start-up experience, technical experiences and political connection and a firm's size, export density, credit access and R&D activities are all related to a significantly higher regional frontier technical efficiency level. But the age, gender and business connections of an entrepreneur and the age of a firm have insignificant relationships with it in non-eastern regions. Another important result found by this research concerns the determinants of technology level used by private SMEs in the manufacturing sector of China. Private manufacturing SMEs built by opportunity-driven entrepreneurs, males and those with

university education, start-up experiences and business connections used more advanced technology than their counterparts. Older SMEs with more export density, credit access and R&D activities also had a higher technology level. However, entrepreneurs with management experience, technical experience and political connections adopted less advanced technologies than their counterparts, while an entrepreneur's age is shown to have no relationship with the technology level of private manufacturing SMEs in China.

Combining the relationships of these factors with the regional frontier technical efficiency in different regions and the technology level of private manufacturing SMEs, the empirical results of this study indicate that private SMEs started by an entrepreneur who is opportunity-driven, younger and male and has university education, start-up experiences and business connections can produce more technically efficiently relative to the metafrontier in China's manufacturing sectors. But the management experience, technical experience and political connections of an entrepreneur has an insignificant relationship with their metafrontier technical efficiency. Moreover, private SMEs that are medium in size and older and have more export, credit access and R&D activities can have a significantly higher metafrontier technical efficiency level.

Based on the empirical results obtained, this research concluded that the policy orientation of the 'Mass Entrepreneurship and Innovation' program should change from merely encouraging more entrepreneurial activities to also improving the performance and quality of private SMEs. The detailed recommendations include decentralising the power of supporting private SMEs by allocating government funds to local government and building regional SME clusters to achieve balanced economic development across regions; further improving the doing business environment in China with less government control over market activities to provide a level playing field for all enterprises; encouraging more highly-educated and opportunity-driven entrepreneurs to conduct and commercialise innovation; encouraging cooperation between university and industry and providing training to entrepreneurs; establishing more business incubators, private 'one-stop shop' service platforms for SMEs and autonomous business associations; helping private SMEs have better access to bank loans; and further improving the Intellectual Property Protection (IPR) environment in China to facilitate innovation by enterprises.

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## Abbreviations

ADB	Asian Development Bank
ACFIC	All-China Federation of Industry and Commerce
AFIC	All-China Federation of Industry and Commerce
AIC	Administration of Industry and Commerce
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asia Nations
BCC	Banker, Charnes and Cooper
CASS	Chinese Academy of Social Sciences
CBE	Commune and brigade enterprises
CBRC	China Banking Regulatory Commission
CCR	Charnes, Cooper and Rhodes
CIRC	China Insurance Regulatory Commission
CNC	Computer numerical control
COLS	Corrected ordinary least squares method
CPC	Communist Party of China
CPPCC	Chinese People's Political Consultative Conference
CRS	Constant returns to scale
DEA	Data Envelopment Analysis
DGP	Data-generating process
DMU	Decision Making Unit
DRS	Decreasing return to scale
EBIT	Earnings before interest and tax
ETDZ	Economic and Technological Development Zones
EU	European Union
EYB	Expand Your Business
FDI	Foreign Direct Investment
FIC	Federation of Industry and Commerce

GAC	General Administration of Customs
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GNP	Gross National Product
GYB	Generate Your Business Idea
ICT	Information and communications technology
ILO	International Labour Organization
IMF	International Monetary Fund
IP	Intellectual property
IPO	Initial Public Offering
IPR	Intellectual Property Rights
IRS	Increasing returns to scale
IT	Information technology
IYB	Improve Your Business
LR	Log-likelihood ratio
MEI	Mass Entrepreneurship and Innovation
MHRSS	Ministry of Human Resource and Social Security
MLE	Maximum likelihood estimation
MIIT	Ministry of Industry and Information Technology
MOE	Ministry of Education
MOF	Ministry of Finance
MOT	Ministry of Technology
NBS	National Bureau of Statistics
NDRC	National Development and Reform Commission
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary least squares
PBC	People's Bank of China
PC	People's Congress
PIM	Perpetual Inventory Method

PMI	Purchase Management Index
PPC	Production possibility curve
PPF	Production possibility frontier
PPP	Purchasing Power Parity
R&D	Research and development
ROA	Return on assets
ROE	Return on equity
ROI	Return on investment
ROS	Return on sales
SAIC	State Administration of Industry and Commerce
SAT	State Administration of Tax
SEZ	Special economic zone
SFA	Stochastic Frontier Analysis
SIPO	State Intellectual Property Office
SIYB	Start and Improve Your Business
SMC	Student mini-company
SME	Small- and medium-sized enterprise
SMF	Stochastic Meta-production Function
SOE	State-owned enterprise
SYB	Start Your Business
TEA	Total Early-stage Entrepreneurial Activity
TVE	Township and village enterprise
UFWD	United Front Work Department of the CPC Central Committee
U-I	University-industry
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
VRS	Variable returns to scale
WTO	World Trade Organization

# Chapter 1 Introduction

## 1.1 Background of the research

The economic development of China since the ‘Reform and openness’ policy proposed and implemented in 1978 has been extraordinary (Garnaut & Song, 2018). Externally, China opened its closed and self-sufficient planned economy by promoting international trade and absorbing foreign investment and technology (Gallagher, 2002; Qian & Wu, 2008; Tisdell, 2009). Currently, China is one of the top countries in terms of trade and FDI usage (UNCTAD, 2018a). Domestically, the economic reforms relating to the rural sector, financial markets, and, most importantly, the private sector have also contributed to the country’s economic development (Lin *et al.*, 2003; Tisdell, 2009). The private sector and entrepreneurial activities were officially allowed from 1988 in China and given further impetus after Deng Xiaoping’s successful tour of southern China in 1992 (Tsai, 2007; Garnaut *et al.*, 2012). With the explicit support of China’s government, by 2017 there were 27.26 million private enterprises, accounting for 84.26 per cent of total enterprises in China (NBS, 2018b). The private sector makes a significant contribution to China’s economy in term of industrial output, employment, exports and innovation (General Administration of Customs, 2017; NBS, 2017a; 2017b; 2017c). Due to the country’s successful international economic integration and domestic private sector growth, China’s real GDP growth rate reached 9.59 per cent per annum, on average, between 1978 and 2017. After nearly forty years of development China has taken 800 million people out of poverty (World Bank, 2018b), making it rise from being one of the poorest countries in the world to being an upper-middle-income country and the largest economy on a Purchasing Power Parity (PPP) basis since 2013 (World Bank, 2018b). It has also successfully transitioned from a factor-driven economy into an efficiency-driven economy (Schwab & Porter, 2008).<sup>1</sup>

But China’s economy has been experiencing a significant slowing down since 2011. Its real GDP growth rate decreased sharply from 10.63 per cent in 2010 to 6.68 per cent in 2017, together with a reduction in exports and FDI inflows since 2015 (World Bank,

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<sup>1</sup> According to Porter (1990), an economy experiences three development stages, including the factor-driven stage, the efficiency-driven stage and the innovation-driven stage. The explanation and characteristics of these stages are discussed in detail in Section 2.3.

2018c; UNCTAD, 2018a). This is mainly due to a loss of competitiveness in its labour-intensive manufacturing sector caused by the ending of abundant and cheap labour, the low position of its firms in global value chains and poor labour productivity (Li *et al.*, 2012; Butollo, 2014; Jiang & Wang, 2016; ILO, 2018). Several other developing economies in the region with abundant and cheap labour, such as some ASEAN countries<sup>2</sup>, have begun to threaten the dominant position of China in labour-intensive, low value adding manufacturing (Witchell & Symington, 2013). China needs to move up the global value chains and transition its comparative advantage from cheap labour to knowledge and innovation intensive activities (State Council, 2015d). To upgrade the manufacturing sector from ‘Made in China’ to ‘Designed in China’, China proposed an important development strategy for its manufacturing sector in 2015–‘Made in China 2025’ (State Council, 2015d).

In the ‘Made in China 2025’ strategy, the role of the private sector and entrepreneurial activities have been emphasised, as entrepreneurship is the link between new knowledge and economic development (Audretsch & Keilbach, 2004; Acs, 2006; Audretsch *et al.*, 2006). By creating private businesses to commercialise innovation, entrepreneurial activities can spill over new knowledge to generate technological progress, and are thus a key driver for endogenous economic growth (Acs *et al.*, 2004; Audretsch *et al.*, 2006; Audretsch & Keilbach, 2007; Acs *et al.*, 2013). By introducing new entrants and ideas into the market, entrepreneurial activities can increase competition and diversity, resulting in higher market efficiency and sustainable growth (Wennekers & Thurik, 1999; Audretsch & Keilbach, 2004). They are also significant for China’s inclusive economic growth<sup>3</sup> by providing job opportunities for disadvantaged groups, such as laid-off workers, females, youth and rural residents (ADB, 2012; Li & Hendrischke, 2014). To promote entrepreneurial activities, China implemented the ‘Mass Entrepreneurship and Innovation’ (MEI) program in 2015. It aims to improve China’s entrepreneurship and innovation level by encouraging its citizens to become more involved in entrepreneurial activities, especially in the manufacturing sector. In this program, small and medium

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<sup>2</sup> ASEAN (Association of Southeast Asian Nations) consists of 10 countries: Indonesia, Malaysia, Philippines, Thailand, Singapore, Brunei, Cambodia, Lao, Myanmar and Vietnam. Of these, Cambodia, Lao PDR, Myanmar and Vietnam have lower labour costs.

<sup>3</sup> Inclusive growth is defined as a growth process in which the benefits from economic growth can be equitably shared by all participants in the economy (Ranieri & Ramos, 2013).



enterprises (SMEs) have been particularly supported because they are the most common enterprise form (99.15 per cent of entrepreneurial enterprises) (Lin & Zhu, 2007). They are the backbone of China's economy and have been the policy focus of the 'Made in China 2025' and MEI programs (State Council, 2015d; 2015e).

Recent research, however, has stressed that not all entrepreneurial activities can contribute to economic growth. Some entrepreneurs do not have the motivation to engage in innovation because they are driven only by the need for income due to a lack of job opportunities in the labour market (Audretsch *et al.*, 2001; Acs & Varga, 2005; Wong *et al.*, 2005; Acs, 2006; Shrivastava & Shrivastava, 2013). Also, new firms created by less capable entrepreneurs without a well-considered business plan may have poor after-entry performance and exit the market quickly (Santarelli & Vivarelli, 2007; Shane, 2009; Vivarelli, 2013). Due to the short survival time of such firms, they may not be able to create real innovation, competition and diversity in the market to generate higher economic efficiency and technological progress, thus cannot contribute to the economy effectively (Fritsch & Schroeter, 2011; Mason & Brown, 2013; Vivarelli, 2013). The quality of entrepreneurial activities is especially important for economic growth in emerging economies such as China, because there are usually a large portion of entrepreneurs with low innovation intention and less capable entrepreneurs with a high exit rate (Robichaud *et al.*, 2010; Vivarelli, 2013). As stated by Goedhuys and Sleuwaegen (2010), high-quality entrepreneurs are of particularly crucial importance in emerging economies for catching up on knowledge capital and the technology level of developed economies. Therefore, the concern of modern research on entrepreneurial activities has changed from the issue of quantity to that of quality, especially in emerging economies (Piergiovanni & Santarelli, 2006; Shane, 2009).

However, the MEI program of China is mainly focused on improving the quantity of entrepreneurial activities, private SMEs in particular, rather than on improving the quality of these activities. In fact, the exit rates of small businesses with less than 1 million RMB registered capital and enterprises with 1-10 million RMB registered capital reached 60 per cent and 40 per cent respectively after 10 years between 2000 and 2010, rates which were much higher than that of large enterprises with more than 10 million RMB registered capital (State Administration of Industry and Commerce, 2013). This raises concern about

the poor performance of private SMEs in China (Zhu *et al.*, 2012; NBS, 2018d), especially in the manufacturing sector (NBS, 2018d). Better prepared and higher quality entrepreneurs are needed to improve the performance of entrepreneurial activities (private SMEs) in China.

To support this development and improve the quality of private SMEs, their current performance and factors contributing to this need to be better understood and measured. The efficiency performance of SMEs is particularly important compared with other performance indicators, because it is an essential determinant of new entrant survival in the market selection process (Jacobs, 1969; Evans, 1987; Vivarelli, 2013). Representing the capability of a firm to transfer inputs into outputs in production (Farrell, 1957), the technical efficiency of SMEs has been estimated for many developing countries such as the Philippines (Mini & Rodriguez, 2000), Thailand (Charoenrat & Harvie, 2014), and Kenya (Lundvall & Battese, 2000). But firm-level estimation of the technical efficiency of private SMEs is still absent in the context of China. This study estimates the technical efficiency of China's private manufacturing SMEs to show their efficiency performance and determinant variables.

Moreover, entrepreneurial factors can be significant in determining firm performance (Vivarelli, 2013). Empirically, there have been some studies linking a firm's performance to some entrepreneurial factors (e.g. Barkham, 1994; Harada, 2004; Huggins *et al.*, 2017), but none of these include comprehensive entrepreneurial factors such as motivation, age, gender, human capital and networks, or use efficiency as the performance indicator in the context of China. This study addresses these problems by identifying the relationships of the entrepreneurial factors discussed above with the technical efficiency of China's private manufacturing SMEs. Using these empirical results, effective policy recommendations on how to improve the performance of entrepreneurs with different characteristics in the context of the MEI program are proposed.

In studying the performance of private SMEs, the regional disparities across China should be considered. Opening and developing eastern coastal regions first during the 'Reform and openness' period resulted in a significant regional income and development disparity between eastern and non-eastern regions (Démurger *et al.*, 2002; Zhou & Song, 2016),

which persists until now (Zhang & Zou, 2012; Zhou & Song, 2016). This inequality is also reflected in the development of private SMEs. China's private SMEs emerged from the most developed eastern regions which have more open and mature economies and well-developed doing business environments. Private SMEs in these developed eastern regions perform better and make a greater contribution to the economy (Liu, 2008; Wu & Xu, 2013). With a different market development, private SMEs in China should, more appropriately, be studied at the regional level and policies for improving the quality of entrepreneurial activities should also have a regional focus to reflect these differences.

In summary, this study conducts a quantitative analysis to estimate the technical efficiency of private manufacturing SMEs in eastern and non-eastern regions of China and the contribution to this of entrepreneur related factors. This can provide MEI program policy makers with a better understanding of the contribution of entrepreneur related factors to efficiency and how to effectively support the performance of entrepreneurs at the regional level. This can assist China to develop more quality entrepreneurial activities to transition to an innovation-driven economy and upgrade its manufacturing sector to become more technology-intensive in the following years.

## **1.2 Research objectives and research questions**

This study aims to examine the efficiency performance and the entrepreneurial determinants of this performance for private manufacturing SMEs in eastern and non-eastern regions of China, respectively. The specific purposes of the study are to:

- a) Evaluate the technical efficiency of private manufacturing SMEs in China, and in eastern and non-eastern regions of China, respectively;
- b) Identify the determinants of technical efficiency with a focus on the characteristics of their entrepreneurs, after controlling for other firm factors;
- c) Provide policy recommendations based on the empirical results derived from this study with the aim of improving the performance and quality of entrepreneurial activities in China's SME manufacturing sector.

The research questions correspond to the above objectives and are as follows:

- a) How do private manufacturing SMEs perform in eastern and non-eastern regions of China in terms of technical efficiency?
- b) What are the relationships of entrepreneurial factors and other firm factors (control variables) with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?
- c) How can the technical efficiency performance of China's private SMEs in the manufacturing sector be improved in eastern and non-eastern regions?

Several sub-research questions are derived from the above research questions:

- (1) How do eastern and non-eastern private manufacturing SMEs perform differently in terms of technical efficiency?
- (2) What is the relationship of an entrepreneur's '*start-up motivation (opportunity-driven or necessity-driven)*' with the technical efficiency of eastern and non-eastern private manufacturing SMEs of China?
- (3) What is the relationship of an entrepreneur's '*age*' with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?
- (4) Do '*male*' entrepreneurs outperform female entrepreneurs in terms of technical efficiency for eastern and non-eastern private manufacturing SMEs in China?
- (5) What is the relationship of an entrepreneur's '*education level*' with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?
- (6) Which type of '*previous experiences*' (start-up experiences, management experiences and technical experiences) has significant relationship with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?

- (7) Which type of ‘*guanxi*’ (political and business connections) has significant relationship with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?
- (8) What are the relationships of the other firm-specific variables such as (i) firm age, (ii) firm size, (iii) export density, (iv) credit access, and (v) R&D activities with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China?
- (9) How can policies be developed to improve the efficiency performance of eastern and non-eastern private manufacturing SMEs to facilitate China’s MEI program?

### **1.3 Contribution and significance of the research**

According to the research objectives and research questions presented above, this thesis will make a significant contribution to the literature in several areas. as follows:

This thesis is the first to estimate the technical efficiency of private manufacturing SMEs across China utilising firm-level data for 2012.<sup>4</sup> Although the technical efficiency of manufacturing SMEs has been estimated in many developing countries (see Section 1.1), there are only four studies on SMEs’ technical efficiency in the context of mainland China. Three of these studies only cover SMEs in a single province, including Hubei (Fan, 2009), Guangdong (Long *et al.*, 2012) and Jiangsu provinces (Zhou & Peng, 2014). The only study covering all provinces of China was conducted by Xu and Song (2013), but their study used aggregate province-level data for estimation purposes. The accuracy of aggregate data in China is questionable compared to that of firm-level data due to China’s vertical statistical reporting system, and conflicts between reporting accurate data and the desire for political promotion by statistical officers (Rawski & Xiao, 2001; Brandt *et al.*, 2014). Thus, an empirical estimation of the technical efficiency performance of manufacturing SMEs across China using more accurate firm-level data is required.

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<sup>4</sup> China’s private enterprises survey data series has been conducted every two years since 1992. While the 2016 survey has already been conducted, the latest data readily available to researchers and the public is that for 2012 (see Chapter 6 for more details).

The significant regional development inequality across China's eastern and non-eastern regions requires a regional estimation and comparison of the technical efficiency levels of SMEs, but current empirical studies on SMEs usually only estimate and compare the technical efficiency levels of SMEs under different regional frontiers directly (e.g. Batra & Tan, 2003; Xu & Song, 2013). However, as pointed out by O'Donnell *et al.* (2008), comparing efficiency levels relative to a frontier with that relative to another frontier is meaningless. To make a reasonable regional comparison, the technical efficiency levels for each region relative to a national metafrontier should be estimated (Battese *et al.*, 2004; O'Donnell *et al.*, 2008). Metafrontier technical efficiency can be decomposed into technical efficiency relative to the regional frontier and the technology gap ratio, which can also help understand the sources of inefficiency (technical inefficiency under regional technology and the technological gap to national technology) of SMEs in different regions (Battese *et al.*, 2004; O'Donnell *et al.*, 2008). This is essential in making policies to address the inefficiency of SMEs. In empirical studies metafrontier technical efficiency has been estimated for farms (Moreira & Bravo-Ureta, 2010), hotels (Huang *et al.*, 2014), accounting firms (Chang *et al.*, 2015) and banks (Huang *et al.*, 2015), but there has been no empirical estimate of metafrontier technical efficiency for SMEs. This study is the first to estimate (i) technical efficiency relative to a regional frontier, (ii) a technology gap ratio, and then (iii) technical efficiency relative to a metafrontier for the entire SME sector. This is also the first study to conduct a comparison of the metafrontier technical efficiency levels between eastern and non-eastern private manufacturing SMEs in China.

More importantly, this thesis also identifies the relationships of entrepreneurial factors and firm-specific factors with private manufacturing SMEs' technical efficiency, which has not been studied comprehensively and in the context of mainland China. This makes important contributions to the literature as shown in the following:

1. While empirical studies have investigated the relationship of an entrepreneur's motivation with firm performance, these have been conducted mainly for developed countries (see Section 4.6.1 for more detail). The relationship of an entrepreneur's motivation with firm performance has not been studied in a developing country like China nor in different regions across China. Also, most of these studies have used growth as the motivation indicator, as identified by self-designed questions in surveys

instead of by official classification of an entrepreneur's motivation (e.g. Miner et al., 1994; Delmar & Wiklund, 2008; Moen et al., 2016; Huggins et al., 2017). The start-up motivation of an entrepreneur was officially classified into opportunity-driven and necessity-driven motivation by the Global Entrepreneurship Monitor (GEM) in 2001 (Reynolds et al., 2002). To date, there have only been a few studies on the performances of opportunity- and necessity-driven entrepreneurs and their SMEs. These studies have used survival, profit and productivity as performance indicators (e.g. Block & Sandner, 2009; Amin, 2010a; Block & Wagner, 2010). No empirical study has conducted an analysis of the performance differences between opportunity and necessity entrepreneurs in terms of technical efficiency.

2. As discussed in the literature review, an entrepreneur's age can have both potential negative and positive relationships with firm performance (see Section 4.6.2). The conclusion to this hypothesis may differ between countries or regions based on their special contexts. Using technical efficiency as the performance indicator, this hypothesis has been examined in many countries, such as the Netherlands (Bremmer *et al.*, 2008) and Nigeria (Amaechi *et al.*, 2014), but there has been no study focusing on China, or even regions across China, especially for private manufacturing SMEs.
3. As shown in the literature review in Section 4.6.2, many empirical studies have examined the underperformance of female entrepreneurs, using sales, survival, growth and profit as performance indicators (e.g. Kalleberg & Leicht, 1991; Robb, 2002; Fairlie & Robb, 2009; Robb & Watson, 2012). Some studies have also studied the relationship of gender with a firm's technical efficiency (Hernández-Trillo *et al.*, 2005; Nordman & Vaillant, 2014), but none of these studies have focused on whether there is an underperformance of female entrepreneurs across China.
4. As an indicator of the generic human capital level, the relationship of an entrepreneur's education level with a firm's performance has been examined by many empirical studies (see Section 4.6.3 for a detailed literature review). Some of these studies have utilised technical efficiency as the performance indicator by which to examine this hypothesis for SMEs (e.g. Burki & Terrell, 1998; Gokcekus *et al.*, 2001; Alvarez & Crespi, 2003; Hernández-Trillo *et al.*, 2005). But there have been no empirical studies investigating whether an entrepreneur's education level has relationship with the technical efficiency performance of SMEs in China.

5. The specific human capital of an entrepreneur can be indicated by different kinds of experiences, such as start-up experience, management experience and technical experience. There have been some empirical studies relating a firm's performance to an entrepreneur's previous management experiences (Stuart & Abetti, 1990; Cooper *et al.*, 1994; Bosma *et al.*, 2004), start-up experiences (Dahlqvist *et al.*, 2000; Dahl & Reichstein, 2007; Haber & Reichel, 2007) and experiences as a technical staff member (Stuart & Abetti, 1990; Bayus & Agarwal, 2007). But the relationship between an entrepreneur's previous experiences and a firm's performance have never been studied for the case of China, especially for private manufacturing SMEs in different regions of China. Moreover, most of the studies discussed above have used growth, profitability and survival as performance indicators. Some studies have used technical efficiency as a measure of performance, but they only examined the impact of management experience (Alvarez & Crespi, 2003; Gokcekus *et al.*, 2001). Until now, no empirical study has investigated the relationships of an entrepreneur's management experience, start-up experience and technical experience with the technical efficiency of firms simultaneously, which is conducted in this research.
6. As a significant informal source for entrepreneurs to obtain scarce resources, information and advice, the networks possessed by an entrepreneur, including political and business networks, have been related to a firm's performance. However, in the 61 studies examining this relationship reviewed by Stam *et al.* (2014), no single study has linked an entrepreneur's networks to a firm's technical efficiency. Empirical studies using China as a case study to examine the relationships of networks with firm performance have only related these to a firm's growth, profit and returns (Peng & Luo, 2000; Park & Luo, 2001; Li *et al.*, 2008; Du & Girma, 2010). Therefore, a study of the ways in which networks can be related to a firm's efficiency performance, specifically for the case of China, has, as yet, not been conducted. Moreover, most of the empirical studies on this relationship in China have concluded that the political and business connections of entrepreneurs are both significantly related to firm performance. Recent developments and reforms relating to China's government and market system indicate, however, that the relationship between networks and doing business may have declined (Gu *et al.*, 2008; Zhang & Keh, 2010; Luo *et al.*, 2012). This calls for evidence from empirical studies using the latest available data. In addition, empirical studies examining these two hypotheses for the case of China have not considered regional



disparities in the process of market development. The influence of networks is expected to be less significant in eastern regions with well-developed markets than in non-eastern regions (Li *et al.*, 2008). This study fills these gaps by identifying the relationships of an entrepreneur's political and business connections with the technical efficiency of eastern and non-eastern private manufacturing SMEs, respectively, using the latest available data for China in 2012.

7. Also, this study uses firm-specific factors, including a firm's age, size, export density, credit access and R&D activities as control variables, to examine their relationships with the technical efficiency of eastern and non-eastern private manufacturing SMEs in China, which have not been identified in previous empirical studies.

In general, this thesis provides a unique regional study on private manufacturing SMEs in China and their efficiency performance. It is also the first study in entrepreneurship research to build a framework linking comprehensive entrepreneurial factors, including start-up motivation, age, gender, human capital and networks, on a private firm's technical efficiency performance, and to examine these relationships specifically for private manufacturing SMEs in eastern and non-eastern regions of China. The empirical evidence obtained from this thesis will be useful for both policy makers and entrepreneurs of private manufacturing SMEs in terms of how to improve their performance as well as the quality of entrepreneurial activities in China. Policy implications and recommendations are provided in detail in Chapter 8. These recommendations can facilitate a better implementation of the MEI program and assist in upgrading China's manufacturing sector and transitioning China into an innovation-driven country.

## **1.4 Methodology**

To achieve the above objectives, this thesis applies different methodologies, and consists of the following five steps:

First, it overviews the economic background of China to provide the context of the study. It overviews China's economic development since the 'Reform and openness' policy in 1979, the development and significance of the manufacturing sector and recent challenges

and development strategies facing this sector and the overall economy. It also overviews the private sector and the significance of entrepreneurial activities, especially through private SMEs, and recent programs designed to further develop entrepreneurial activities in China. Regional disparities in private sector development between eastern and non-eastern regions of China are also reviewed, highlighting the significance of regional studies and policies.

Second, this study reviews the literature to show the definition of entrepreneurship and the significance of entrepreneurial activities to the endogenous, sustainable and inclusive economic growth of an economy. It also reviews the different contributions of entrepreneurial activities, based on different motivations and quality, to economic growth, especially in an emerging economy like China. The main motivation of this study is to identify how best a country such as China should transition from quantity to quality of entrepreneurial activities.

Third, it conducts a literature review of different measurements of firm performance, especially technical efficiency, and the estimation of technical efficiency in a developing country such as China. A review of the literature regarding entrepreneurial factors that can have significant relationship with firm performance for China's private manufacturing SMEs is also provided. These factors include (i) an entrepreneur's start-up motivation (opportunity-driven or necessity-driven motivation), (ii) personal characteristics (age and gender), (iii) human capital (education level, management experiences, start-up experiences and technical experiences) and (iv) networks (political connections and business connections). The literature on the relationships of firm-specific factors (e.g., firm age, firm size, export density, credit access and R&D activities), which are used as control variables in this research, with firm performance are also reviewed. The hypotheses about the relationship of each entrepreneurial and firm factor with the technical efficiency of private manufacturing SMEs are provided in this part.

Fourth, it surveys the measurement of technical efficiency. It discusses the significance of estimating metafrontier technical efficiency, compared with the traditional technical efficiency relative to regional frontiers, when regional disparity exists. The survey also covers different approaches that can be used to estimate technical efficiency including

parametric Stochastic Frontier Analysis (SFA) and non-parametric Data Envelopment Analysis (DEA). After comparing the advantages and disadvantages of DEA and SFA, it is suggested that the parametric SFA is more appropriate for estimating the metafrontier technical efficiency of eastern and non-eastern private manufacturing SMEs in this research using the *China private enterprises survey* data from 2012.

Fifth, results from the empirical analysis of the eastern and non-eastern regions are interpreted, discussed and compared to show the different performances of eastern and non-eastern private SMEs in China's manufacturing sector. Based on the empirical results, policy recommendations for the MEI program are developed to improve the efficiency performance and quality of China's manufacturing entrepreneurial activities (SMEs).

## **1.5 Research scope**

This research focuses on the performance of private manufacturing SMEs in China. Thus, this study does not cover state-owned and foreign-owned SMEs. Enterprises that are not operating in the manufacturing sector, including those in (i) agriculture, (ii) mining, construction, electricity, gas, water and (iii) service sectors, are not considered in this research. Also, enterprises with more than 1,000 employees or 400 million RMB annual revenue, which are classified as large enterprises (NBS, 2018f), are excluded from the study. As a result, data for 664 private manufacturing SMEs in 2012 are used to conduct the empirical analysis of this thesis.

This study uses firm-level data from the 2012 *China private enterprises survey* for the empirical analysis. This survey covers all 31 provinces of China. Within the 664 private manufacturing SMEs used in the analysis, 439 of them are located in eastern regions while 225 of them are located in non-eastern regions.

## **1.6 Organisation of the thesis**

This thesis consists of nine chapters. The structure is outlined as follows:

Chapter 2 overviews (i) economic developments and the internationalisation of China's economy after reform and openness from 1979, (ii) the significance of China's manufacturing sector to its economic development, (iii) the current dilemma of China's manufacturing sector including the end of cheap labour, and its low value-adding and low labour productivity levels, and (iv) the 'Made in China 2025' development program to upgrade China's manufacturing sector in which entrepreneurs and SMEs are seen to play a significant role.

Chapter 3 provides overviews of (i) the embryonic development of the private sector and entrepreneurship in China arising from the township and village enterprises (TVEs), (ii) the multidimensional definitions of entrepreneurship and the entrepreneurship utilised in this study in the context of China, (iii) the significance of the private sector to China's general and inclusive economic growth, (iv) the characteristics of China's entrepreneurs, and (v) the MEI program aimed at promoting entrepreneurial activities in China. It also overviews the SME sector in China, which is the most common means through which entrepreneurial activities occur, including: (i) the definition of China's SMEs, (ii) the significance of SMEs in China's industrial sector, and (iii) their obstacles to survival and development. The regional disparities in the development of private SMEs across China are also introduced at the end of Chapter 3.

In Chapter 4, the evolutionary process of economic growth theory from a capital-based economy into an entrepreneurial economy is reviewed. The literature reviewed in Chapter 4 also discusses the significance of entrepreneurial activities to the endogenous, sustainable and inclusive economic development of an economy. The different contributions of entrepreneurial activities to economic growth due to the different motivation and quality of entrepreneurs are emphasised. It also reviews the literature on technical efficiency estimation in China and other developing countries, and then focuses on entrepreneurial factors which can have significant relationship with the efficiency performance of private manufacturing SMEs in China. These include: (i) an entrepreneur's start-up motivation (opportunity-driven or necessity-driven motivation), (ii) personal characteristics (age and gender), (iii) human capital (education level, management experience, start-up experience and experience as technical staff), and (iv) networks (political and business connections). The literature on the relationship between

firm-specific factors (e.g., firm age, size, export density, credit access and R&D activities) and a firm's performance is also reviewed. The hypotheses of this study outlined in Section 1.3 are discussed in more detail in Chapter 4.

Chapter 5 introduces concepts associated with firm efficiency measures including: (i) Shephard's distance function as the theoretical foundation for firm efficiency measures, (ii) Farrell's traditional technical efficiency type measures, (iii) and measures for returns to scale. Then the concepts of (i) technical efficiency relative to a group-specific frontier, (ii) technology gap ratio and (iii) technical efficiency relative to the metafrontier are explained. Two competing approaches, SFA and DEA, for estimating technical efficiency are introduced. Their strengths and weaknesses and the reasons for choosing SFA in this research are discussed. The fully parametric Stochastic Meta-production Function (SMF) model proposed by Huang *et al.* (2014) and the Tobit regression model are employed to estimate the scores and determinants of technical efficiency relative to the regional frontier, the technology gap ratio and technical efficiency relative to the metafrontier in this study.

Chapter 6 introduces the data used in this study for empirical analysis. The data comes from the 2012 *China private enterprises survey*, covering private enterprises in all industries and regions of China. The extracting steps for drawing usable sample data from the original sample and the location and size distribution of the private manufacturing SMEs used in the final sample are introduced. The efforts to minimise survey errors are also introduced. The chapter then describes all variables used in the empirical analysis, including the inputs and outputs used for estimating technical efficiency and variables on entrepreneurial factors, including (i) an entrepreneur's start-up motivation (opportunity-driven or necessity-driven motivation), (ii) age, (iii) gender, (iv) education level, (v) management experience, (vi) start-up experience, (vii) experience as a technical staff member, (viii) political connections and (ix) business connections, and firm-specific factors, including (x) firm age, (xi) firm size, (xii) export density, (xiii) credit access and (xiv) R&D activities, used for identifying determinants of the estimated scores by the SMF-Tobit model.

Chapter 7 conducts an empirical analysis related to the hypotheses discussed in Chapter 4 for 439 eastern and 225 non-eastern private manufacturing SMEs in China in 2012. A statistical summary of the entrepreneurial and firm characteristics of private manufacturing SMEs in eastern and non-eastern regions is shown. It firstly applies the traditional one-stage SFA model proposed by Battese and Coelli (1995) to simultaneously estimate the technical efficiency scores and determinants of aggregate SMEs in the sample by *FRONTIER 4.1*, regardless of a regional technology disparity. Then, considering regional differences, (i) the scores and determinants of the technical efficiency relative to the regional frontiers for eastern and non-eastern SMEs in the sample, respectively, are estimated using the first step of the SMF model simultaneously, (ii) the scores and determinants of the technology gap ratio using a pooled sample of eastern and non-eastern SMEs are estimated by the second step of the SMF model simultaneously, and finally, (iii) the scores of the technical efficiency relative to the metafrontier are estimated by the product of technical efficiency relative to the regional frontier and technology gap ratio. The determinants of metafrontier technical efficiency are estimated by a Tobit regression model to support or reject the hypotheses proposed in Chapter 4. Steps (i) and (ii) are computed by *FRONTIER 4.1*, while step (iii) is computed by *STATA 14.0*.

Chapter 8 provides evidence-based policy recommendations to improve the performance and quality of entrepreneurial activities in China's manufacturing sector. Policy recommendations are proposed based on the empirical evidence of each hypothesis about the relationships of an entrepreneur's start-up motivation, age, gender, human capital and networks and the firm's age, size, export density, credit access and R&D activities with a firm's technical efficiency performance. Focusing on how the quality of entrepreneurial activities can be improved with respect to each entrepreneurial and firm factor, this chapter gives detailed policy recommendations for the MEI program.

Chapter 9 provides a summary of this thesis. It emphasises the implications of this study for entrepreneurship and SME research in developing countries like China. It also outlines the limitations of this study and future research possibilities on this topic.

## **Chapter 2 China's economy and manufacturing sector— development and contemporary challenges**

### **2.1 Introduction**

This chapter overviews economic developments in the Chinese economy after reform and openness from 1979, the 'Innovation-driven Country by 2020' strategy, the significance and current dilemma of China's manufacturing sector and the 'Made in China 2025' development program in which entrepreneurs and SMEs are foreseen as playing a significant role. Since reform and openness from 1979, China's economy experienced an extraordinarily high and sustained growth due, in part, to its successful integration into the global economy and development of the private sector. After experiencing growth over more than 35 years, China's economic development has evolved to the efficiency-driven stage and aims to further develop into the innovation-driven stage<sup>5</sup> by means of an 'Innovation-driven Country by 2020' strategy.

However, today, China's economy is facing new challenges and economic growth has begun to slow down since 2014. This is mainly due to a loss of competitiveness by China's manufacturing sector, a traditionally significant sector in China, because of the end of cheap labour, a low value-adding level and inefficient production (World Bank, 2012; Dollar, 2014). Consequently, China has introduced a new development strategy, 'Made in China 2025,' to update China's manufacturing to make it more innovative and efficient. In this new development strategy, entrepreneurship and SMEs have been given the most emphasis because they are the most vigorous and innovative part of China's economy (State Council, 2015d). Promoting entrepreneurship and SMEs and increasing the efficiency of SMEs in the manufacturing sector will be the focus of China's economic transition in the following years (State Council, 2015c; 2015d).

This chapter is structured as follows. Section 2.2 discusses economic growth and the internationalisation of China after 1979. Section 2.3 introduces the 'Innovation-driven Country by 2020' strategy since 2006 and its current progress. Section 2.4 discusses the

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<sup>5</sup> The development stages of an economy, including the factor-driven stage, the efficiency-driven stage and the innovation-driven stage, were proposed by Porter (1990) (see details in the following section).

significance of the manufacturing sector for China's GDP, employment, exports and innovation and the challenges facing China's manufacturing sector in terms of: increasing labour cost, low value-added ratio and inefficient production due to low labour productivity and an excess capacity problem, and the policy priorities for promoting entrepreneurship and SMEs in the new 'Made in China 2025' strategy. Section 2.5 summaries the key points of this chapter.

## **2.2 Economic development after reform and openness in 1979**

The year 1978 represented a breakthrough point for the Chinese economy due to the introduction of the 'Reform and openness' policy with the official slogan '*dui nei gai ge, dui wai kai fang*' ('reform the domestic economy, open up to the outside of the country') proposed at the Third Plenary Session of the Eleventh Central Committee of the Communist Party of China (CPC). Before 1978, China was one of the poorest countries in the world (Zhu, 2012). The Chinese economy was burdened by Soviet-style central planning, although China's centrally planned economy was much more decentralised than its Soviet equivalent (Naughton, 2007). The market still played a limited role, but interaction with other economies was extremely restricted. During this period China experienced major fluctuations in its economic growth due to instabilities in political and economic policies, such as the successful industrial development in the 'First Five Year Plan' (1953-1957), the unrealistic ambition in the 'Great Leap Forward movement' (1958), the economic and population collapse in the 'Three-year Famine' (1958-1961) and the destruction of China's economy, especially its private sector, during the 'Great cultural revolution' (1966-1967) (Peng, 1987; Nolan & Ash, 1995; MacFarquhar, 1997; Li & Yang, 2005; Bernstein, 2006; Naughton, 2007; Clark, 2008; Kung & Chen, 2011; Brown, 2012). According to the National Bureau of Statistics (NBS) of China (2010a), from 1949 to 1977 China's real GDP annual growth rate fluctuated between -27.3% (in 1961) and 21.3% (in 1958) and resulted in instability of the economy and in residents' normal lives. Until 1977 China was still an extremely poor country with a GDP per capita of only US\$279 (at constant 2010 US\$ prices). China, at that time, urgently needed sustainable and fundamental economic reforms with practical goals and outcomes.

In December 1978 the reformist agenda proposed by Deng Xiaoping, aimed at building



‘socialism with Chinese characteristics’, was officially accepted. China began to implement a series of significant reforms from 1979 aimed at its economic system and following a new development path (Yu *et al.*, 2004; Qian & Wu, 2008; Tisdell, 2009). As a significant part of the ‘Reform and Openness’ policy, openness to international trade and absorbing foreign investment began to be allowed and promoted. In pre-reform China, the economy was limited relative to the international market, such that the economy was regarded as closed and self-sufficient, consistent with the objectives of a planned economy at that time (Qian, 2000; Gallagher, 2002; Keller *et al.*, 2011). Imports and exports were controlled by the central government through state-owned enterprise (SOE) monopolies and foreign investment was also strictly forbidden (Naughton, 1996; Cui, 2008; Keller *et al.*, 2011). The reform and openness policy led China’s international trade and foreign capital usage into a new era.

Many policies were implemented after 1979 to encourage exports by more state-owned enterprises, and private-owned firms were officially allowed to export directly from 1999 (NBS, 1999). Besides the development of exports, the strict limitations on foreign investment were also subsequently removed with the establishment of the *Law of the People’s Republic of China on Chinese-Foreign Equity Joint Ventures* in 1979 (NBS, 1999). Immediately after that, China established four special economic zones (SEZs)<sup>6</sup> in coastal Guangdong and Fujian provinces in 1980 to attract foreign investment, mainly from Hong Kong and Taiwan. More areas were further opened in the following years<sup>7</sup>. Foreign investors were attracted by the cheap productive resources, the flexibility of doing business, tax incentives and the infrastructure they could enjoy in China, especially in SEZs and open cities<sup>8</sup> (Hu & Khan, 1997; Zhang, 2001; Sun *et al.*, 2002; Wei, 2005).

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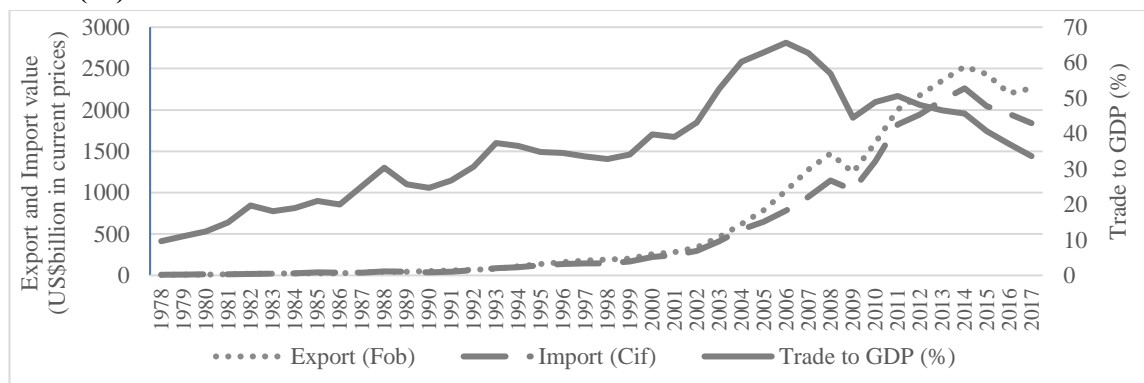
<sup>6</sup> The original four special economic zones (SEZs) included Shenzhen, Zhuhai and Shantou in Guangdong province and Xiamen in Fujian province. Investment from Hong Kong mainly focused on Shenzhen, Zhuhai and Shantou, while Taiwanese investment focused on Xiamen.

<sup>7</sup> In 1984, China further opened 14 coastal cities to foreign investment: Dalian, Qinhuangdao, Tianjin, Yantai, Qingdao, Lianyungang, Nantong, Shanghai, Ningbo, Wenzhou, Fuzhou, Guangzhou, Zhanjiang and Beihai. Since 1988, mainland China’s opening to the outside world has been extended to its border areas, areas along the Yangtze River and more inland areas. The state decided to turn Hainan Island into mainland China’s biggest special economic zone (SEZ) in 1988. Kashi and Huoerguosi in Xinjiang province were turned into SEZs in 2010 and 2014 respectively to attract investment from Central and Eastern Europe under ‘The Belt and Road’ program. Currently, China has seven SEZs: Shenzhen, Zhuhai, Shantou, Xiamen, Hainan, Kashi and Huoerguosi.

<sup>8</sup> It is worth noting that there were also some domestic investors who channelled funds through Hong Kong to benefit from the tax advantages offered to FDI; thus not all of these investment was strictly FDI.

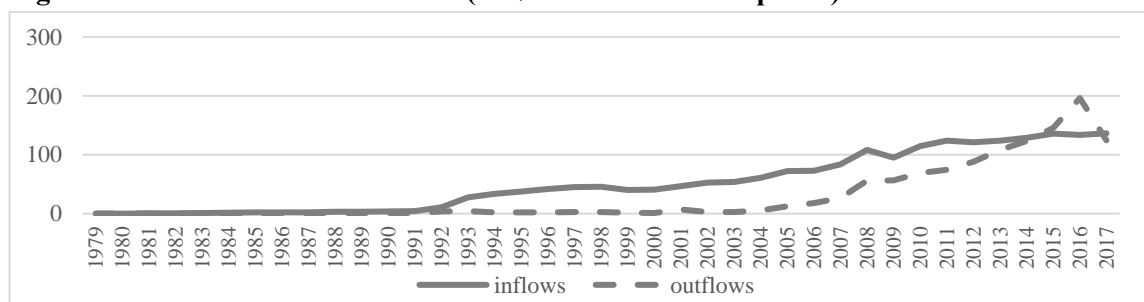
Moreover, China's accession into the World Trade Organization (WTO) in December 2001 brought it new opportunities to further fortify its economic integration and growth. Trade liberalisation and fewer tariff and non-tariff barriers imposed by WTO members benefited trade, foreign capital inflows and then the economy of China (Ianchovichina & Martin, 2001; Agarwal & Wu, 2004). Due to this openness, the export and FDI inflow increased significantly and Chinese firms could use the cheapest and most efficient imported inputs, advanced technology and foreign capital from other countries for their production instead of being restricted to using only domestic resources (Feder, 1983; Lardy, 1992).

**Figure 2.1 International trade values (US\$ billion in current prices) and ratio of trade to GDP (%) of China from 1978 to 2017**



Source: World Bank (2018c). <http://data.worldbank.org/country/china>

**Figure 2.2 FDI inflows and outflows (US\$ billion in current prices) of China 1979-2017**



Source: UNCTAD (2018b). <http://unctadstat.unctad.org/EN/Index.html>

Figures 2.1 and 2.2 illustrate the international trade and FDI inflows and outflows of China from 1978 to 2017. In 1978, China's total export and import values were US\$6.81 billion and US\$7.62 billion respectively, and the share of trade in China's GDP was only 9.65 per cent. After 1978, China's international trade gradually grew due to the reform and openness policies and then exploded after accession into the WTO in 2001. The ratio

of trade to GDP peaked at 65.62 per cent in 2006, after which the dependence on trade began to decrease because of the global financial crisis (2007-2009) and a re-focusing of policy on developing domestic demand and reducing the dependence on global conditions and markets. Similarly, the FDI inflow of China was nearly zero (only US\$80,000) in 1979. It increased gradually and boomed with accession into the WTO in 2001, although it experienced two clear reductions due to the Asian financial crisis (1997-1999) and the global financial crisis (2007-2009). In 2017, China's total export and import values were US\$2.26 trillion and US\$1.84 trillion respectively, while the contribution of trade to GDP reached 33.60 per cent. In 2017, China contributed 13.4 per cent of world trade in goods and services, following the U.S.A to become the second biggest trading economy (European Commission, 2018). It is even the largest trading nation in the world in terms of merchandise trade (WTO, 2018). Besides trade, China's foreign direct investment (FDI) inflows also increased dramatically to US\$136.32 billion in 2017, making China the second largest recipient of FDI after the U.S.A (UNCTAD, 2018a). In recent years, China has become a major source of FDI for other developing countries (e.g., Vietnam, Cambodia and Laos) (Ministry of Commerce, 2017). The outward FDI of China sharply increased after 2005 to reach US\$124.63 billion in 2017, following the U.S.A and Japan to become the third biggest source for world FDI (UNCTAD, 2018a).

The significant and successful integration of China's economy into the global economy, together with other domestic economic reforms in China, such as rural reforms, SOE reforms, development of the private sector and financial markets, subsequently resulted in extraordinarily high and sustained economic growth (Lin *et al.*, 2003; Tisdell, 2009). Figure 2.3 shows the value and growth of Chinese real GDP from 1978 to 2017. After reform and openness, the Chinese economy maintained its growth at a fast and steady pace. It experienced less volatility than was the case before 1978, excluding the years 1981 (official stepping down of Hua Guofeng), 1989 and 1990 (Tiananmen Square incident) due to short-term political instabilities (Marti, 2002; Li & Tian, 2013). The economic growth rate of China peaked at over 14 per cent real GDP growth rate in 1984, 1992 and 2007, when economic reforms were extended to the whole economy<sup>9</sup>, China's

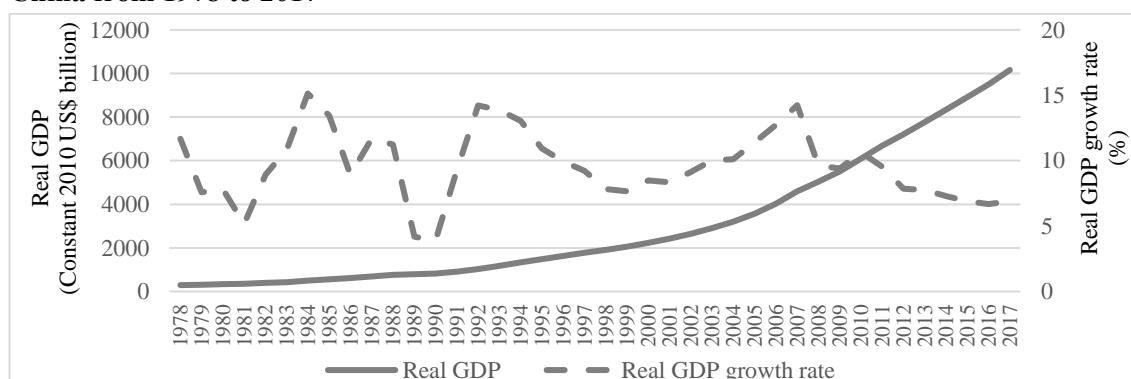
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<sup>9</sup> In 1984 economic reform was extended from rural agriculture to the whole economy (the urban sector e.g. SOEs). Emphasis was placed on removing the monopoly privilege of SOEs and that the economy should be further opened to the international market.

central planning economy transitioned to a market economy<sup>10</sup> and the scientific development strategy<sup>11</sup> were approved, respectively. In the 39 years of reform from 1978 to 2017, total real GDP increased by more than 30 times to US\$10.16 trillion in constant 2010 US\$. The Chinese economy after 1978 enjoyed the fastest growth in the world. The average growth rate of Chinese real GDP between 1978 and 2017 reached up to 9.59 per cent. China had risen abruptly from being one of the poorest and most introverted countries in the world to being the second largest outward open oriented economy measured by US dollars, overtaking Japan in 2010 (Barboza, 2010; Flanders, 2011), or even the largest economy when measured by international dollars (PPP), overtaking the U.S.A in 2013 (World Bank, 2018c).

The extraordinary economic development since the reform and openness policy removed around 800 million people from poverty up to 2018 (World Bank, 2018b). Real GDP per capita of China also rose by more than 22 times from US\$307.80 in 1978 to US\$6,893.80 in 2016 in constant 2010 US\$ (World Bank, 2018c). With the improvement of household income, China's GNI per capita reached US\$7,930 in 2016, resulting in it becoming classified as an upper-middle-income country (World Bank, 2017; 2018).

**Figure 2.3 Real GDP (US\$ billion in constant 2010 prices) and real GDP growth rate (%) of China from 1978 to 2017**



Source: World Bank (2018c). <http://data.worldbank.org/country/china>

<sup>10</sup> In 1992, a major report presented by Chairman Jiang Zemin indicated the termination of the Chinese centrally planned economy and the approval of the construction of a market-oriented economy with Chinese characteristics.

<sup>11</sup> In 2007, a major report presented by Chairman Hu Jintao officially approved the *Scientific Development* strategy emphasising the transition of the economy into an innovation-driven economy.

### 2.3 ‘Innovation-driven Country by 2020’ development strategy

The extraordinary economic development of China since reform and openness in 1979 has made China’s economy step up into a new development stage. Along with the economic development of a country or a region, it can experience three different development stages based on the competitive advantages arising at each stage, including the factor-driven stage, the efficiency-driven stage and the innovation-driven stage, and two transition stages (Porter, 1990; 2004). While countries in the factor-driven stage have low-cost productive factors and/or abundant resource endowments as their key sources of competitive advantage, and produce unsophisticated products based on foreign designed technology, the competitiveness of efficiency-driven economies is based on productive efficiency and an ability to improve upon and utilise foreign designed technology in a better way. The most developed stage is the innovation-driven stage where competitive advantage depends on investments in new knowledge creation and commercialisation activities, enhancing the education level and encouragement of entrepreneurial activities. In order to be an innovation-driven country, there should be more industry clusters and more domestically developed knowledge and technology. Table 2.1 shows the development stage classification criteria developed by the *World Economic Forum* based on the income level (wage) of a country using GDP per capita as a proxy<sup>12</sup>.

Based on this classification China has already finished its transition from the factor-driven stage to the efficiency-driven stage based on its \$3,433 GDP (in current US\$) per capita in 2008 due to its dramatic economic growth since 1978 (Schwab & Porter, 2008b). However, the efficiency-driven stage of China, which relies heavily on foreign technology, is not sustainable. In recent years, China has gradually lost its competitiveness in cheap labour and thus many foreign investments with advanced technology flow offshore (Li *et al.*, 2012; Butollo, 2014; Donaubauer & Dreger, 2018) (see the following section in detail). In order to be less dependent on foreign investment and technology, China decided to begin an economic transition from an efficiency-driven economy to an innovation-driven economy from 2006 (State Council, 2016b). Transitioning into an innovation-driven

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<sup>12</sup> GDP per capita is used as a proxy due to the unavailability of an internationally comparable wage level. The second criterion is the extraction of resources measured by the percentage of exports of mineral goods in total exports as a proxy. If this number is more than 70 per cent, this country is regarded as a factor-driven one even though its income level may be much higher than the factor-driven criterion.

economy has become a focal point of contemporary concern for the Chinese government to boost the Chinese economy again in a more sustainable way (Hutschenreiter & Zhang, 2007; Liu, 2009; Fan, 2014).

**Table 2.1 Development stage main classification criteria by World Economic Forum**

	Development stages				
	Stage 1 Factor-driven	Transition from stage 1 to stage 2	Stage 2 Efficiency-driven	Transition from stage 2 to stage 3	Stage 3 Innovation-driven
<b>GDP per capita (in current US\$)</b>	<2,000	2,000-2,999	3,000-8,999	9,000-17,000	>17,000

Source: Global Competitiveness Index 2017-2018 (Schwab & Sala-i-Martin, 2017).

To finish this transition, a significant development program—the *National Outlines for Medium and Long-Term Planning for Scientific and Technological Development (2006-2020)*—was implemented by the Chinese government in 2006, aimed at transitioning China into an ‘Innovation-driven Country by 2020’. The supporting policies in this development plan include: (1) fiscal and taxation policy aimed at stimulating innovation by enterprises, (2) improving the utilisation and renovation of imported technology, (3) government purchasing of new products, (4) improving intellectual property protection and technology standards, (5) improving financial support for entrepreneurs and innovation, (6) improving industrialisation of high-technology and the spilling over of advanced technology, (7) promoting military-civilian cooperation on production and consumption, (8) extending international and intra-regional cooperation and communication on technology development, and (9) improving the education level and constructing an innovation friendly society (State Council, 2005a). Under this development plan, entrepreneurship, which can commercialise innovation by creating private enterprises and especially SMEs, is highly promoted in China (State Council, 2005a; 2006).

Since the implementation of this development strategy, China’s R&D activities and innovation results have increased rapidly. As shown in Table 2.2, the ratio of expenditure on R&D activities to China’s GDP increased gradually from only 1.40 per cent in 2007 to 2.12 per cent in 2017, showing a higher level of effort in innovation by China. The majority of innovation activities in China are now conducted by enterprises instead of government-led research institutions. During the period from 2007 to 2017, R&D expenditure by enterprises increased much more sharply than that invested by

government, from 261.1 billion RMB to 1373.3 billion RMB. In 2017, 78.47 per cent of R&D expenditures were invested by enterprises other than the government. With increasing R&D activities, China has obtained impressive innovation results. The invention patent number, which is a commonly utilised indicator of domestic self-innovation (Pavitt, 1985), has grown sharply since 2007 from 351,782 units to 1,836,434 units.

**Table 2.2 R&D expenditures and certified patent numbers for China from 2006 to 2017**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>R&amp;D expenditure (in billion current RMB)</b>											
Total	371.0	461.6	580.2	706.3	868.7	1029.8	1184.7	1301.6	1417.0	1567.7	1750.0
Government	91.4	108.9	135.8	169.6	188.3	222.1	250.1	263.6	301.3	314.1	354.6
Enterprises	261.1	331.2	416.3	506.3	642.1	762.5	883.8	981.7	1058.9	1192.4	1373.3
<b>R&amp;D expenditure/ GDP (%)</b>											
	1.40	1.47	1.70	1.73	1.78	1.91	1.99	2.02	2.07	2.11	2.12
<b>Certified patent (thousand units)</b>											
	351.8	412.0	582.0	814.8	960.5	1255.1	1313.0	1302.7	1718.2	1753.8	1836.4

Source: China Statistical Yearbook 2018 (NBS, 2018b).

However, according to the Global Competitiveness Report 2017-2018 (Schwab & Sala-i-Martin, 2017), China is still experiencing efficiency-driven development based on its \$8,113.3 (in current US\$) GDP per capita in 2016. In order to become an innovation-driven country by 2020, R&D expenditure needs to further increase to more than 2.5 per cent of GDP (State Council, 2006). With more intensive R&D activities, China's government expects that the contribution of technology progress to economic growth will increase to more than 60 per cent and foreign technology dependence will drop to below 30 per cent, while the number of invention patents will be in the top five in the world by 2020 (State Council, 2006). China still needs to make a big effort to finish this transition in order to be a successful 'innovation-driven country'. Due to the significant role of enterprises in innovation, as discussed above, further policies will focus on supporting entrepreneurial enterprises and especially SMEs, which account for most entrepreneurial enterprises, in order to achieve the goal of becoming an innovation-driven country in 2020 (State Council, 2016b). Hence the focus of this thesis is on private SMEs.

## **2.4 The manufacturing sector in China: Significance, dilemmas and transition by promoting entrepreneurship and SMEs**

There has been a slowdown in the dramatic economic development in China's economy over the past four years. As shown in Figure 2.1, China's international exports by value declined by 3.68 per cent and 9.51 per cent in 2015 and 2016 respectively. China's FDI inflows by value also declined by 1.41 per cent from \$135.61 billion in 2015 to \$133.70 billion in 2016 due to the shedding of foreign invested labour-intensive enterprises (UNCTAD, 2018a). These, together with declining population growth and restructuring of the economy, have led to the slowing down of the economy (Lee, 2017; Wei *et al.*, 2017). The real GDP growth rate has steadily declined from 10.6 per cent in 2010 to 6.7 per cent in 2016 (see Figure 2.3), caused mainly by a loss of competitiveness in its traditionally dominant manufacturing sector. Thus China needs to undergo economic transformation, especially of its manufacturing sector (Wei *et al.*, 2017). The significance and current challenges of China's manufacturing sector and a new development strategy to promote manufacturing sector are introduced in the following section.

### **2.4.1 Significance of the manufacturing sector in China**

The main contributor to the rapid growth of the Chinese economy has been its manufacturing industry. Within three decades China has raised its position to that of a global economic powerhouse through manufacturing-led-development (McKay & Song, 2010). During the 1980s, a successful structural transformation from agriculture to the manufacturing and service sectors in China led to a dramatic growth of manufacturing enterprises, especially township and village enterprises (TVEs) (Du & Izumida, 2006). Foreign investors, mainly from Hong Kong, Macau and Taiwan, were attracted by cheap labour and the 'open door' policies. They built factories or outsourced their manufacturing production to China, leading to a boom in export-oriented manufacturing firms in China (Kumar *et al.*, 2009; Zhang & Huang, 2012). By the end of 2016 there were 3,019,269 manufacturing entities, which made up 16.59 per cent of total entities in China (NBS, 2018b). Due to this rapid growth the manufacturing sector became the most important in China and has made a significant contribution to GDP, employment, exports and, especially, innovation. The competitiveness of China in the global market was also mainly dependent on its manufacturing sector. Tables 2.3 and 2.4 show the contributions of the



manufacturing sector to China's economy from 2005 to 2017.

**Table 2.3 Contribution of the manufacturing sector to China's GDP, urban employment and exports from 2007 to 2017, US\$ trillion and percent**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<i>Contribution to GDP</i>											
<b>Manufacturing value added (trillion in constant 2010 US\$)</b>											
	1.37	1.53	1.70	1.92	2.11	2.30	2.46	2.65	2.82	3.00	3.19
<b>Share of manufacturing value added to total GDP (%)</b>											
	30.5	30.5	30.9	31.6	31.9	32.1	32.1	31.9	31.8	31.7	31.6
<i>Contribution to employment</i>											
<b>Employment by manufacturing (in million persons)</b>											
	34.7	34.3	34.9	36.4	40.9	42.6	52.6	52.4	50.7	48.9	
<b>Share of manufacturing to total employment (%)</b>											
	27.97	28.36	27.87	27.77	28.17	28.82	28.61	28.16	27.49	27.36	
<i>Contribution to exports</i>											
<b>Export value of manufactured commodities (US\$ trillion in current prices)</b>											
	1.16	1.35	1.14	1.50	1.80	1.95	2.10	2.23	2.17	1.99	
<b>Share of manufactured commodities in total merchandise exports (%)</b>											
	94.77	94.55	94.75	94.82	94.70	95.09	95.14	95.19	95.43	94.99	

Source: The data about manufacturing value added is from the Manufacturing Value Added Database (UNIDO, 2018b), <http://stat.unido.org/database/MVA%202018.%20Manufacturing>; employment and exports: *China Statistical Yearbook 2018* (NBS, 2018b).

A number of important observations can be made about the manufacturing sector. First, the manufacturing sector has played a significant role in the dramatic GDP growth of the country in the last decade. As shown in Table 2.3, from 2007 to 2017 the value-added output of China's manufacturing sector increased from US\$1.37 trillion to US\$3.19 trillion in constant 2010 US\$. According to UNIDO (2015) the average growth rate of real manufacturing value added of China between 1990 and 2000 reached 12.8 per cent. Although this rate decreased to 10.3 per cent during the period from 2000 to 2016, the growth of manufacturing production in China still led the world (UNIDO, 2018a). As shown in Table 2.3, the share of the manufacturing sector in China's GDP remained at more than 30 per cent from 2007, demonstrating the significant contribution of this sector to China's GDP.

Second, the manufacturing sector has become a principal source of employment in China. Due to the rapid growth of labour-intensive industries, led by increased exports and outsourcing to China during the 1990s, the manufacturing sector provided massive job opportunities, especially for rural migrant labour and low-skilled workers with inadequate

education (Dahlman & Aubert, 2001; Karlsson *et al.*, 2007). Employment by the manufacturing sector between 2007 and 2016 is shown in Table 2.3. With an average annual growth rate of 4.94 per cent, the number of workers employed in the manufacturing sector increased from 30.5 million in 2004 to 50.7 million in 2015. The contribution of manufacturing to total employment, however, remained between 27 per cent to 29 per cent.

**Table 2.4 R&D employees and expenditure by sector in 2009**

	R&D full-time employees			R&D Expenditure		
	Number (persons per year)	Share (%)	Intensity (%)	Value (billion in RMB)	Share (%)	Intensity (%)
<b>Total</b>	2,291,252	100.00	1.82	580.21	100.00	1.70
Agriculture	12,196	0.53	0.33	1.35	0.23	0.04
Mining	75,624	3.30	1.37	17.03	2.93	1.02
Manufacturing	1,355,658	59.17	3.88	357.13	61.55	3.24
Electricity, gas and water	15,544	0.68	0.50	3.42	0.59	0.41
Construction	63,432	2.77	0.54	13.51	2.33	0.60
Services <i>et al.</i>	768,798	33.55	1.15	187.78	32.36	1.27

Source: Second R&D Census of China (NBS, 2010b).

Note: R&D full-time employee intensity is the ratio of the R&D full-time employee number to the total employee number; R&D expenditure intensity is the R&D expenditure per 100 RMB value added.

As a significant symbol of China's economic development, manufactured commodities have played a vital role in the country's export success. In 1980, China's merchandise exports were mainly in the form of primary goods (NBS, 2014b). Since the implementation of the reform and openness policy, increasing foreign market access, low product prices and many preferential policies for foreign investors, international demand for China's manufactured products increased and resulted in a boom in manufacturing industry exports (Cui, 2003; Chen *et al.*, 2006). China's manufacturing exports were further enhanced by new export opportunities, particularly in textiles and garments, and the improved investment climate for FDI arising from China's accession to the WTO in 2001 (Lall & Albaladejo, 2004). Because of the significant development of China's manufacturing exports, the export value of manufactured commodities increased from US\$1.16 trillion in 2007 to US\$1.99 trillion in 2017. By 2017 the share of manufactured commodities in total merchandise exports reached 94.99 per cent, showing the significant contribution of the manufacturing sector to China's exports (see Table 2.3).

The manufacturing sector contributes not only to China's GDP, employment and exports. Since the proposed 'Innovation-driven Country by 2020' program in 2006, China has prioritised indigenous innovation to reduce its reliance on imported technology (Dobson & Safarian, 2008). Technical innovation and renovation and product innovation in manufacturing enterprises are highly promoted by the Chinese government (State Council, 2006). The restructuring from low-tech/labour-intensive sectors to high-tech/technology-intensive industries has made the manufacturing sector the base for innovation in China (Vaidya *et al.*, 2007; Dobson & Safarian, 2008). According to the second R&D census of China (NBS, 2010b), 59.17 per cent of full-time employees and 61.55 per cent of expenditure involved in total R&D activities was contributed by the manufacturing sector (see Table 2.4). The R&D intensity of the manufacturing sector reached 3.88 per cent and 3.24 per cent in terms of employee numbers and expenditure, respectively, which were much higher than for other industries (see Table 2.4). By 2016, manufacturing enterprises had 2.59 million employees and spent 10.57 trillion RMB on R&D activities, contributing 79.84 per cent of total full-time R&D employees and 67.42 per cent of total R&D expenditure in China (NBS, 2017b). They had 748,396 units of patents granted, accounting for around 42.67 per cent of all granted patents in 2016 (NBS, 2017b). Hence the manufacturing sector has been the innovation incubator of the Chinese economy.

The spectacular development of the manufacturing sector has driven the sharp growth of China's share in world manufacturing value added by 6.5 times from 1990 to 2016 and reached 24.82 per cent in 2017 (UNIDO, 2018a). China has been the largest manufacturing producer in the world and its manufacturing value-added was more than the combined value of all other emerging economies (UNIDO, 2018a). China's share ranked top in many manufacturing subsectors, especially in traditional labour-intensive industries such as textiles, wearing apparel and leather products (UNIDO, 2017). China also increased its share in the global manufacturing trade to 18.35 per cent in 2015, becoming the largest manufacturing exporter in the world (UNIDO, 2018a). China's manufacturing is now leading the world as a result of its large value. However, it is still heavily focused on labour-intensive industry with low value-added, capacity utilisation and labour productivity levels. It urgently needs a transition aimed at improving productivity, involvement in higher value adding activity and maintaining its competitiveness in global manufacturing.

## 2.4.2 Current challenges for China's manufacturing

China's economic growth and manufacturing development have enjoyed considerable success since 1978 but have been slowing down since 2014. Many reports claim that this is caused by China's manufacturing sector losing its comparative advantage (World Bank, 2012; Dollar, 2014). China's manufacturing growth has slowed down more quickly than its aggregate economic growth (Eloot *et al.*, 2013). The manufacturing Purchase Management Index (PMI)<sup>13</sup> has declined sharply and fell below the standard 50 point mark (49.7 per cent) at the end of 2015 (NBS, 2016a). The majority of sub-indexes of the PMI, including raw material inventory, employment, new export orders, imports and inventory of orders remained below the standard 50 point mark for nearly 6 years, showing a recession and an alarming situation for China's manufacturing (NBS, 2016a). China's manufacturing sector faces significant challenges because of increasing labour cost, a low value-added ratio and low labour productivity, which are discussed in the following sub-sections.

### 2.4.2.1 End of abundant and cheap labour

China's spectacular economic growth since reform and openness has relied on a big demographic dividend with enormous cheap labour due to the large working age population and millions of rural migrants moving into urban centres in China since the 1980s (Cai & Wang, 2006; Meng, 2012; Cai & Lu, 2013; Nahm & Steinfeld, 2014; Cai, 2016). They provided abundant labour resources for the significant development of low value-added labour-intensive manufacturing over three decades (Cai *et al.*, 2009; Hannan, 2009). However, this demographic dividend has been disappearing in recent years (Cai & Zhao, 2012; Golley & Tyers, 2012; Meng, 2012; Eggleston *et al.*, 2013). The low fertility level due to the one-child policy in the 1980s increased the current proportion of elderly people in China, which can be shown in the increase in the age dependency ratio since 2011 (see Table 2.5). This has led to significant stress on social security and caused a

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<sup>13</sup> The Purchase Management Index (PMI) is an internationally used tool for reflecting and forecasting the business conditions of a country's manufacturing and non-manufacturing sectors. The manufacturing PMI is released monthly and is derived from survey results on manufacturing firms across the country. It includes information on new orders, production, employment, supplier deliveries and inventories. Generally, the number 50 is regarded as a demarcation line. A PMI above 50 illustrates an expansion of a country's manufacturing sector while a PMI below 50 would be regarded as a sign of a declining manufacturing sector.

significant decline in the working age population (between 15 and 64 year old individuals) (Eggleston *et al.*, 2013). Data from the World Bank indicates a shrinkage in the working age population of China since 2014 to 993.79 million in 2017 (see Table 2.5). Although some views assume that the reduction of the working age population in China can be partly offset by later retirements and further expansion of rural migrant labour (Knight *et al.*, 2011; Rush, 2011), the actual situation of China’s labour market in recent years is that the retirement age has not yet been changed and the growth rate in the number of rural migrants moving out of agriculture has sharply decreased from 5.42 per cent in 2009 to 1.71 per cent in 2017 (NBS, 2017f). Labour abundance in China appears to be gradually disappearing, although this viewpoint is not universally accepted (e.g. Golley & Meng, 2011).

**Table 2.5 China’s working age population and labour force participation rate 2007 - 2017**

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Working age population (15-64) (in million people)</b>										
965.90	974.38	981.23	986.58	990.70	993.57	995.25	996.05	996.03	995.07	993.79
<b>Age dependency ratio (population younger than 15 or older than 64/the working-age population) (%)</b>										
36.44	35.95	35.67	35.59	35.67	35.94	36.39	36.97	37.67	38.55	39.51

Source: World Bank (2018c). <http://data.worldbank.org/country/china>

Moreover, improvement in living standards and growing shortages of ordinary labour in China have also contributed to a significant increase in the wage level of unskilled labour (Cai & Zhao, 2012). As the main source for unskilled labour, the monthly average wage for rural migrants increased sharply from RMB1,417 in 2009 to RMB3,480 in 2017 (NBS, 2017f). This affects most of China’s manufacturing sectors, especially labour-intensive industries. For example, China’s monthly minimum wage in the garment sector reached US\$266 per month in early 2014, which was much higher than in Asian export competitors such as Sri Lanka, Bangladesh and Vietnam with US\$66, US\$68 and US\$128 monthly minimum wages, respectively (Huynh, 2015). Considering productivity, a report by Oxford Economics (2016) showed a dramatic increase in the unit labour cost in China which was only 4 per cent less than that in the U.S. in 2016. It seems that the era of ‘Cheap China’ has ended, resulting in an undermining of the country’s competitive edge in labour-intensive low value-adding industries (Li *et al.*, 2012; Butollo, 2014; ILO, 2014).

#### 2.4.2.2 Low value-adding manufacturing

As discussed above, China previously focused on labour-intensive manufacturing, mostly assembly, due to its abundant and cheap labour, which is usually low value-adding (Koopman *et al.*, 2008). Although achieving enormous manufacturing value, China is still in the lower value-adding position in global value chains (Steinfeld, 2004; Yue & Eventt, 2010; Jiang & Wang, 2016). China's manufacturing has relied on processing and assembling for foreign products instead of creating self-innovated products and technology (Gaulier *et al.*, 2007; Zhao & Yang, 2012). Table 2.6 shows the value-added to production ratio of China and selected countries from 1995 to 2011.

**Table 2.6 Value-added as a % of production by selected countries 1995-2011**

Country	1995	2000	2005	2008	2009	2010	2011
<b>China</b>	39.09	37.03	34.41	32.91	32.55	32.03	32.22
<b>The other four top manufacturing countries</b>							
Germany	54.48	51.68	51.41	49.33	50.74	50.07	48.98
Japan	54.29	54.48	52.91	50.25	53.66	53.16	52.32
Korea	45.03	42.92	41.37	36.62	37.75	36.84	35.34
United States	54.40	53.67	54.10	53.23	56.37	55.51	54.76
<b>Other main Asian competitors of China</b>							
India	51.80	52.58	50.18	49.01	49.50	50.32	51.36
Indonesia	52.10	49.90	51.63	51.38	51.57	51.84	51.86
Malaysia	46.32	36.81	31.12	34.03	33.66	34.47	34.65
Philippines	50.90	49.94	50.10	51.71	52.52	51.86	52.31
Thailand	48.49	45.14	41.03	39.47	40.71	40.36	40.82
Viet Nam	46.04	45.00	39.40	39.19	39.17	38.86	39.14

Source: Trade in Value-Added Database (OECD-WTO, 2016). <https://stats.oecd.org>

According to the table the value-added to production ratio of China has been one of the lowest in the world for more than 15 years. In 2011, value-added in China accounted for only 32.22 per cent of total output production value. This was not only much lower than for other leading countries involved in manufacturing activity, including Germany, Japan, Korea and the United States, but it also fell behind China's main manufacturing competitors in Asia such as India, Malaysia and Vietnam. The low value added of Chinese manufacturing is also demonstrated by its exports. The share of domestic value added in its gross exports amounted to only around 65 per cent, much lower than that of the U.S.A and Japan (both around 85 per cent) (OECD-WTO, 2016). In 2015 35.1 per cent of China's total exports were low-end processed exports (Comprehensive Department, 2016). This implies that China's manufacturing exports remained predominantly based

on low value-adding and less sophisticated processing of foreign goods and technology.

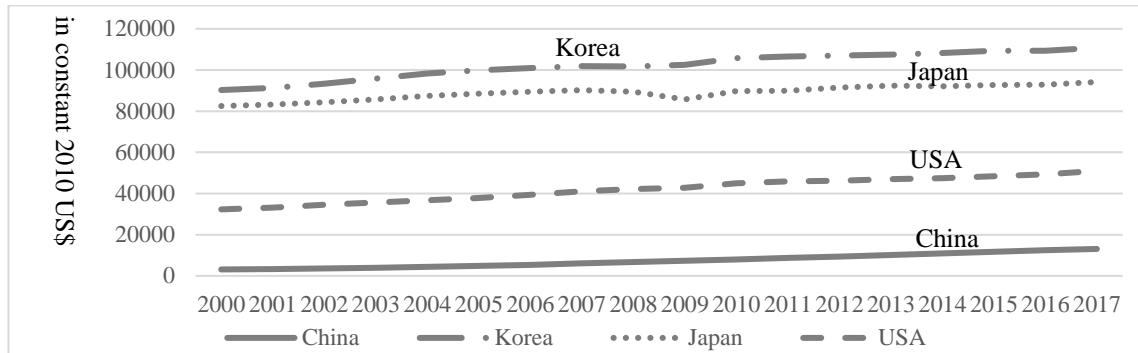
Since the establishment of the ‘Innovation-driven Country by 2020’ strategy in 2006, the Chinese government has put most emphasis on developing high-tech industries such as pharmaceuticals and aircraft with the objective of moving China up the value chain (Hubbard & Navarro, 2010; Yue & Eventt, 2010). However, these high-tech industries promoted by the Chinese government still rely heavily on processing instead of self-innovation. In 2015, low value-added processing exports accounted for more than half (61.09 per cent) of total high-tech products by export value (NBS, 2017d). China’s high-tech manufacturing is still a labour-intensive process, using partial or whole foreign technology to assemble imported intermediate inputs (Jarreau & Poncet, 2012). Also, high-tech manufacturing production is mainly conducted by non-domestic enterprises. In 2016, 76.88 per cent of high-tech exports by China were contributed by Hong Kong, Macau, Taiwan and foreign owned companies (NBS, 2017d). The low value-adding and high reliance on foreign technology need to be addressed (State Council, 2015d).

#### 2.4.2.3 Low labour productivity

Besides its low position in the manufacturing value chain, another significant problem for China’s manufacturing sector is its low labour productivity. As a significant driver of economic development, China’s labour productivity has increased gradually since reform and openness in 1979 (Bosworth & Collins, 2008; Brandt *et al.*, 2012). Figure 2.4 shows the labour productivity of the top five manufacturing countries—United States, China, Japan, Germany and Korea—from 2000 to 2017 in real terms.

Using constant 2010 US\$, China’s labour productivity increased dramatically from US\$3,138 in 2000 to US\$13,084 in 2017, equivalent to an 8.8 per cent annual real growth rate on average. However, although China has been the largest manufacturer in terms of manufacturing value-added, its labour productivity is still much lower than that of the other top manufacturing countries. In 2017 China’s labour productivity ranked 97<sup>th</sup> in the world and was only 11.81 per cent of the labour productivity in the U.S.A (US\$110,800). It was much lower than the world average level (US\$24,253) and the average level of upper-middle income countries (US\$16,750), where China is positioned (ILO, 2018).

**Figure 2.4 Labour productivity of top manufacturing countries 2000-2017**



Source: ILO Database of Labour Statistics (ILO, 2018).

<http://ilo.org/global/statistics-and-databases/lang--en/index.htm>

Moreover, the growth of manufacturing labour productivity in China is much slower than its wage level growth rate. According to the NBS (2016c), the average annual growth rate of real labour productivity in the manufacturing sector between 2005 and 2014 was 8.38 per cent, while the manufacturing average annual real wage level increased by 13.92 per cent during the same period. This led to a sharp increase in unit labour costs in China, as discussed previously, which erodes the comparative advantage of China's labour-intensive manufacturing.

In summary, China's manufacturing sector currently faces several challenges due to the disappearance of the demographic dividend, a low position in the manufacturing value chain and low labour productivity. Several other developing economies began to threaten the dominant position of China in global manufacturing. Investment from foreign countries in manufacturing is beginning to diversify away from China to some other Asian countries with lower labour costs, such as Vietnam, Indonesia and Cambodia in the ASEAN economy (Vuving, 2008; Vu, 2009; Enderwick, 2011; Thoburn, 2013; Witchell & Symington, 2013). Even the traditional domestic low value-adding activities in China have moved to countries with lower labour costs via outward FDI (Cheung & Qian, 2009; Cozza *et al.*, 2015; You, 2017). Therefore, besides promoting overseas investment for traditional manufacturing activity, China should reduce its reliance on foreign investment and technology and be more selective in relation to inward FDI based on filling existing technology gaps which exist in the country and transition its comparative advantage from low value-adding manufacturing with low-cost labour to higher value-adding sophisticated manufacturing with domestic self-developed brand and technology (State Council, 2015d; World Bank, 2016). It should also increase its labour productivity to



reduce its unit labour cost and generate new comparative advantages based on higher productive efficiency (State Council, 2015d). In order to finish this manufacturing upgrading, the role of private sector entrepreneurs and their SMEs should be given more emphasis and should be promoted by policy support (State Council, 2015d). By creating private SMEs to commercialise innovation, entrepreneurs can drive China's domestic self-innovation and eliminate the dominant role of foreign technology in Chinese manufacturing (Wu & Benson, 2017). Given the large number of private SMEs in China, they can play a significant role in spreading the benefits of technological progress more widely throughout the economy, which can generate an inclusive economic growth in China (ADB, 2012; Li & Hendrichske, 2014). Thus, they are significant for domestic technological progress to enhance the value-adding level and labour productivity. Meanwhile, the efficiency level of manufacturing enterprises, especially private SMEs, should also be promoted to reduce the per unit labour cost in China's manufacturing sectors. These are embodied in a new strategy for the manufacturing sector introduced by the Chinese government—'Made in China 2025'.

### **2.4.3 Overcoming China's manufacturing dilemma: 'Made in China 2025'**

In order to establish a new competitive advantage to compete in global manufacturing, the State Council of China issued a first ten-year plan for promoting China's manufacturing sector in 2015, which is the 'Made in China 2025' strategy. This strategy aims to transition China's manufacturing from 'Made in China' to 'Designed in China', from 'Chinese Speed' to 'Chinese Quality', and from 'Chinese Products' to 'Chinese Brand' (State Council, 2015d).

According to this strategy China aims to become one of the most powerful manufacturing countries within a ten-year period to 2025 (2015-2025). Until 2025, (1) the domestic innovation capability and the integration of technology and industry in the manufacturing sector will be improved substantially; (2) the efficiency of the manufacturing sector will be promoted by increasing labour productivity and reducing energy and material usage; (3) the pollutant discharge level will be reduced to meet the standards of developed countries; (4) a series of industrial clusters and multinational companies with strong international competitiveness will be established, and (5) the position of China in the global industrial division and value chain will move up (State Council, 2015d). The main

targets of ‘Made in China 2025’ are shown in Table 2.7.

**Table 2.7 Main targets of ‘Made in China 2025’ strategy**

<b>Indicator</b>	<b>2015</b>	<b>2020</b>	<b>2025</b>
<b>Innovation capability of manufacturing firms</b>			
Internal R&D expenditure/revenue (%)	0.95	1.26	1.68
Invention patents number per million RMB revenue	44	70	110
<b>Quality and performance</b>			
Quality Competition Index <sup>1</sup>	83.5	84.5	85.5
Value added/total output (%)	-	Increase by 2% from 2015	Increase by 4% from 2015
Annual growth rate of labour productivity (%)	-	7.5	6.5
<b>Integration of technology and industry</b>			
Popularising rate of broadband connection <sup>2</sup> (%)	50	70	82
Popularising rate of digitalised R&D equipment <sup>3</sup> (%)	58	72	84
Numerical control rate of production process (%)	33	50	64
<b>Green development</b>			
Energy consumption/value added	-	Reduce by 18% from 2015	Reduce by 34% from 2015
CO <sub>2</sub> emissions/value added	-	Reduce by 22% from 2015	Reduce by 40% from 2015
Water usage/value added	-	Reduce by 23% from 2015	Reduce by 41% from 2015
Utilisation rate of industrial solid wastes (%)	65	73	79

Source: State Council (2015d).

Note: 1. The manufacturing Quality Competition Index is used to measure the quality and technology condition of Chinese manufacturing industry by considering twelve indicators of quality level and development capability.

2. Popularising rate of broadband connection = Number of households with access to fixed broadband/Number of households.

3. Popularising rate of digitalised R&D equipment = Number of firms applying digital R&D equipment/Number of firms.

In order to increase innovation capability at the domestic level, China will further invest in research and development (R&D) and encourage the innovation activities of manufacturing enterprises. By 2025 the ratio of manufacturing firms’ internal R&D expenditure to their total revenue will reach 1.68 per cent from 0.95 per cent in 2015, while the number of invention patents created by manufacturing enterprises will increase to 110 units per million RMB revenue. With the effort of both government and enterprises, especially private enterprises, the innovation capability of China’s manufacturing firms is expected to improve significantly.

The quality of Chinese manufactured products and the performance of manufacturing enterprises also need to improve to generate competitive advantages in global manufacturing. The quality level and development capacity estimated by the Quality Competition Index is expected to reach 85.5 in 2025 with a 0.19 per cent average annual growth rate from 2015. To move China up the global manufacturing value chain, improving the value-added ratio is an essential target. By 2025, the value-added ratio to

total output of China's manufacturing is targeted to increase by 4 per cent from that in 2015, such that this ratio can recover to the level at which it stood before the global financial crisis in 2008 (State Council, 2015d). Moreover, China's government set the target to further improve the real annual growth rate of labour productivity in the manufacturing sector from 5.91 per cent (2003-2015) to 7.5 per cent between 2015 and 2020 and 6.5 per cent in the following five years (2020-2025). This can help China's manufacturing to increase its efficiency level.

Another part of the 'Made in China 2025' strategy is to improve the application of technology in industry, which can increase technological progress in production to achieve more efficient and sophisticated manufacturing (State Council, 2015d). To achieve this objective the popularising rate of broadband connection in China, a significant indicator for ICT usage, is aimed to increase from 37 per cent in 2015 to 82 per cent in 2025. The ratio of manufacturing enterprises using advanced digitalised R&D equipment is also expected to increase significantly to 84 per cent in 2025. In the production process it is expected that more than half (64 per cent) of the manufacturing production process will be under automatic computer numerical control (CNC)<sup>14</sup> systems by 2025.

Moreover, green development is an important element in upgrading manufacturing. Currently, China's inefficient utilisation of energy in manufacturing production has resulted in a significant environmental problem in terms of pollution and carbon dioxide emissions (Liu & Diamond, 2005; Liu, 2015). In order to address this problem China aims to reduce energy consumption and water consumption ratios to value-added by 34 per cent and 41 per cent respectively from 2015 to 2025. With more efficiency in using energy, CO<sub>2</sub> emissions are expected to decline by a 41 per cent during the same period.

As discussed above, an increase in the innovation capability and utilisation of labour, technology, materials and energy of China's manufacturing enterprises are all emphasised in the 'Made in China 2025' strategy to address a lack of domestic self-innovation and low efficiency in the manufacturing sector. In order to achieve these targets, the

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<sup>14</sup> Computer numerical control (CNC) is the automation of machine tools by means of computers executing pre-programmed sequences of machine control commands instead of manually control of machines.

government established policy priorities for ‘Made in China 2025’ in which promoting entrepreneurs and SMEs is stressed as private SMEs are the most vigorous and innovative part of the economy (State Council, 2015d). These policy priorities emphasising the development of entrepreneurship and SMEs are as follows (State Council, 2015d):

First, structural reform of China’s manufacturing sector should be further accelerated. In this, enterprises, especially those in the private sector, should be the dominant players, rather than the government, in determining investment and innovation outcomes. The commercialisation of innovation should be promoted to motivate innovation in the manufacturing sector. This would be achieved by boosting innovation in incumbent enterprises and also through entrepreneurial start-ups. Moreover, the relationship between state-owned and private enterprises should also be reformed. The industrial monopoly of state-owned enterprises should be eliminated to promote the development of private enterprises, helping China move toward a mature market economy.

To promote entrepreneurship and private enterprises, the business environment relating to China’s manufacturing sector should be further improved. Reforming the market access system is essential. The state monopolies and unfair competition in the market should be eliminated and the barriers to entry for private SMEs should be addressed to create a level playing field for all enterprises irrespective of ownership type. A new Competition Law will be required to address these issues in China. The burdens on enterprises should be reduced by clarifying government administration fees and abolishing unreasonable fees and apportions. Moreover, to encourage innovation by small private enterprises the protection of Intellectual Property Rights (IPR) should be further promoted. Several innovation/entrepreneurship-based cities will be established in the following years.

The labour productivity of manufacturing enterprises should be modified. The application of technology in manufacturing production would be improved by encouraging the collaboration of research institutes and enterprises, and higher education in IT, engineering technology and management should be further promoted. It is necessary to provide training programs to improve labour skills and labour specialisation would be enhanced through the provision of training. Two projects, the ‘Enterprise management

personnel quality promotion’ program and the ‘National small and medium-sized enterprise galaxy training’ program, will be conducted to develop a series of entrepreneurs and managers with a high level of knowledge on operating their private enterprises, and especially SMEs. Incentive policies on encouraging foreign talents and Chinese diaspora entrepreneurs to build businesses back in China should be implemented.

The development of small, medium and micro-scaled enterprises would be further promoted under the ‘Made in China 2025’ strategy. The tax burdens on SMEs should be reduced. Access to finance is the key issue for SMEs’ start-up, growth and development. The use of a ‘National development fund for SMEs’ should be optimised and capital from the private sector should be introduced into the building of this fund to give SMEs more fiscal support. The venture capital market should be further developed to finance entrepreneurial start-ups, especially in the high-tech industry. To expand the availability of financial resources for SMEs, the establishment of private small banks, besides state-owned big banks, that can provide more credit to SMEs should be supported; the development of a lending system for SMEs in commercial banks should be encouraged; and a credit guarantee system for SMEs’ financing should be modified by allowing intellectual property and insurance on credit as collateral. Moreover, innovation by SMEs would be further promoted by encouraging investment in SME innovation and the sharing of experimental facilities owned by research institutions with SMEs. Also, a ‘one-stop shop’ for servicing manufacturing SMEs, including services for start-up business, innovation, financing, training and talent information, should be developed.

As can be seen from the policy priorities in the ‘Made in China 2025’ strategy, promoting entrepreneurship and SMEs has been highly emphasised to upgrade China’s manufacturing sector to be more innovative and efficient. The performance of entrepreneurial enterprises, especially private SMEs, is the critical factor for attaining a successful transition of China’s manufacturing sector. Due to the implementation of this strategy, the slowing down of China’s economy gradually began to recover in 2017 (NBS, 2018e). The export value increased by 10.8 per cent, ending the large declines in 2015 and 2016 (see Figure 2.1). This was mainly driven by the 13.3 per cent growth in the export of high-tech products (NBS, 2018e). The real GDP growth rate increased slightly to 6.9 per cent in 2017, ending the consecutive reductions since 2011 (see Figure 2.3).

The manufacturing PMI also began to stay above the standard 50 points, representing an expansion from mid-2016 (NBS, 2018c). To help China avoid the middle-income trap by transitioning its manufacturing sector via innovation, private SMEs should be further promoted. The significance of entrepreneurship and SMEs, the obstacles that they face and current policies to support them in China are discussed in detail in Chapter 3.

## **2.5 Summary**

Since the implementation of reform and openness measures from 1979, China's economy has significantly integrated into the global economy through international trade and attracting FDI based on its initial competitive advantage in low labour costs (Lardy, 1992; Hu & Khan, 1997; Zebregs & Tseng, 2002). With successful international integration, China's economy has experienced extraordinary growth, with an average annual real GDP growth rate of 9.59 per cent from 1978 to 2017, and it has become the largest economy since 2013 on a PPP basis. This dramatic economic development has involved China transitioning from a factor-driven economy to an efficiency-driven economy. To transition to a more sustainable innovation-driven economy, China established an 'Innovation-driven Country by 2020' development strategy in 2006. Entrepreneurship is highly promoted under this strategy because it is the main driver of innovation and the innovation level of China has improved significantly since 2006. But more efforts are still needed to finish this transition successfully (State Council, 2016b).

In recent years, China began to experience a slowing down in its economy with decreasing exports and decelerating FDI inflows between 2014 and 2016. This led to the GDP growth rate of China declining to 6.9 per cent in 2015 and 6.7 per cent in 2016. This has been caused mainly by the gradual loss of competitive advantage in China's significant manufacturing sector, which contributed 31.6 per cent of GDP in 2017, 27.36 per cent of employment, 94.99 per cent of merchandise exports, 79.84 per cent of total R&D employees, 67.42 per cent of R&D expenditure and 42.67 per cent of granted invention patents in 2016. However, the competitive advantage of China's manufacturing sector in past years was based on cheap labour cost. Although China has become the largest manufacturer in terms of total value-added, it still focuses on low value-added processing and assembling of products designed in foreign countries utilising foreign technology.

This has resulted in its manufacturing activities being located in a low position in global manufacturing value chains, even in high-tech industries. Domestic innovation in China's manufacturing sector needs to be promoted urgently to move China up global value chains (Jarreau & Poncet, 2012; World Bank, 2016). Also, manufacturing production in China is still inefficient due to its low labour productivity; China's labour productivity is only around 11.81 per cent of that in the U.S.A. The growth of labour productivity was much slower than the increase in the wage level in the manufacturing sector, leading to a sharp increase in unit labour cost. China needs to increase the efficiency level of its manufacturing by improving labour productivity.

Facing a decrease in the proportion of the population of working age and a sharp increase in the wage level, China appears to be coming to the end of its abundant and cheap labour era leading to the loss of its competitive advantage in traditional areas of manufacturing activity. The country now faces the challenge of transitioning its competitive advantage in the manufacturing sector from low labour cost to high value-adding, innovation-oriented productive efficiency activity. In order to address the challenges facing China's manufacturing, China established a new 'Made in China 2025' strategy aimed at upgrading the country's manufacturing sector and generating new competitive advantages. In this strategy, promoting entrepreneurs and SMEs are a major focus, because they are the most vigorous and innovative sector in China's economy. Their performance will play a key role in upgrading China's manufacturing sector (State Council, 2015d). The strategy emphasises that entrepreneurs and SMEs should be supported by eliminating burdens on them in entering markets and operating their businesses, providing fiscal support and services for their development, expanding financing sources for them and promoting their innovation and efficiency levels.

Due to the implementation of this strategy, China has gradually recovered from its slowing economy. Its export and real GDP growth rate began to increase in 2017, ending consecutive years of decline. Its manufacturing sector also began to expand from mid-2016 after the recession in 2015 and the first half of 2016. Therefore, China should further implement this strategy and promote private SMEs in the following years to avoid being in a middle-income trap. The significance of entrepreneurship and SMEs, the obstacles faced by them and current policies supporting them in China are discussed in Chapter 3.

## **Chapter 3 Entrepreneurs and SMEs in China**

### **3.1 Introduction**

This chapter overviews the definition of entrepreneurship, the development and significance of the private sector and entrepreneurship in China, the characteristics of Chinese entrepreneurs, and the recent ‘Mass Entrepreneurship and Innovation’ program aimed at promoting entrepreneurial SMEs in different development regions to generate more quality entrepreneurial activities in China. The private sector in China was heavily restricted before the legalisation of private businesses in 1988, and experienced extraordinary growth thereafter (Liao & Sohmen, 2001; Garnaut & Song, 2004; Tsai, 2007). The private sector has now become China’s biggest industrial output producer, exporter and employer and a significant innovator, driving the general economic growth of China (Gregory *et al.*, 2000; Garnaut *et al.*, 2012; Lardy, 2014). Private businesses can also contribute to inclusive economic growth in China by providing job opportunities to less advantaged groups and minorities, such as women and youth (ADB, 2014; Li & Hendrischke, 2014). To encourage more entrepreneurial private enterprises, promoting SMEs is essential because they are the primary vehicle through which entrepreneurial activity takes place. However, SMEs need special support in China because they face many obstacles in terms of access to finance, exporting and innovation, which restrict their development (Liu & Yu, 2008; Zhu, 2012; Sham & Pang, 2014; Zhang & Xia, 2014). Moreover, the business environment and development of SMEs in eastern and non-eastern regions are different due to the significant regional disparities in economic development across the country (China Center of SME Cooperation Development & Promotion, 2012). Thus, policies supporting entrepreneurial SMEs should consider regional differences. In promoting entrepreneurial SMEs, encouraging more quality entrepreneurs that can operate their SMEs more efficiently, instead of just increasing the number of entrepreneurs, has become a significant issue for China (Shane, 2009).

The remainder of this chapter is structured as follows. Section 3.2 reviews the multidimensional definitions of entrepreneurship and the definition used in this study. Section 3.3 discusses the development of the private sector and entrepreneurship in China, the contribution of the private sector to China’s general and inclusive economic growth,



the characteristics of China's entrepreneurs and the recent 'Mass Entrepreneurship and Innovation' program. Section 3.4 introduces the definition and contribution of SMEs to China's private industrial sector and the obstacles that they face, followed by Section 3.5 which discusses regional disparities in the development of SMEs across China. Finally, Section 3.6 summarises the major conclusions from this chapter.

## **3.2 Definition of entrepreneurship**

The term 'entrepreneurship' was first proposed by Cantillon in 1755 (Hoselitz, 1951). Some two hundred years later the study of entrepreneurship has been recognised as multidimensional in nature and covering many disciplines such as economics (Acs & Szerb, 2007; Galindo & Méndez, 2014), management (Mitchell *et al.*, 2002; Kaplan & Warren, 2009), human behavior (Bird, 1989; Gartner *et al.*, 2010) and even social psychology (Hisrich *et al.*, 2007; Baum *et al.*, 2014). Therefore, although there is flourishing research on entrepreneurship, it does not have a universally accepted definition across a range of contexts and research areas (Hébert & Link, 1989; Shane & Venkataraman, 2000; Klapper *et al.*, 2010).

In the original definition of entrepreneurship proposed by Cantillon (1755), entrepreneurs were viewed as a different type of economic agent from labour. They were defined as arbitrageurs who buy products at constant prices and then sell them at uncertain prices, and thus bear the risk of obtaining profit (Van Praag, 1999). Expanding on Cantillon's view, Knight (1921) distinguished uncertainty from risk. While risk is measurable and insurable, uncertainty is not. He defined entrepreneurs as those who act on the basis of their forecasting on market developments and as a consequence bear the uncertainty of market dynamics. This view is also adopted by Von Mises (1949) who argues that entrepreneurs are speculators dealing with future uncertainty. Thus, in this context, entrepreneurs are risk or uncertainty bearers. Following the view that entrepreneurs are risk-takers, Say (1803) and Marshall (1890) regarded entrepreneurs as leaders and managers of firms who allocate productive resources and coordinate the production process, and thus bear all the risks related to that production. This view is followed by Coase (1937), Casson (1982) and Hébert and Link (1989), who defined entrepreneurs as those who specialise in making judgments and decisions to coordinate scarce resources

in business. This view emphasises the managerial role of entrepreneurs. However, some researchers pointed out that entrepreneurial ability should be distinguished from managerial ability, which is used mainly to maintain the profitability of current operations (Gifford, 1993; Douglas & Shepherd, 2002).

By contrast, the economic viewpoint emphasises that entrepreneurs are those who recognise and exploit new market opportunities. Following Walras (1954) and Penrose (1959), Kirzner (1973) pointed out that entrepreneurs are mainly arbitrageurs. They are 'alert' to unexploited opportunities that arise from information asymmetry within the existing framework and technology. Entrepreneurs, unlike others, have the capacity to recognise, seize and exploit these new opportunities to obtain profit. They help the economy to achieve Pareto optimality by pushing the economy onto the production possibility curve (PPC) instead of remaining inside the PPC.

But in the entrepreneurship theory proposed by Schumpeter (1934), entrepreneurs are actually innovators who engage in 'creative destruction', instead of being merely arbitrageurs who operate within the existing framework and technology in Kirzner's view. He defined entrepreneurs as those carrying out new combinations of production factors and thus creating technological progress, which shifts the production possibility frontier of an economy. They bring a new framework and technology into the market, including introducing a new good or improving quality, introducing a new method of production, opening a new market, introducing the use of a new material and introducing a new organisation in an industry. By means of these innovations, entrepreneurs disrupt the existing economic status and create technological progress, which can lead to bursts of economic growth (Gifford, 1993; Smilor, 1997).

Based on the ideas of Schumpeter, some researchers pointed out that the disruption of the existing economic status created by entrepreneurs should not only refer to new products, but also give rise to new businesses and sectors (Ardichvili *et al.*, 2003). This is because entrepreneurship can introduce new businesses into the market, creating new operational forms, competition and diversity and commercialising new ideas, products and technology (Audretsch & Keilbach, 2004). Developing this viewpoint, Drucker (1985) implied that entrepreneurs are the founders of new businesses. In this way, entrepreneurs

can be regarded as the creators of new organisations rather than the maintainers or changers of established organisations (Gartner, 1985; Gartner & Carter, 2003).

The complex and multidimensional definition of entrepreneurship has led to increased complexity in the study of entrepreneurship. Researchers need to choose a specific perspective or definition in their studies (Kao, 1993). Following the viewpoint that entrepreneurs are founders of new businesses as discussed above, this research defines entrepreneurs as privately-owned start-up business owners. Compared with other definitions, start-up numbers are much easier to investigate and measure in empirical studies than risk attitudes, motivation and innovation. Thus, entrepreneurship or entrepreneurship capital is traditionally measured as the number of start-ups in the economy (Audretsch & Keilbach, 2004; Parker, 2009). As stated by Carland *et al.* (1984), small business owners are often chosen to be proxies for entrepreneurs in many studies (e.g. Bates (1990), Ensley *et al.* (2000) and Burns (2010)) by assuming that entrepreneurs are individuals bringing resources together and initiating new ventures. Thus, in this research, we define entrepreneurs in China as new business creators and choose private SME owners as representatives for entrepreneurs.

### **3.3 Entrepreneurship and the private sector in China**

Entrepreneurship and the private sector in China have experienced tortuous growth (Pistrui *et al.*, 2001; Tsai, 2004; 2007; Huang, 2008; Chen & Dickson, 2010). They were officially forbidden by the Chinese government during the planned economy period and have only been legally permitted since 1988. With the rapid development of entrepreneurship and the private sector over the past 30 years, they have become the main drivers of China's economic restructuring and growth (Chen & Feng, 2000; Tsai, 2007; State Council, 2015e; 2016a). This section will overview the development and significance of entrepreneurship and private enterprises in the country.

#### **3.3.1 Development of entrepreneurship and the private sector in China**

In contemporary China the growth of entrepreneurship and private enterprises started with the development of commune and brigade enterprises (CBEs) and township-village

enterprises (TVEs), which are the predecessors of real private enterprises and entrepreneurship before 1988. In the pre-reform era (before 1979), entrepreneurial activities and the private sector were restricted in the central planning system (Liao & Sohmen, 2001). Private businesses were largely controlled by government and required to transition to collective CBEs when People’s communes were established in 1958 (Garnaut *et al.*, 2012). Although supported to develop in order to facilitate economic recovery after the Great Famine and the Cultural Revolution, CBEs did not represent a key sector in China’s pre-reform economy (Harvie, 1999; Xu & Zhang, 2009). They only contributed 21.2 per cent of total rural output value in 1978, and most of them were concentrated in the grain processing and handicrafts sectors (Garnaut & Song, 2004).

**Table 3.1 Number and contribution of TVEs 1978-1988**

	Number (million)	Employment		Value added		Export	
		Person (million)	Share to rural employment (%)	Value (billion RMB)	Share to GDP (%)	Value (billion RMB)	Share to total export (%)
1983	1.35	32.35	9.33	40.84	6.85		
1984	6.07	52.08	14.48	63.32	8.78		
1985	12.22	69.79	18.83	77.23	8.57		
1986	15.15	79.37	20.89	87.31	8.50	9.95	9.20
1987	17.50	88.05	22.58	141.64	11.75	16.92	11.51
1988	18.88	95.45	23.82	174.20	11.58	26.87	15.21

Source: Firm numbers, employment, value-added and exports of TVEs were obtained from Statistics of Township and Village Enterprises (1978-2002), Bureau of Township Enterprises (2003); share of TVEs to rural employment, GDP and exports were estimated by the author based on rural employment, GDP and total exports data obtained from China Compendium of Statistics, 1949-2008 (NBS, 2010a).

With reform and the opening of China’s economy from 1979, a dramatic development of rural industries was generated. From 1980, reform of the fiscal contracting system led to a change of township and village level governments’ role from fully controlling CBEs to being ‘residual claimants’ of these enterprises, which were now known as the so-called TVEs (Qian, 1999; Zhu, 2012). With the ending of the commune system in 1983, TVEs were officially recognised by the Chinese government which resulted in CBEs evolving into TVEs. At the early stage of reform and openness, when markets remained underdeveloped, TVEs could be more effective because they could utilise their political connections to gain access to capital, labour and land, and were also more motivated to produce efficiently by binding appointed enterprise managers’ remuneration to firm performance as in the private sector (Che & Qian, 1998; Jin & Qian, 1998; Harvie, 1999; Fu & Balasubramanyam, 2003). Therefore, TVEs became the major driving force for the

revival of China's entrepreneurial activity and economic growth in the 1980s (Weitzman & Xu, 1994; Che & Qian, 1998).

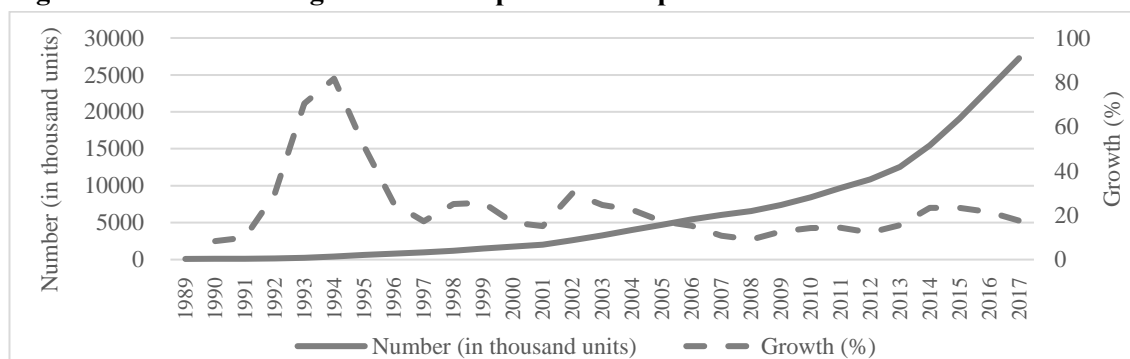
According to Table 3.1 the number of TVEs increased dramatically from 1.35 million in 1983 to 18.88 million in 1988. They accounted for 23.82 per cent of total rural employment and contributed 11.58 per cent of total GDP with 174.20 billion RMB value-added output in 1988. Since TVEs were allowed to export in 1986, their exports grew rapidly to 26.87 billion RMB in 1988, accounting for 15.21 per cent of total exports. Their managers were given the autonomy to decide prices and controlled costs for the purpose of generating profit and, hence, acted with entrepreneurial characteristics (Liao & Sohmen, 2001). Entrepreneurship capability, which had lain dormant and been suppressed in the central planning economy period, was reinvigorated in the rural TVEs sector with reform (Harvie, 1999). TVEs played a pivotal role in the re-emergence of contemporary entrepreneurs and provided a foundation for the rapid development of private entrepreneurship in China (Liao & Sohmen, 2001; Li, 2002).

After the initial extraordinary growth of TVEs, the Chinese government began to envisage the significant opportunity and vitality that private enterprises could bring to the economy. Private sector activity, including one-person businesses (*Getihu*) and private enterprises (*Siying qiye*), was officially allowed and promoted from 1988, recognising that it was an important supplement to socialist public ownership and that such businesses should be given the status of legal entities (Garnaut & Song, 2004; Lin & Zhu, 2007). However, before 1992, the private sector was still subject to many limitations. Only rural residents, unemployed labour, individual business owners and resigned and retired individuals could conduct entrepreneurial activities with the objective of building private enterprises, and they were still restricted in their access to some crucial resources such as bank loans, petroleum and coal (Gregory *et al.*, 2000; Tsai, 2007).

Despite these limitations, the relaxation of government regulations resulted in a sharp increase in the number of private enterprises from only 90,581 in 1989 to 107,843 in 1991 (see Figure 3.1). The attitude of the Chinese government to private enterprises changed radically with the transition from a centrally planned economy to a market-oriented economy in 1992 after Deng Xiaoping's tour in southern China. The role of the private

sector in China's economy was emphasised, along with more support policies aimed at addressing private sector limitations (Tsai, 2007; Garnaut *et al.*, 2012). More entrepreneurial activities appeared in the Chinese market and the number of private enterprises increased dramatically by 70.39 per cent from 139,630 in 1992 to 237,923 in 1993 and further increased by 81.68 per cent to 432,248 in 1994 (see Figure 3.1).

**Figure 3.1 Number and growth rate of private enterprises in China from 1989 to 2017**



Source: Report on the Development of Market Entities in China (2000-2017) (State Administration of Industry and Commerce, 2018).

The private sector was further boosted due to the privatisation of TVEs and state-owned enterprises (SOEs) in the mid-1990s. After 1992 many TVEs began to convert explicitly to private ownership. Under more leniency for private ownership, the so-called ‘red hats’ TVEs were the first to declare that they wished to become private enterprises, because they were effectively privately owned despite being classified as collectives (Harvie, 1999). Therefore, when the local governments’ fiscal deficits hardened after 1992, they were sold off to be privatised in order to provide these governments with additional funds (Li, 2003; Guo & Yao, 2005; Kung & Lin, 2007). Moreover, SOEs were in fact the least efficient ownership type because their priority was to ensure the implementation of five-year plans instead of profitability (Jefferson *et al.*, 2000; Wen *et al.*, 2002). The central government decided to reform the SOE sector, allowing local governments to privatise small and medium-sized SOEs from 1997 to get more income for local governments and improve the efficiency level of China’s economy (Cai, 2006; Yusuf *et al.*, 2006). With the privatisation of TVEs and SOEs, the number of private enterprises kept growing rapidly by 25.01 per cent and 25.64 per cent in 1998 and 1999 respectively (see Figure 3.1).

The privatisation reforms discussed above put China in a good position when it joined the WTO in 2001. Increased foreign investment and expanded trade from joining the WTO

presented many opportunities for budding entrepreneurs to start their own businesses, especially export-oriented private small and medium-sized firms (Zapalska & Edwards, 2001). As a consequence, private enterprises experienced a new boom after 2001 (see Figure 3.1). With this significant development, the number of officially registered private enterprises increased sharply from 139,633 in 1992 to 27.26 million in 2017, a factor of nearly two hundred times. The private sector, which is mainly in the form of small and micro businesses, has now become the largest ownership type in China, accounting for 84.26 per cent of total enterprise numbers in 2017 (NBS, 2016c). The role of entrepreneurial private enterprises changed from supplementing socialist public ownership to becoming a significant part of China's economy, driving the country's economic growth, employment, exports and innovation.

### **3.3.2 Contributions of private enterprises to China's general economic growth**

Entrepreneurial private enterprises are the most vigorous and innovative sector of an economy. They can commercialise innovation, create greater market competition and diversity and, thereby, drive economic growth (Audretsch & Keilbach, 2004; Acs, 2006). Bringing in new ideas and products, entrepreneurial private enterprises are critical in the context of a market economy (Chen & Feng, 2000; He, 2009). As the largest ownership type in China, private enterprises built by entrepreneurs contribute significantly in terms of industrial output, employment, exports and innovation.

#### ***Industrial output***

Since the 1990s China has established several supporting policies and built economic zones and industrial clusters to promote the industrial production of private enterprises (Chen & Feng, 2000; Tsai, 2007; Zeng, 2011). These preferential policies resulted in a significant change in the structure of China's industrial production with dramatic increases in the contribution of the private sector, thereafter, as shown in Table 3.2.

In 1988 the gross industrial output value produced by private-owned enterprises was only 0.21 trillion RMB, equivalent to 3.07 per cent of total industrial output in China. The state-owned or controlled enterprises dominated industrial production at that time. Due to promoting policies and the privatisation of TVEs and SOEs as discussed in the previous section, industrial output by private enterprises increased to 0.88 trillion RMB in 2001.

After China's accession to the WTO the private sector developed further. Industrial output by the private sector kept dramatically increasing year by year to 41.36 trillion RMB in 2017. This growth was much quicker than that of state-owned or controlled enterprises and foreign-owned enterprises during the same period, enabling the private sector to become the largest industrial producer in China since 2009. In 2016 the private sector contributed 35.91 per cent of total industrial output, while the shares of state-owned and foreign-owned enterprises were only 19.75 per cent and 21.58 per cent, respectively.

**Table 3.2 Industrial output by ownership type from 1998 to 2016**

	1998	2001	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
<b>Nominal industrial output value (in trillion RMB)</b>												
<b>Total</b>	<b>6.77</b>	<b>9.54</b>	<b>40.52</b>	<b>50.73</b>	<b>54.83</b>	<b>69.86</b>	<b>84.43</b>	<b>90.98</b>	<b>101.94</b>	<b>109.22</b>	<b>110.40</b>	<b>115.20</b>
Private	0.21	0.88	9.40	13.63	16.20	21.33	25.23	28.53	34.18	37.51	39.16	41.36
State	3.36	4.24	11.97	14.40	14.66	18.59	22.10	22.87	24.03	24.45	22.84	22.75
Foreign	1.68	2.72	12.76	14.98	15.27	18.99	21.84	21.99	24.13	25.09	24.54	24.86
Others	1.53	1.71	6.38	7.72	8.70	10.95	15.25	17.58	19.60	22.18	23.86	26.22
<b>Share to total nominal industrial output (%)</b>												
Private	3.07	9.18	23.21	26.88	29.55	30.54	29.89	31.36	33.53	34.34	35.47	35.91
State	49.63	44.43	29.54	28.38	26.74	26.61	26.18	25.14	23.57	22.38	20.68	19.75
Foreign	24.74	28.52	31.50	29.53	27.85	27.19	25.87	24.17	23.67	22.97	22.23	21.58
Others	22.56	17.87	15.75	15.21	15.86	15.66	18.06	19.33	19.23	20.31	21.60	22.76

Source: China Industry Economy Statistical Yearbook 2012-2017 (NBS, 2012a; 2013a; 2014a; 2015a; 2016b; 2017a).

### ***Employment***

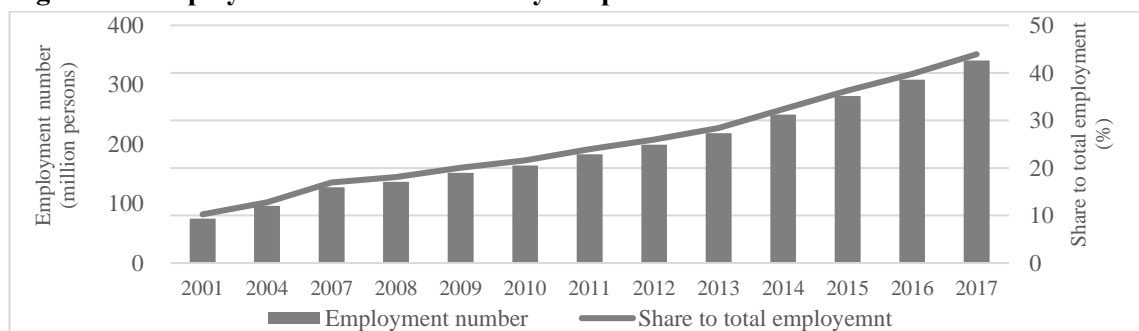
Bankruptcy, labour shedding and the privatisation of SOEs and TVEs since the 1990s resulted in a rapid build-up of more than 30 million laid off workers until 2000, who were then mostly re-employed in the private sector (Cai, 2002; 2006; Wang & Vongalis-Macrow, 2012). In the place of SOEs, private enterprises have become a significant contributor to China's employment generation. They not only absorb investors and entrepreneurs into self-employment but also employ workers from the labour market (Zhao, 2002). Figure 3.2 illustrates employment contributed by the private sector from 2001 to 2017.

As shown in this figure, employment by the private sector, including private enterprises with more than eight employees (Siyong qiye) and individual businesses with fewer than eight employees (Getihu), has increased year by year. In 2001 the private sector only employed 74.80 million workers, contributing just 10.24 per cent of total employment in



both urban and rural areas. With the development of entrepreneurship and private enterprises, employment by the private sector has grown since, even during the global financial crisis between 2007 and 2009. By 2017 there were 341million workers employed in the private sector, contributing 43.92 per cent of total employment in China. Now the private sector has become the biggest contributor to employment with the greatest capability to create new jobs. Although the average annual wage in private firms was lower than that in state-owned and foreign-owned enterprises (NBS, 2018a), they could still provide opportunities to secure an income for those turned down or retrenched by SOEs and foreign firms.

**Figure 3.2 Employment value and share by the private sector from 2001 to 2017**



Source: China Statistical Yearbook 2001; 2006; 2011; 2016; 2018 (NBS, 2001; 2006; 2011; 2016c; 2018b).

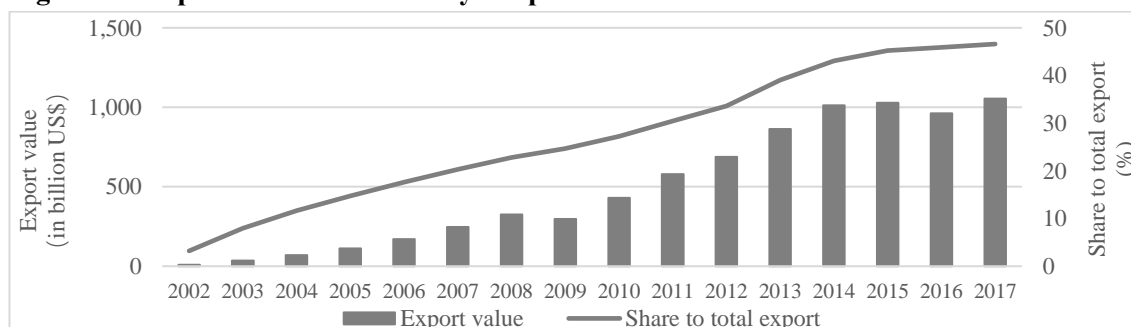
### ***Exports***

One of the two significant policy foci of the open-door and reform measures in 1979 was to develop international trade, especially exports to the international market. However, before 1999, the right of exporting directly was controlled by the government and not open to private enterprises. Nearly all of the enterprises with export licenses were SOEs and the direct export value of private enterprises was almost zero at that time (Gregory *et al.*, 2000). With the changing attitude to private enterprises by the late 1980s, government leaders realised that restricting the private sector in international trade was limiting the competitiveness of China in the international market. Moreover, in order to gain access to the WTO in 2001, China had to create a fairer trading market by allowing private enterprises to participate (Lardy, 2004). Therefore, in 1999, China began to grant direct export rights to private enterprises (Moser & Yu, 2014). By the end of 1999 there had been 150 private enterprises granted direct export licenses (Gregory *et al.*, 2000). With the easing of regulations for international trade on the private sector and also more opportunities provided from joining the WTO, the role of private enterprises in China's

international trade has become increasingly significant.

As shown in Figure 3.3 the export value of private enterprises has increased dramatically since China joined the WTO, rising from US\$9.48 billion in 2002 to US\$1.05 trillion in 2017. Although experiencing some decline in 2009 due to the influence of the global financial crisis and in 2016 due to the decrease in exports of traditionally dominant labour-intensive manufactured goods (see details in Section 2.4.2), the export value by the private sector enjoyed an extraordinary 46.25 per cent average annual growth rate between 2003 and 2017. With this dramatic development, the share of private enterprises in total exports by China increased from only 3.21 per cent in 2002 to 46.60 per cent in 2017. It surpassed that of state-owned or controlled enterprises in 2007 and foreign enterprises in 2015, becoming the biggest export sector in China.

**Figure 3.3 Export value and share by the private sector from 2002 to 2017**



Source: China Customs Statistics Yearbook (2003-2018) (General Administration of Customs, 2003; 2004; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017; 2018).

### ***Innovation***

Entrepreneurs are the main conduit through which new knowledge can be transmitted into new innovative products (Wong *et al.*, 2005; Audretsch & Keilbach, 2007; Acs *et al.*, 2013). Over a long period, enterprises have become the dominant source of innovation and R&D activities, replacing research institutes in China (Zhang *et al.*, 2009). In particular, private enterprises driven by entrepreneurial activities have great potential to innovate and increase China’s innovative capability as a whole. As shown in Table 3.3, there were 10,304 industrial private enterprises engaging in R&D activities in 2009, with 256,945 R&D employees and 58.29 billion RMB in intramural R&D expenditure. During subsequent years the innovation activities of private enterprises have further grown rapidly. By 2016 there were 44,485 industrial private enterprises with R&D activities.

They employed 732,439 workers and spent 280.05 billion RMB in R&D activities, contributing 27.10 per cent of total industrial R&D employees and 25.59 per cent of R&D expenditure. The innovation outcome of private enterprises was even more remarkable. In 2016, the number of new products created by private enterprises reached 145,329, nearly triple the number in 2009 and accounted for 37.09 per cent of total new products in China. The patent application number of private enterprises increased even more sharply from 83,153 in 2009 to 237,820 in 2016, accounting for 33.24 per cent of total patent applications in China. As a major contributor to R&D inputs and outputs, private enterprises have now become a significant sector and source of innovation in China.

**Table 3.3 R&D activities and innovation achievements by private enterprises 2009-2016**

	2009	2011	2012	2013	2014	2015	2016
<b>R&amp;D activities</b>							
Firm number with R&D activities (units)	10,304	15,811	21,178	26,036	31,354	37,113	44,485
R&D full-time employees (in thousands of persons)	256.95	345.10	419.11	523.55	606.23	662.02	732.40
R&D expenditure (in billion RMB)	58.29	94.40	124.65	169.01	202.68	236.36	280.05
<b>Contribution to total R&amp;D activities in China (%)</b>							
R&D full-time employees	17.77	17.80	18.66	20.99	22.95	25.09	27.10
R&D expenditure	15.44	15.75	17.31	20.32	21.90	23.60	25.59
<b>Innovation outcomes</b>							
New products (units)	57,464	67,557	83,612	103,038	119,467	113,439	145,329
Patent applications (units)	83,153	111,705	144,168	174,650	202,849	215,465	237,820
<b>Contribution to total Innovation achievements in China (%)</b>							
New products	24.17	25.38	25.85	28.76	31.78	34.77	37.09
Patent applications	31.28	28.93	29.43	31.14	32.17	33.74	33.24

Source: China Statistical Yearbook on Science and Technology (2010-2017) (NBS, 2012c; 2013c; 2014c; 2015c; 2016d; 2017c).

Due to their significant contribution to China's general economic growth in terms of industrial production, employment, exports and innovation, the role of entrepreneurial private enterprises has been emphasised in the 'Innovation-driven Country by 2020' and 'Made in China 2025' strategies (State Council, 2006; 2015d).

### 3.3.3 Contribution of private enterprises to China's inclusive economic growth

Inclusive economic growth is a new concept given increasing focus in recent years, which is regarded as the base for sustainable long-term economic growth (World Bank, 2009; Samans *et al.*, 2015). It is defined as a process which leads to an equitable share of benefits from economic growth for all participants, especially for poorer people (World Bank,

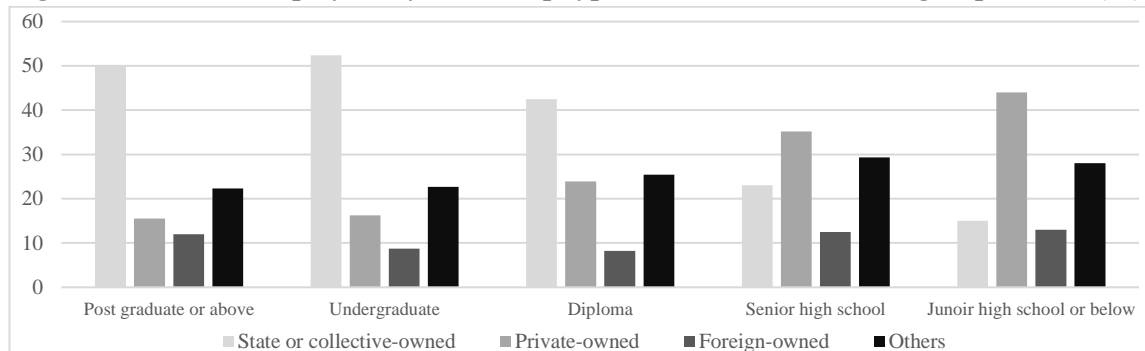
2009; Ranieri & Ramos, 2013). This involves not only the need to reduce poverty but also the need to eliminate inequality across different social layers and regions (Zhuang & Ali, 2007; Rauniar & Kanbur, 2010; Li & Hendrischke, 2014). With inclusive development the benefits from economic growth should reach all groups, especially women, children, youth, minorities and the extremely poor in rural areas (Rauniar & Kanbur, 2010). The private sector is vital in helping China to achieve this inclusive economic growth, besides its contribution to China's general economic development as discussed previously. This is because the private sector, especially SMEs, can provide self-employment and job opportunities for laid-off workers, females and workers with low education and skill levels, as well as providing fiscal funds for better implementation of policies aimed at achieving inclusive growth in China (Li & Hendrischke, 2014).

The reform of SOEs in the late 1990s and early 2000s brought serious economic and social challenges arising from unemployment to China. The number of laid-off workers from SOEs was officially reported to be more than 34.37 million workers from 1997 to 2003 (Wang & Vongalis-Macrow, 2012). The actual number could have been even larger, leading to a serious problem in terms of social stability (Solinger, 2001). These laid-off workers were mainly absorbed by the private sector. Besides being re-employed by incumbent private enterprises, they were also encouraged to take entrepreneurial activities through a 'Start Your Business' program. They were provided with training, tax reductions and loans to start their own businesses (Guiheux, 2007; Wang & Vongalis-Macrow, 2012; Shah *et al.*, 2014). Therefore, entrepreneurial private enterprises played a significant role in the re-employment of laid-off workers. According to the State Council (2004) more than 19 million laid off workers from SOEs were re-employed from 1998 to 2003, mostly by private SMEs (Li, 2012).

Besides general job creation, private enterprises, mostly private SMEs, employed more migrants from the rural sector with less-educated workers than other ownership types. While the highly-educated labour force preferred to work in state-owned enterprises with more secure positions and wages, less competitive workers with a low education level, such as rural migrants, were mainly absorbed by the private sector (Li & Hendrischke, 2014). As shown in Figure 3.4, more than half of the workers with at least a bachelor's degree were employed by state or collective-owned enterprises in 2008. Private

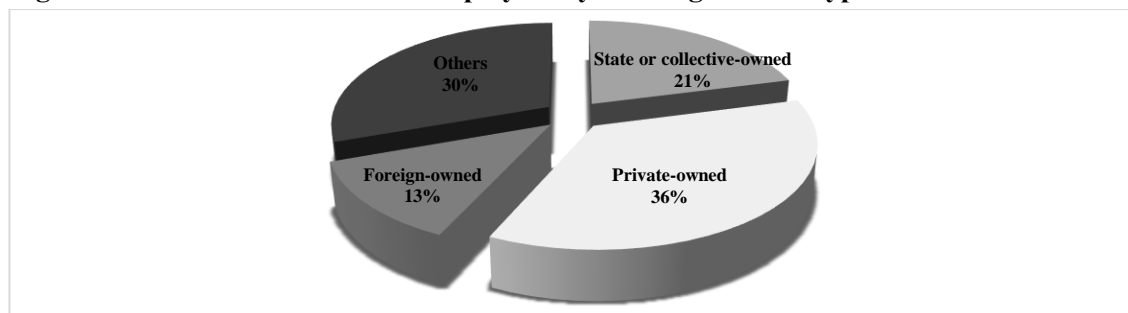
enterprises only employed around 16 per cent of these highly-educated workers. However, most less-educated workers were employed by private enterprises. They provided job opportunities for 35.16 per cent of workers with a senior high school qualification and 43.97 per cent of those with junior high school or below qualifications. Private enterprises have become the main source of employment for the undereducated labour force.

**Figure 3.4 Share of employees by ownership type in each education level group in 2008 (%)**



Source: China Economic Census Yearbook 2008 (Leading group office of the second national economic census in the State Council, 2010).

**Figure 3.5 Distribution of female employees by firm registration type in China in 2013**



Source: China Economic Census Yearbook 2013 (Leading group office of the second national economic census in the State Council, 2015).

Moreover, China has a long history of male domination in all economic and social areas, including education, social status and employment (Hannum & Yu, 1994; Li, 1995). In the labour market, females are more likely to be unemployed and laid off and find it more difficult to become re-employed than their male counterparts (Gu, 2003; Brown, 2009). With large enterprise numbers, private firms are the main source of employment for females in China. Private firms in labour-intensive sectors, such as textiles and garments, have a heavy concentration of female workers because they are regarded as being more dexterous than male workers (Zhang & Dong, 2008). As shown in Figure 3.5, while state or collective-owned and foreign-owned enterprises only employed 21 per cent and 13 per

cent of total female workers respectively in 2013, the majority (36 per cent) of female workers were employed by private enterprises which provided job opportunities for 44.07 million women. Also, the private sector provides females with opportunities for self-employment with the number of Chinese female entrepreneurs exceeding 29 million in 2011 (Mehta *et al.*, 2015). The private sector has become a significant source for employment and self-employment of females in China, especially in sectors such as textiles and garments which have a heavy contribution of female workers and contribute to a reduction in China's gender inequality in the labour market.

The contribution of private enterprises to local finance can also lead to long-term economic benefits for China. China began the process of government decentralisation in the 1980s, when financial support from the central government to local governments declined and local governments needed to collect local tax revenue on their own to cover their expenditures (Zhang, 2006; World Bank, 2012). The private sector can create large local tax revenue for local government. In 2015, among the 5.48 trillion RMB total local tax revenue collected in China, that contributed by private enterprises reached 632.63 billion RMB (State Administration of Taxation, 2016). These local tax revenues provided by private enterprises facilitated fiscal policies for promoting inclusive growth in the local region (Li & Hendrischke, 2014).

Because of the significant role of private enterprises in providing job opportunities for disadvantaged groups and providing finance for local governments to better implement inclusive growth policies, the private sector is regarded by China's policy makers as the most important sector for the attainment of inclusive and sustainable economic growth both now and into the future (ADB, 2014; Li & Hendrischke, 2014).

#### **3.3.4 Characteristics of entrepreneurs in China: Who are they?**

Commensurate with the growth of private enterprises, China's entrepreneurs have become increasingly important in the society. More attention has been paid to them in terms of identifying who they are. As China experienced a significant transition in its attitude to the private sector, the characteristics of its entrepreneurs, in terms of age, gender, education level and experience, have undergone a major change.

#### 3.3.4.1 Age

Nascent entrepreneurs usually consist of a group of young people because they are less averse to risk-taking in their entrepreneurial activities (Rotefoss & Kolvereid, 2005). But Table 3.4 shows that the middle-aged group has dominated China's entrepreneurial activities. In 2016 68.6 per cent of entrepreneurs in China were in the 36-55 age group. In the 1990s the great entrepreneurial opportunities in China's immature market were seized mainly by risk-taking groups in their 20s (Liao & Sohmen, 2001). Also, the SOE reforms in the 1990s generated millions of laid-off workers in their 20s who were encouraged to start their own businesses (Yao, 2004). These people, who are middle-aged today, have become the major source of entrepreneurs in contemporary China. However, compared with the 1990s, the involvement of young people in entrepreneurial activities in the 2010s has declined because of better job opportunities in the labour market (Liao & Sohmen, 2001; Chen *et al.*, 2006). As can be seen from Table 3.4, young people under 35 years of age, who are believed to be more creative and have a more risk-taking appetite and greater willingness to explore new opportunities (Tsai, 2004), only contributed 17.3 per cent of the total entrepreneurs in China in 2016 (see Table 3.4). With a big potential for entrepreneurial activities and innovation, young entrepreneurs should be further promoted, which is currently occurring in China (State Council, 2015c).

**Table 3.4 Age group share of entrepreneurs in China (%)**

Age group	0-35	36-45	46-55	56-65	66 or above
Share	17.3	31.3	37.3	12.4	1.7

Source: Annual Report on non-state-owned economy in China No. 13 (2015-2016) (All-China Federation of Industry and Commerce, 2017).

#### 3.3.4.2 Gender

Gender inequality in entrepreneurial activities persists in China. Females are regarded as having a 'work-family' conflict and are more risk-averse and less financially capable in their entrepreneurial activities (Mueller, 2004; Brindley, 2005; Marlow & Patton, 2005). According to private enterprise surveys conducted by the Chinese government (All-China Federation of Industry and Commerce & Chinese Private Economy Research Association, 2013), the proportion of female entrepreneurs was only 13.5 per cent of the total number of entrepreneurs in 1993 and decreased further to 8.3 per cent in 1997.

This ratio subsequently began to rise from the late 1990s due to many laid-off females being forced to take on entrepreneurial activities with the reform of the SOEs and TVEs. From 1997 the share of females in total entrepreneurs increased gradually in every year, reaching 20.3 per cent in 2016 (All-China Federation of Industry and Commerce, 2017). Although the gap between the number of male and female entrepreneurs has been narrowing, males still dominate entrepreneurial activities in China. In contemporary China, there appear to be no significant differences in the perceived opportunity and capabilities of engaging in entrepreneurial activities between males and females (GEM, 2018). In fact, female entrepreneurs tend to have a higher education level, are more optimistic about their career future, use advanced information communication technology more often and have more access to international markets (Adema *et al.*, 2014). Female entrepreneurs also give a higher priority to their local community because women spend more of their disposal income in the local economy, which directly benefits local society and thus inclusive economic growth (APEC, 2013). But their need to take care of families and their lack of capital, entrepreneurial inexperience and limited skills have hindered their participation in entrepreneurial activities (Zhu & Chu, 2010; Hendrshke & Li, 2012; Adema *et al.*, 2014). Females have considerable potential in terms of engaging in entrepreneurial activities, but their potential has not been fully developed in China (All-China Federation of Industry and Commerce, 2017).

#### 3.3.4.3 Education level

The education level of China's entrepreneurs has been relatively low during the early reform period because of scarce access to higher education. The minority with higher education would be provided with jobs in more stable SOEs in the 'iron rice bowl' era, such that they were seldom laid off or chose to engage in self-employment (Adema *et al.*, 2014). Therefore, the majority of self-employed entrepreneurs in the private sector during this period had a lower education level. In 1993 only 17.2 per cent of private entrepreneurs in China had a university education background (see Table 3.5). Most of them had only a diploma or senior high school qualification, accounting for 35.8 per cent and 36.1 per cent respectively of the total entrepreneur cohort. Despite the end of the 'iron rice bowl' period and the promotion of entrepreneurs in the 1990s, this pattern did not change until 2006 when China established the 'Innovation-driven Country by 2020' strategy.



**Table 3.5 Chinese private entrepreneurs grouped by level of education (%)**

	1993	1997	2000	2002	2004	2006	2008	2010	2012	2014
<b>Postgraduate</b>	0.6	0.7	3.4	5.8	5.7	4.5	12.7	7.1	8.1	9.23
<b>Undergraduate</b>	16.6	19.5	8.8	33.0	15.0	13.1	22.4	20.6	23.9	26.44
<b>Diploma</b>	35.8	41.7	25.8		31.1	31.7	26.7	33.5	33.2	32.74
<b>Senior high school</b>	36.1	31.5	39.5	41.6	33.6	36.6	29.7	28.4	25.5	24.21
<b>Junior high school</b>	9.9	6.3	19.6	17.4	12.9	12.6	7.8	9.2	8.2	9.2
<b>Primary or under</b>	1.0	0.3	2.9	2.2	1.7	1.5	0.7	1.2	1.1	0.94

Source: Yearbook of China Private Economy (2000-2001; 2006-2008; 2010-2012) (All-China Federation of Industry and Commerce & Chinese Private Economy Research Association, 2003; 2009; 2013); Annual report on non-state-owned economy in China No.12 (2014-2015) (All-China Federation of Industry and Commerce, 2016).

In order to improve the innovation capabilities of China, several policies encouraging university students and graduates to become entrepreneurs by providing them with special financial support and training programs were implemented after 2006 (Hong, 2011). Also a ‘Thousand Talents Program’ was launched in China in 2008 aiming to attract top overseas talent with a doctoral degree to come (back) to China and engage in entrepreneurial activities (General Office of the CPC Central Committee, 2008). Due to these policies, several highly educated individuals chose to become involved in entrepreneurial activities in China. The share of entrepreneurs with at least a bachelor’s degree increased gradually to 35.67 per cent of the total cohort in 2014 (see Table 3.5). This indicates an increasing trend in the education level of China’s entrepreneurs. However, it should be noted that the education level of entrepreneurs in China was still low with only one third of all entrepreneurs having at least a bachelor’s degree. More highly-educated entrepreneurs should be promoted to transition their knowledge into innovation by, for example, building innovation incubators in universities, so as to improve China’s innovation capability (State Council, 2016b).

#### 3.3.4.4 Experience

The previous experience profile of Chinese entrepreneurs also experienced a significant change. Before the legalisation of the private sector in 1988, private entrepreneurs were regarded as illegal and thus were strongly connected to a rural background and low social status (Chen *et al.*, 2006). Therefore, entrepreneurial activities mainly involved those with few technological or managerial skills, such as farmers, industrial workers, service and general staff as can be seen from Table 3.6. However, the privatisation of SOEs and TVEs in the 1990s resulted in more owners and managers becoming entrepreneurs by taking

over privatised firms or building new private businesses. Also, in order to promote the private sector, the government encouraged government cadres to build their own businesses from the 1990s, forming the so-called ‘*Xiahai*’ wave during this period (Dickson, 2003; 2007). Therefore, the share of entrepreneurs who were owners and managers and those with governmental experience increased sharply to 32.3 per cent and 13.7 per cent respectively in 2012 (see Table 3.6). Moreover, since the ‘Innovation-driven Country by 2020’ strategy in 2006, there have been more returnees and former employees in foreign or Hong Kong, Macao or Taiwan-owned enterprises, with advanced foreign technological managerial knowledge, becoming entrepreneurs (see Table 3.6). China’s entrepreneurs have more knowledge now than two decades ago (Chen & Dickson, 2010).

The increasing involvement of former cadres and owners and managers of SOEs in entrepreneurial activity has also led to a rise in the political connections (*guanxi*) of entrepreneurs because they were all communist party members (Li *et al.*, 2008). Even though they may have resigned from government positions, they still maintained their party membership and good relationships with government agencies to avoid obstacles in acquiring scarce resources (Xu *et al.*, 2013). In 2014, about 32.49 per cent of entrepreneurs were members of the Chinese Communist Party (All-China Federation of Industry and Commerce, 2016). Political connections (*guanxi*) have become a significant characteristic of entrepreneurs for the conduct of business in the special context of China.

**Table 3.6 Previous occupation of new private business founders (%)**

	before 1991	1992- 1995	1996- 2000	2001- 2005	2006- 2010	2011- 2012
Farmer/ industrial worker/ service staff/ normal employee	30.2	26.7	24.7	26.1	14.7	14.0
Cadre in different levels	5.9	10.6	12.3	9.7	17.1	13.7
Owner/manager of domestic firms	22.0	18.8	23.9	22.3	28.9	32.3
Salesmen/technician in domestic firms	12.2	18.0	15.1	13.5	14.1	11.0
Individual business owner	24.2	20.0	18.2	21.3	13.5	16.8
Soldier and other occupations	3.4	4.0	3.7	3.6	3.9	4.2
Laid-off worker/never employed labour	2.1	1.9	2.1	3.5	2.3	2.3
Student or worker abroad/worker in foreign, HMT firms	-	-	-	-	5.5	5.7

Source: Yearbook of China Private Economy (2000-2001; 2006-2008; 2010-2012) (All-China Federation of Industry and Commerce & Chinese Private Economy Research Association, 2003; 2009; 2013).

Note: HMT represents Hong Kong, Macao and Taiwan.

As discussed above, the characteristics of entrepreneurs in China have experienced significant changes since the 1990s. Although there has been an apparent increase in the

ability and social status of entrepreneurs, entrepreneurial activity in China has experienced a decline since 2014. According to GEM (2015; 2018) the Total Early-stage Entrepreneurial Activity (TEA), which is the percentage of 18–64 year olds in the population who are either nascent entrepreneurs or owner-managers of new businesses, decreased from 15.53 per cent in 2014 to 9.87 per cent in 2017. This reflects that the previous entrepreneurship in China was mainly necessity-based due to lack of opportunities in the labour market and a business cycle effect (Braunerhjelm *et al.*, 2016). In current China, promoting entrepreneurship, especially opportunity-driven entrepreneurs who are expected to be more efficient and thereby make a bigger contribution to economic development (Williams & Gurtoo, 2016), is essential to help China to transition to an innovation-driven economy and move up the manufacturing value chain. To address this issue, a new promotion program, ‘Mass Entrepreneurship and Innovation’, has been established by the Chinese government.

### **3.3.5 Promoting entrepreneurship: ‘Mass Entrepreneurship and Innovation’**

Realising the significant role of entrepreneurship in driving the general and inclusive economic growth of China, the entrepreneurship improvement has become a key policy focus to improve the competitiveness of China’s economy, especially the manufacturing sector, through innovation (State Council, 2015e). Therefore, in 2015, China’s government implemented a program called ‘Mass Entrepreneurship and Innovation’, aimed at promoting innovation and entrepreneurship by the whole society. The policy orientations contained in this program are summarised in Table 3.7 (Ministry of Science and Technology, 2015).

As can be seen from Table 3.7, the policy orientations established by the Chinese government in promoting entrepreneurship and innovation focus on: (1) building a better doing business environment, (2) providing various fiscal and monetary preferential policies, (3) improving financial support by banks and the capital market, (4) encouraging investment from various sources of capital, (5) providing special services for entrepreneurial activities and (6) promoting innovation-driven entrepreneurship. The first five policies aim to eliminate obstacles for both necessity-based entrepreneurs (e.g., unemployed labour, rural migrant workers and veterans) and entrepreneurs driven by opportunities in the market. However, in the context of the necessity to promote more

efficient and innovative opportunity-driven entrepreneurs, the last policy orientation, aimed at encouraging more innovation-driven entrepreneurship with higher potential to drive economic growth, is especially important.

Three types of individuals are especially supported as innovation-driven entrepreneurs: scientific and technical personnel, enrolled college students and graduates and talented individuals studying or working in foreign countries (State Council, 2015e). Each of these is now discussed in more detail. First, scientific and technical personnel are encouraged to be entrepreneurs by allowing them to retain positions in universities and research institutes for three years. A consulting service is provided to scientific and technical personnel to facilitate their involvement in entrepreneurial activities.

**Table 3.7 Mass Entrepreneurship and innovation program–Policy orientation summary**

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- **Improve the doing business environment**
  - Improve transparency and the credit system for entrepreneurial enterprises
  - Increase public goods and services supply for entrepreneurs
  - Simplify the business license application and verification process
  - Improve the protection of intellectual property, and entrepreneurial training and education
  - Remove restrictions on labour mobility due to the ‘hukou’ system

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- **Support entrepreneurs by fiscal and monetary policy for entrepreneurial enterprises**
  - Provide entrepreneurial subsidies
  - Reduce fees paid for land, water, energy and brand networks used in production by entrepreneurial firms
  - Provide tax preferences for entrepreneurial enterprises, especially high-tech enterprises
  - Provide government purchase contracts

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- **Support the financing of entrepreneurial enterprises**
  - Encourage IPOs and equity pledge financing of entrepreneurial enterprises
  - Encourage banks to provide special equity and debt financing support to entrepreneurial enterprises
  - Widen the measures of financing for entrepreneurial firms including internet finance and insurance capital

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- **Improve investment in entrepreneurial enterprises**
  - Extend the social investment scale and investment from state-owned capital
  - Relax restrictions on the investment scope of foreign capital
  - Promote the establishment of funds such as the Innovation Fund and the Fund for the Development of SMEs

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- **Improve services for entrepreneurial activities**
  - Establish entrepreneurial zones
  - Support cooperation between research institutes and entrepreneurial zones
  - Build internet platforms for information exchange and policy establishment

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- **Improve innovation-driven entrepreneurship**
  - Encourage scientific researchers to become involved in entrepreneurial activities
  - Encourage enrolled and graduate college students to be entrepreneurs
  - Provide preferential policies to attract those studying or working abroad to be returnee entrepreneurs

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Source: State Council (2015c).

Second, the program of guiding college students to be entrepreneurs would be further implemented. Subjects, supervision and training about entrepreneurship would be provided in college. Several subsidies would be provided to college students to start businesses. Venture funds from enterprises, associations and angel investors for entrepreneurial firms by college students would be encouraged. A flexible education system would be established to allow the retention of student status for those who suspend their courses to do business.

Finally, talented individuals who have finished their study or work in foreign countries are especially encouraged to come back to China and build entrepreneurial firms. These returnee entrepreneurs are encouraged by simplifying the process for them to start businesses. The visa grant process for foreign talents to work and live in China would also be simplified. For those building high-tech enterprises, one-off start-up capital would be provided. Medical insurance, housing issues, social security issues, job opportunities for their partners and the education of their children would be supported.

Although there is a significant effort to promote entrepreneurship through this program, most of the current policies still focus on increasing the number of entrepreneurs. There is still a lack of more specific policies targeting improvement of the quality of entrepreneurs in China. However, as pointed out by Acs (2008), it is entrepreneurs of high quality that can make a real contribution to economic growth. Policy focus should turn from the number of entrepreneurs to their quality (Shane, 2009).

Under this circumstance, there are still some questions that need to be answered in order to improve the quality of entrepreneurs in China, such as whether female entrepreneurs require special support and what kind of experiences should be the focus of targeted training programs. This research is aimed at providing empirical evidence regarding key entrepreneurial characteristics that can lead to more efficient production. This is significant for current China with the objective of implementing better targeted policies to promote entrepreneurship not only in terms of numbers, but also in terms of quality.

### **3.4 An overview of Chinese small and medium-sized enterprises**

Because the most common form of entrepreneurial enterprises is small and medium-sized enterprises (SMEs), promoting SMEs is essential for the development of entrepreneurship and the private sector (Lin & Zhu, 2007). Accounting for around 97 per cent of total enterprises in China, SMEs have been the backbone of China's economic development, especially in the private sector (Harvie & Lee, 2002; Wang & Yao, 2002; Chen, 2006; Liu, 2008; Zhang & Round, 2012). Their development has been the policy focus in the 'Innovation-driven Country by 2020', 'Made in China 2025' and 'Mass Entrepreneurship and Innovation' programs. However, SMEs in China face many barriers and difficulties in terms of their survival and development (Liu, 2008; Li & Ritchie, 2009; Cardoza & Fornes, 2011; Zhu *et al.*, 2012; Ma *et al.*, 2017), such that they need more support to improve their performance, especially in terms of their efficiency. In this section, the definition, number, contributions and key barriers of SMEs are introduced.

#### **3.4.1 Definition and contribution of general SMEs to the industry sector**

In China, SMEs can be further classified into medium-sized, small-sized and micro-sized enterprises. The official definition of SMEs changed in 2007 and was further modified in 2011 and 2017. The latest modified definition of an SME varies by sector, taking employee numbers, operating revenues and total assets into consideration (NBS, 2018f). A detailed summary of definitions of an SME and criteria by size of SMEs in different sectors is contained in Table 3.8. As can be seen from this table, SMEs in the industry sector (including the mining, manufacturing and electricity, gas & water production and supply sectors) are defined as enterprises with fewer than 1,000 employees or less than 400 million RMB operating revenue. Medium-sized industrial enterprises are those with 300-1,000 employees and 20-400 million RMB operating revenue. While an enterprise with 20-300 employees and 3-20 million RMB operating revenue is classified as a small-sized industrial enterprise, micro-sized enterprises in the industry sector are defined as firms with fewer than 20 employees or less than 3 million RMB operating revenue.

SMEs dominate the number of enterprises in China (Firth *et al.*, 2009; Singh *et al.*, 2009; Zhu *et al.*, 2012), especially small and micro-sized enterprises, which account for 95.6 per cent of China's non-agricultural enterprises (State Administration of Industry and

Commerce, 2014). Table 3.9 demonstrates the size distribution of industrial enterprises in China from 2011 to 2016<sup>15</sup>.

**Table 3.8 Definition and classification criteria of SMEs by sector in China**

Sectors	Criteria	SMEs			
			Medium	Small	Micro
<b>Agriculture</b>	Operating revenue (Y) (million RMB)	Y<200	$5 \leq Y < 200$	$0.5 \leq Y < 5$	Y<0.5
<b>Industry</b>	Employee number (X)	X<1000	$300 \leq X < 1000$	$20 \leq X < 300$	X<20
	Operating revenue (Y) (million RMB)	Y<400	$20 \leq Y < 400$	$3 \leq Y < 20$	Y<3
<b>Construction</b>	Operating revenue (Y) (million RMB)	Y<800	$60 \leq Y < 800$	$3 \leq Y < 60$	Y<3
	Total assets (Z) (million RMB)	Z<800	$50 \leq Z < 800$	$3 \leq Z < 50$	Z<3
<b>Wholesale</b>	Employee number (X)	X<200	$20 \leq X < 200$	$5 \leq X < 20$	X<5
	Operating revenue (Y) (million RMB)	Y<400	$50 \leq Y < 400$	$10 \leq Y < 50$	Y<10
<b>Retail</b>	Employee number (X)	X<300	$50 \leq X < 300$	$10 \leq X < 50$	X<10
	Operating revenue (Y) (million RMB)	Y<200	$5 \leq Y < 200$	$1 \leq Y < 5$	Y<1
<b>Transport</b>	Employee number (X)	X<1000	$300 \leq X < 1000$	$20 \leq X < 300$	X<20
	Operating revenue (Y) (million RMB)	Y<300	$30 \leq Y < 300$	$2 \leq Y < 30$	Y<2
<b>Warehousing</b>	Employee number (X)	X<200	$100 \leq X < 200$	$20 \leq X < 100$	X<20
	Operating revenue (Y) (million RMB)	Y<300	$10 \leq Y < 300$	$1 \leq Y < 10$	Y<1
<b>Postal service</b>	Employee number (X)	X<1000	$300 \leq X < 1000$	$20 \leq X < 300$	X<20
	Operating revenue (Y) (million RMB)	Y<300	$20 \leq Y < 300$	$1 \leq Y < 20$	Y<1
<b>Lodging and catering</b>	Employee number (X)	X<300	$100 \leq X < 300$	$10 \leq X < 100$	X<10
	Operating revenue (Y) (million RMB)	Y<100	$20 \leq Y < 100$	$1 \leq Y < 20$	Y<1
<b>Information transfer</b>	Employee number (X)	X<2000	$100 \leq X < 2000$	$10 \leq X < 100$	X<10
	Operating revenue (Y) (million RMB)	Y<100	$10 \leq Y < 100$	$1 \leq Y < 10$	Y<1
<b>Software and IT service</b>	Employee number (X)	X<300	$100 \leq X < 300$	$10 \leq X < 100$	X<10
	Operating revenue (Y) (million RMB)	Y<100	$10 \leq Y < 100$	$0.5 \leq Y < 10$	Y<0.5
<b>Real estate</b>	Operating revenue (Y) (million RMB)	Y<2000	$10 \leq Y < 2000$	$1 \leq Y < 10$	Y<1
	Total assets (Z) (million RMB)	Z<100	$50 \leq Z < 100$	$20 \leq Z < 50$	Z<20
<b>Property management</b>	Employee number (X)	X<1000	$300 \leq X < 1000$	$100 \leq X < 300$	X<100
	Operating revenue (Y) (million RMB)	Y<50	$10 \leq Y < 50$	$5 \leq Y < 10$	Y<5
<b>Leasing/business service</b>	Employee number (X)	X<300	$100 \leq X < 300$	$10 \leq X < 100$	X<10
	Total assets (Z) (million RMB)	Z<1200	$80 \leq Z < 1200$	$1 \leq Z < 80$	Z<1
<b>Other sectors</b>	Employee number (X)	X<300	$100 \leq X < 300$	$10 \leq X < 100$	X<10

Source: Statistical Definitions of Large-Sized, Medium-Sized, Small-Sized and Micro-Sized Enterprises (NBS, 2018f).

Note: Medium-sized and small-sized enterprises must satisfy all criteria, otherwise they are put into a lower size classification.

<sup>15</sup> The data used to show the number and performance of SMEs in China in this research is from 2011. This is because the classification criteria of SMEs changed in 2011, such that the numbers and performance of SMEs before and after 2011 are not directly comparable.

**Table 3.9 Number of enterprises in the industry sector by size from 2011 to 2016**

	2011	2012	2013	2014	2015	2016
<b>Total number</b>	325,609	343,769	352,546	377,888	383,148	378,599
Large	9,111	9,448	9,411	9,893	9,633	9,631
SMEs	316,498	334,321	343,135	367,995	373,515	368,968
Medium	52,236	53,866	53,817	55,408	54,070	52,681
Small and micro	264,262	280,455	289,318	312,587	319,445	316,287
<b>Percentage (%)</b>						
Large	2.80	2.75	2.67	2.62	2.51	2.54
SMEs	97.20	97.25	97.33	97.38	97.49	97.46
Medium	16.04	15.67	15.27	14.66	14.11	13.91
Small and micro	81.16	81.58	82.07	82.72	83.37	83.54

Source: China Statistical Yearbook (2012-2017) (NBS, 2012b; 2013b; 2014b; 2015b; 2016c; 2017b).

Among the total 325,609 industrial enterprises 316,498 were SMEs in 2011, consisting of 52,236 medium-sized enterprises and 264,262 small-and-micro-sized enterprises. SMEs made up 97.20 per cent of total industrial enterprises in 2011, showing their dominant role. By 2016 the number of industrial SMEs increased gradually to 368,968. SMEs are predominant in the industry sector, contributing 97.46 per cent of all enterprises in 2016. Within industrial SMEs, small-and-micro-sized enterprises are the majority, accounting for 83.54 per cent of total industrial enterprises in 2016. SMEs contribute the highest enterprise numbers in China.

The large number of SMEs in China has seen them become the main driver of China's economic growth (Chen, 2006; State Administration of Industry and Commerce, 2014; Zhang & Xia, 2014). In the industrial sector, in particular, SMEs are the main contributor to industrial production, employment, exports, foreign capital and innovation as shown in Table 3.10 and Table 3.11. According to Table 3.10 58.17 per cent of industrial production was produced by SMEs rather than larger enterprises in 2011, valued at 48.19 trillion RMB. Since 2011, the contribution by SMEs to industrial production in China has continued to increase. In 2016 73.28 trillion RMB in industrial output was created by SMEs, accounting for 63.61 per cent of total industrial output in the industry sector. The average annual growth rate of industrial output by SMEs from 2011 to 2016 was 8.85 per cent, much higher than that of large enterprises (3.96 per cent) during the same period. SMEs have become the leading sector for China's industrial development.

SMEs, with their great number, are significant generators of jobs (Chen, 2006; Liu, 2008; State Administration of Industry and Commerce, 2014). Employee numbers in industrial



SMEs were large at 59.36 million in 2011 as shown in Table 3.10, equivalent to 64.75 per cent of total employment in the industry sector. With the further development of SMEs their significance to total industrial employment has further increased. In 2016 they employed 62.78 million employees which was equivalent to 66.25 per cent of total industrial employment. SMEs have become dominant in providing job opportunities in the industry sector of China. They are the key sector in addressing the unemployment problem and will be significant for the attainment of social stability in China due to their large employment capacity (Katua, 2014; Sham & Pang, 2014).

SMEs have also been an important contributor to China's exports and FDI attraction (Liu, 2008). Industrial SMEs exported 4.14 trillion RMB of a total of 9.96 trillion RMB by the industrial sector in 2011, equivalent to 41.58 per cent of total exports by the industry sector. Their export value and share of total exports by the industry sector increased to 5.21 trillion RMB and 44.21 per cent respectively in 2016. Their importance in exports has been catching up to that of large enterprises in the industry sector, with great potential for further exports to be explored and promoted (China Center of SME Cooperation Development & Promotion, 2015). Moreover, in 2013, there were 57,402 foreign (including Hong Kong, Macau and Taiwan) funded industrial enterprises in China; 54,169 or 94.37 per cent of them were SMEs (China Center of SME Cooperation Development & Promotion, 2015). As shown in Table 3.10, in 2011 industrial SMEs utilised 1.93 trillion RMB in foreign capital. Their foreign capital usage increased dramatically to 2.37 trillion RMB in 2016. Although experiencing some fluctuations, their share of total foreign capital usage in the industry sector has remained above 60 per cent since 2011. Therefore, SMEs are significant attractors of foreign capital in the industry sector.

China's decreasing comparative advantage in terms of labour abundance and costs has led it to refocus attention on stimulating innovation, especially in SMEs, with the introduction of the 'Innovation-driven Country by 2020' strategy in 2006 (State Council, 2006). With support from the Chinese government, SMEs are playing an increasingly significant role in both innovation input and innovation achievements in China. In 2016 there were 86,891 industrial enterprises engaged in R&D activities, 93.08 per cent, or 80,874, of which were SMEs (NBS, 2017c). As shown in Table 3.11, industrial SMEs employed 2.13 million personnel and spent 0.52 trillion RMB on R&D activities, making

up 55.09 per cent and 47.75 per cent of total R&D personnel and expenditure by industrial enterprises respectively. As a consequence of these efforts in R&D activities by SMEs, they have achieved more innovation outcomes than large enterprises. In 2016 304,377 new products and 444,835 patent applications were created by industrial SMEs, equivalent to 77.67 per cent and 62.18 per cent of total new products and patent applications in the industry sector of China. SMEs have become the major force and carrier of technological innovation in China (Ministry of Science and Technology, 2011; State Administration of Industry and Commerce, 2014).

**Table 3.10 Contribution of SMEs in the industry sector of China from 2011 to 2016**

	2011	2012	2013	2014	2015	2016
<b>Industrial output</b>						
Total value (in trillion RMB)	82.78	90.98	101.94	109.22	110.40	115.20
Large	34.63	36.75	39.91	41.66	40.52	41.92
SMEs	48.15	54.23	62.04	67.56	69.88	73.28
Share of SMEs (%)	58.17	59.61	60.85	61.86	63.30	63.61
<b>Employee number</b>						
Total value (in million persons)	91.67	92.73	97.91	99.77	97.75	94.76
Large	32.32	31.44	34.15	34.05	32.93	31.98
SMEs	59.36	61.29	63.76	65.73	64.82	62.78
Share of SMEs (%)	64.75	66.10	65.12	65.88	66.31	66.25
<b>Exports</b>						
Total value (in trillion RMB)	9.96	10.66	11.29	11.84	11.60	11.78
Large	5.82	6.24	6.35	6.73	6.53	6.57
SMEs	4.14	4.42	4.94	5.11	5.07	5.21
Share of SMEs (%)	41.58	41.49	43.71	43.17	43.68	44.21
<b>Foreign capital usage</b>						
Total value (in trillion RMB)	3.05	3.98	3.45	3.63	3.53	3.72
Large	1.12	1.21	1.30	1.33	1.31	1.36
SMEs	1.93	2.76	2.15	2.23	2.22	2.37
Share of SMEs (%)	63.24	69.49	62.35	61.45	62.89	63.58

Source: China Industry Economy Statistical Yearbook 2012-2017 (NBS, 2012a; 2013a; 2014a; 2015a; 2016b; 2017a).

Note: Foreign capital includes capital from Hong Kong, Macau, Taiwan and other countries.

**Table 3.11 Contribution to innovation by firm size in the industry sector of China in 2016**

	Innovation input (R&D)		Innovation outcome	
	Expenditure (in trillion RMB)	Personnel (in million persons)	New products (units)	Patent application (units)
<b>Total</b>	<b>1.09</b>	<b>3.87</b>	<b>391,872</b>	<b>715,397</b>
Large	0.57	1.74	87,495	270,562
SMEs	0.52	2.13	304,377	444,835
<b>Share of SMEs (%)</b>	<b>47.75</b>	<b>55.09</b>	<b>77.67</b>	<b>62.18</b>

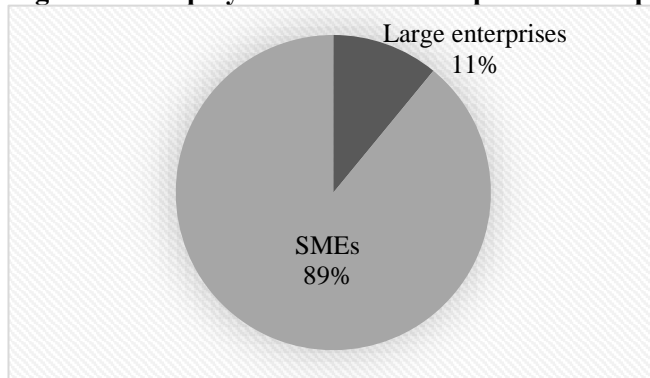
Source: China Statistical Yearbook on Science and Technology 2017 (NBS, 2017c).

### **3.4.2 Contribution of private SMEs in the industry sector**

As a logical means through which to conduct entrepreneurial activity, the significance of SMEs as discussed above is particularly apparent in the private sector. In China, most entrepreneurs choose to start a small or micro-sized business because of perceived lower risk and less financial requirement (Lin & Zhu, 2007). Therefore, the number of SMEs in the private sector is overwhelming and the ratio of SMEs in the private sector is the highest among all ownership types (State Administration of Industry and Commerce, 2014). As shown in Table 3.12, around 99.15 per cent of private enterprises in the industry sector are SMEs. The dominance of SMEs in terms of enterprise numbers has resulted in its special significance for the development of the private sector in China.

As shown in Figure 3.6 around 89 per cent of workers in industrial private enterprises were employed by SMEs, while large enterprises made up only the remaining 11 per cent of employment in 2011, indicating that SMEs have created most of the employment in the private sector. As the main size type in the private sector, SMEs also contributed around 88 per cent of total industrial output by industrial private enterprises during the period 2011-2013 (see Table 3.12). Industrial output by these SMEs increased by 15.58 per cent annually, on average, from 21.73 trillion RMB in 2011 to 29.03 trillion RMB in 2013. This growth rate was faster than that of large enterprises (14.60 per cent) during the same period, showing the leading position of SMEs in the development of industrial production in the private sector of China. Another noticeable contribution of SMEs in the private sector has been their significance in preventing the slowing down of exports by the private sector. As shown in Table 3.12, the export value provided by industrial private enterprises grew from 1.36 trillion RMB to 1.67 trillion RMB from 2011 to 2013; almost the entire growth of this has been contributed by SMEs. The export value of industrial private SMEs increased from 1.07 trillion RMB in 2011 to 1.39 trillion RMB in 2013, while exports by large private enterprises in the industry sector only increased by 0.01 trillion RMB during this same period. As a consequence of leading the growth of exports by the private sector, the contribution of SMEs to total exports by industrial private enterprises amounted to 82.92 per cent in 2013. They have become the dominant source of exports by industrial private enterprises in China.

**Figure 3.6 Employment of industrial private enterprises by size in 2011**



Source: Yearbook of China Small and Medium Enterprises (China Center of SME Cooperation Development & Promotion, 2012).

**Table 3.12 Enterprise numbers, industrial output, exports and tax revenue of private enterprises by firm size in the industry sector of China from 2011 to 2013**

	2011	2012	2013
<b>Number of private enterprises</b>			
Total	180,612	189,289	194,945
Large	1,527	1,638	1,645
SMEs	179,085	187,651	193,300
Share of SMEs (%)	99.15	99.13	99.16
<b>Industrial output (in trillion RMB)</b>			
Total	24.73	28.53	32.97
Large	3.00	3.46	3.94
SMEs	21.73	25.08	29.03
Share of SMEs (%)	87.89	87.88	88.05
<b>Exports (in trillion RMB)</b>			
Total	1.36	1.48	1.67
Large	0.28	0.27	0.29
SMEs	1.07	1.21	1.39
Share of SMEs (%)	79.09	81.88	82.92

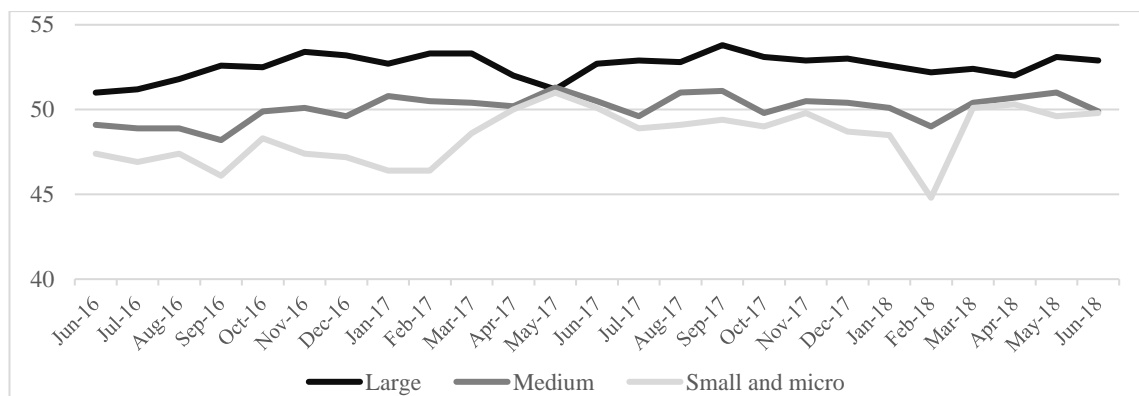
Source: Yearbook of China Small and Medium Enterprises 2012-2014 (China Center of SME Cooperation Development & Promotion, 2012; 2013; 2014).

As discussed above, SMEs have become the most significant source for the development of the private sector in China (Lin & Zhu, 2007; State Administration of Industry and Commerce, 2014). Therefore, the promotion of entrepreneurship in China should focus on the improvement of private SMEs. It is important for China to promote the performance of SMEs, so that they achieve better outcomes under the ‘Mass Entrepreneurship and Innovation’ development strategy (State Council, 2016a), but to do so will require addressing ongoing barriers to their development.

### 3.4.3 Barriers to private SME development in China

Despite private SMEs playing a vital role in China's economy in numerous ways, especially in the development of the private sector, they face many difficulties and are more likely to be loss making. In 2017, 11.8 per cent of industrial SMEs experienced a loss and this ratio was much higher than that of large enterprises (NBS, 2018d). On average, nearly 68 per cent of SMEs in China close down within five years while only 13 per cent of SMEs exist for more than ten years (Zhu *et al.*, 2012). The much higher exit rate of SMEs than that of large enterprises raises concern over the poorer performance of SMEs in China (Yang, 2004). In fact, the recession experienced by China's manufacturing sector, as discussed in Chapter 2, is mainly driven by the underachievement of manufacturing SMEs.

**Figure 3.7 Monthly manufacturing PMI by firm size in China from 06/2016 to 06/2018**



Source: Monthly Manufacturing PMI of China (NBS, 2018c).

As shown in Figure 3.7 the monthly manufacturing PMI of large enterprises remained above the standard 50 per cent mark from June 2016 to June 2018, indicating the development of large manufacturing enterprises. However, the manufacturing PMI for medium-sized enterprises was still much lower than that of large enterprises. The performance of small- and micro-sized enterprises was even worse. Their manufacturing PMI remained below the standard 50 per cent for a majority of months over these two years, showing a continuous recession of manufacturing small and micro enterprises in China. The poorer performance of SMEs was made exacerbated by the many barriers that they face, including obstacles to internationalising, a lack of innovation and, most significantly, limited financial support (Liu, 2008). These barriers are now discussed.

### ***Lack of financial support***

A lack of financial support has become the most important barrier facing SMEs in China (Garcia-Fontes, 2005; Cheng & Sun, 2006; Li & Ritchie, 2009; Sham & Pang, 2014; OECD, 2017). Limited internal capital has resulted in their heavy reliance on finance from other sources, especially bank loans (Shi, 2013). According to OECD (2017), in 2015 63.88 per cent of SMEs in China applied for bank loans. However, while SMEs accounted for more than 97 per cent of China's enterprises, only 23.2 per cent of bank loans were extended to SMEs in 2013 (Tsai, 2015). SMEs are still a disadvantaged sector in accessing bank loans and the rejection rate of loan applications by SMEs was as high as 11.72 per cent in 2015, much higher than that of large enterprises (6.83 per cent) (OECD, 2017).

A first major reason for the difficulties SMEs face in gaining access to finance is their lack of or low credit rating. The credit rating system in China for SMEs has not been well developed and there are very few organisations that can provide reliable credit assessment services (Cheng & Sun, 2006; Zhao, 2009; Gartner *et al.*, 2010; Li, 2012). Therefore, most SMEs in China have not participated in credit assessment and have a lack of evidence of their credit and risk level when they apply for bank loans (Cheng & Sun, 2006; Sham & Pang, 2014). Moreover, among a small number of SMEs that have been assessed for their credit level, most of them are subject to a high level of risk and end up having a low credit rating because of their poor performance, low level of financial transparency and high risk of bankruptcy, leading to a small possibility of securing a loan from a bank (Liu & Yu, 2008; Li, 2012; Li & Hendrischke, 2014; Sham & Pang, 2014).

A lack of collateral is another major reason for the financing difficulties of SMEs, especially in China (OECD, 2010). Because of the higher risk of default of SMEs, collateral is an important assessment criterion for the approval of bank loan applications. In 2009, 50.55 per cent of SMEs in China needed collateral to obtain bank loans and this ratio further increased to 55.67 per cent in 2015 (OECD, 2017). However, the smaller scale of SMEs means that they may not have enough sound collateral, usually fixed assets such as land and buildings, required by the banks, leading to the rejection of their loan applications (Mu & Zhang, 2007; Ayyagari *et al.*, 2010; OECD, 2010).

Besides bank loans, few SMEs can meet the requirements for IPOs in order to obtain finance from the equity market because of their poor performance and lower financial transparency. In 2015 only 44 small companies and 86 small businesses were listed in the SME Board and Venture Board in China (OECD, 2017). This, combined with the obstacles to getting bank loans, indicates that the difficulties faced by SMEs in obtaining financial support remain a persistent and significant problem in China.

### ***Less capability to export***

Exporting is a significant strategy for SMEs to be engaged in internationalisation (Zahra *et al.*, 1997; Bell, 2012). As discussed previously, SMEs have been a key driver of China's export growth, especially in the private sector. However, this significant contribution is mainly due to the sheer number of exporting SMEs rather than their outstanding capability in exporting. In fact, SMEs in China still have a poorer performance than large enterprises in exporting. Although the export value of industrial SMEs reached 5.21 trillion RMB in 2016, their export density, as represented by the ratio of export value to total industrial output, was only 7.11 per cent, much less than that of their large counterparts (15.67 per cent) (see Table 3.10). Only a small proportion (around 9 per cent) of SMEs choose to be involved in export activities and SMEs still face many barriers to entering international markets (OECD, 2008). The most significant barrier for SME exports is non-tariff barriers.

In order to export, SMEs need to pay the extra costs involved in international market exploration, getting export certificates, transportation, insurance and also passing inspections, updating technology and repackaging to get certificates to fulfil the requirements of the export destination countries, besides the tariffs they face (OECD, 2009; Mok *et al.*, 2010). In 2014, China's enterprises need to spend US\$823 per 20-foot container to export, which was higher than its main Asian competitors such as Vietnam (US\$610) and Thailand (US\$595) and Cambodia (US\$795) (World Bank, 2014). These costs would be a small payment for a large enterprise with a large turnover, big profits and asset values, but represent a significant burden for SMEs with lower turnover and less access to finance (Zhang *et al.*, 2008; Ministry of Science and Technology, 2013).

Moreover, a large proportion of private SMEs are family businesses and seldom employ professional managers (All-China Federation of Industry and Commerce, 2016). They

lack knowledge of international markets, export procedures and also foreign languages and laws, resulting in inadequate information, opportunity exploration, trade negotiation skills and dispute handling skills to export (Yi *et al.*, 2003; Bell, 2012; Liang *et al.*, 2014; Henson & Yap, 2016). In addition to limited capability, a lower level of innovation by SMEs has been another export barrier. In China, technological innovation is closely related to the export performance of enterprises (Zhao & Li, 1997). But the low level of innovation of SMEs, which will be discussed in the following section, has resulted in their lack of sustainable competitiveness in foreign markets, implying that their export orientation and performance is likely to remain poor (Zhang & Xia, 2014). The export potential of SMEs needs to be addressed by removing these obstacles.

### ***Lack of innovation***

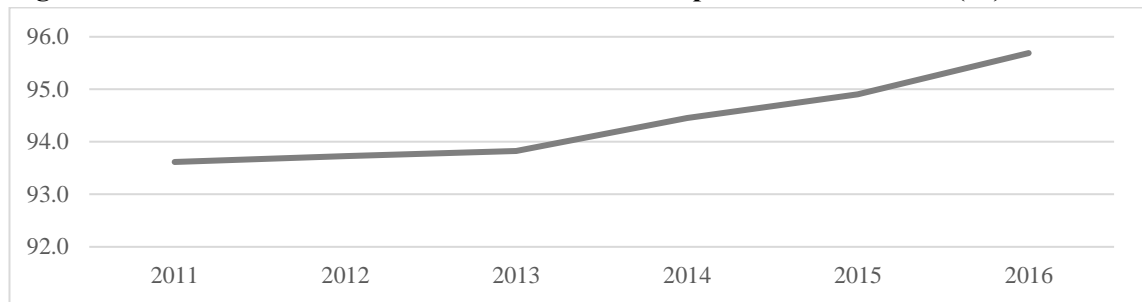
As for the case of exporting, while the contribution by the SME sector to R&D activity and innovation outcomes has been significant, this contribution has been mainly driven by the sheer number of SMEs. In fact, only a small number of all private SMEs are engaged in innovation activities (Zhu & Wu, 2009; Liang & Qi, 2013). While more than half of large industrial enterprises have R&D departments and activities, only 15.29 per cent of industrial SMEs had R&D departments and 21.92 per cent of them had R&D activities in 2016 (NBS, 2017c), indicating their low innovation density level.

In China the most significant innovation barrier reported by SMEs is a lack of technical expertise (Xie *et al.*, 2010; Zhang & Xia, 2014). A large number of employees in SMEs are those with a lower educational and skill attainment, such that their knowledge to innovate is inadequate (MIIT, 2015). According to a survey conducted by Xie *et al.* (2010), only 11.7 per cent of investigated SMEs reported that they had an adequate number of technical experts. This severe lack of technical experts has become a big problem in innovation orientation and the performance of SMEs (Zhang *et al.*, 2009). Also, R&D activity needs a large capital input, including equipment, purchase of new technology and the employment of experts, which is hard for SMEs to afford by themselves (Xie *et al.*, 2010). Government funding can become a significant financial source for SME innovation activity. But most of the government's funds for innovation are provided to universities and research institutes and the remaining funds mainly go to support large SOEs in China (Huang, 2007). The funding for R&D expenditure still needs to be raised



mainly by SMEs themselves, and, as shown in Figure 3.8, the share of self-raised funds in SME total R&D expenditure increased from 93.62 per cent in 2011 to 95.69 per cent in 2016. Together with the fact that SMEs are facing difficulties in getting financial support, the financial burden on SMEs to innovate remains a serious problem.

**Figure 3.8 Share of self-raised funds to SMEs' R&D expenditure 2011-2016 (%)**



Source: China Statistical Yearbook on Science and Technology 2012-2017 (NBS, 2012c; 2013c; 2014c; 2015c; 2016d; 2017c).

Moreover, most SMEs in China believe that innovation is an activity with a low rate of return (Xie *et al.*, 2010). This is not only related to the 'high-cost and high-risk' nature of innovation activity but also because of the still unfair competition in the market (World Economic Forum, 2016). According to Zhu *et al.* (2012) 67 per cent of managers in SMEs regarded unfair competition in the marketplace, monopolised by large enterprises, as the most important institutional barrier for SMEs' innovation. Also, the intellectual property protection system, with a high cost for taking legal action, low level of transparency of patent enforcement mechanisms, difficulties in evidence collection, insufficient monetary punishment and difficulties in giving injunctions to defendants, has resulted in China's SMEs preferring imitation rather than innovation (Singh *et al.*, 2009; Zhan, 2014; Zhang & Xia, 2014). Their innovation needs to be further supported.

In general, SMEs make a significant contribution to China's economic development, especially in the private sector. The development of SMEs is essential for promoting China's entrepreneurship and in helping the country to move up its manufacturing value chain to be an innovation-driven country. But they still face many obstacles in accessing finance, exporting and innovation, leading to the poor performance of SMEs. Thus, policies aimed at promoting the performance of SMEs are necessary, particularly those aiming to improve the quality of their entrepreneurs.

### 3.5 Regional disparity of private SME development in China

China is a vast land with 31 provinces, autonomous regions and municipalities, which can be classified into eastern, western and central regions based on their geographic location as shown in Table 3.13. Although China has enjoyed extraordinary economic development in the last three decades, as discussed in Chapter 2, this development has not been spread evenly across all regions, resulting in a significant disparity in income and regional development levels (Wang & Fan, 2004; Kanbur & Zhang, 2005). This significant regional disparity is partly caused by geographic factors such as natural resource endowments, availability of infrastructure and length of coastline, representing access to port facilities and foreign markets (Démurger, 2001; Bao *et al.*, 2002; Jones & Cheng, 2003; Wang & Fan, 2004; Fan *et al.*, 2011). But the most significant reason is the regional preferential policies implemented during the reform and openness process (Démurger *et al.*, 2002; Li & Wei, 2010; Sun, 2013).

China's economic reform and openness policy was mainly based on an unbalanced growth pole theory (Jones & Cheng, 2003; Fan *et al.*, 2011; Lu & Deng, 2013) with two stages: (1) some growth poles with comparative advantages were planned to be developed first to enable some people (regions) to get rich first, hoping that then (2) this growth could be spread to lagging regions via a diffusion effect in order to achieve the inclusive prosperity of China<sup>16</sup> (Weng, 1998; Démurger *et al.*, 2002; Zhou & Song, 2016). During the first stage the geographical position of eastern coastal regions put them in a good position to reach growing export markets in Asia and the U.S. With unique comparative advantage in exporting via ports, they were chosen as growth poles and to be preferentially developed. As discussed in Chapter 2, China firstly set up four coastal Special Economic Zones (SEZs) and then further opened more eastern cities in the following years to attract FDI and further expand exports (Bell *et al.*, 1993; Yang *et al.*, 2012). Increased exports by these eastern provinces resulted in growth directly through more international demand and indirectly by raising the productivity of domestic firms

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<sup>16</sup> In December 1978 the guideline that China should 'let some people get rich first' was firstly proposed by Deng Xiaoping in the CPC central committee work conference (Deng, 1984). He then clarified this guideline as 'Some areas and some people can get rich first, lead and help other regions and people, and gradually achieve common prosperity' when meeting with a senior U.S. business delegation on 23 October 1985 (Deng, 1995).

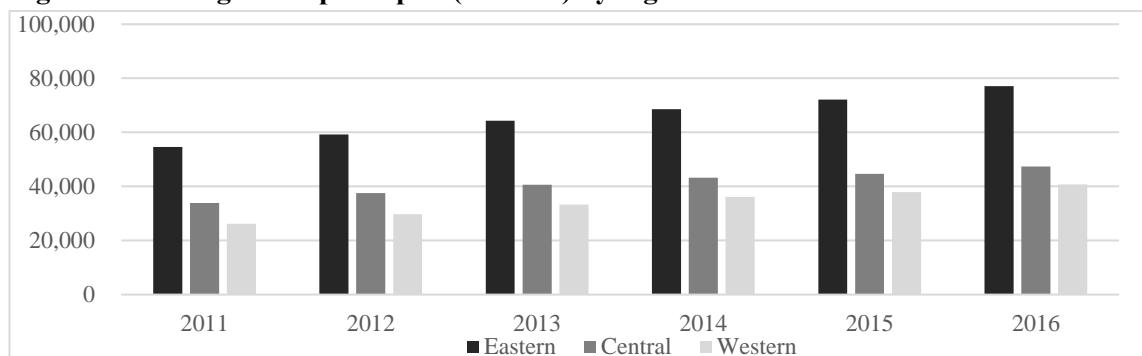
through a learning by exporting process (Liu *et al.*, 2002; Wei & Liu, 2006; Wagner, 2007). Foreign investment introduced more capital and spilled over more advanced technology to domestic enterprises (Hu & Jefferson, 2002; Madariaga & Poncet, 2007). Also, the entrance of foreign firms increased the competition level in the domestic market, such that higher productivity was achieved (Marcin, 2008; Lin *et al.*, 2009). These benefits were expanded after China decided to transition to a market economy from 1992. Eastern provinces grew more rapidly than the poorer central and western provinces, resulting in severe inequalities in China's regional development (OECD, 2002).

**Table 3.13 China's regional classification by province**

Region	Provinces
<b>Eastern</b>	Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, Hainan
<b>Central</b>	Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan
<b>Western</b>	Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang

Source: China Statistical Yearbook 2016 (NBS, 2016c).

**Figure 3.9 Average GDP per capita (in RMB) by region in China from 2011 to 2016**



Source: China Statistical Yearbook 2012-2017 (NBS, 2012b; 2013b; 2014b; 2015b; 2016c; 2017b).

Aware of the increasing regional disparity, the authorities started to develop poorer western and central provinces from 1985, such as establishing the Pearl River Delta and Yangtze River Delta development zones in 1985, Border Economic Cooperation Zones in 1992 and the 'Western Development Campaign' program<sup>17</sup> in particular in 2000, to achieve a more balanced and inclusive economic growth (Lai, 2002; Goodman, 2004; Yang *et al.*, 2012; Sun, 2013). However, despite these efforts, inter-regional disparity remains in contemporary China due to the better economic foundations of the eastern

<sup>17</sup> The Western Development Campaign strategy involved twelve provinces including Inner Mongolia, Shaanxi, Ningxia, Gansu, Xinjiang, Qinghai, Tibet, Chongqing, Sichuan, Guizhou, Yunnan and Guangxi.

provinces arising from the preferential policies during the reform and openness era (Candelaria *et al.*, 2009; Zhang & Zou, 2012; Zhou & Song, 2016). As shown in Figure 3.9, in 2011 the average GDP per capita of the 12 eastern provinces was 54,620 RMB, while those of the central and western provinces were only 33,906 RMB and 26,210 RMB respectively. Although the average GDP per capita for western provinces increased to 40,798 RMB in 2016, it was still nearly half that in eastern provinces. Regional disparity in China is still a serious problem and a very pressing issue for the Chinese authorities.

**Table 3.14 Number of industrial SMEs by region in China from 2011 to 2017**

Region	2011	2012	2013	2014	2016	2017
<b>Total</b>	<b>316,498</b>	<b>334,322</b>	<b>343,135</b>	<b>367,995</b>	<b>369,676</b>	<b>375,831</b>
Eastern	213,014	221,119	224,597	236,828	229,750	228,852
Central	74,628	81,354	84,841	93,781	99,025	103,740
Western	28,856	31,849	33,697	37,386	40,901	43,239
<b>Share (%)</b>						
Eastern	67.30	66.14	65.45	64.36	62.15	60.89
Central	23.58	24.33	24.73	25.48	26.79	27.60
Western	9.12	9.53	9.82	10.16	11.06	11.51

Source: Yearbook of China Small and Medium Enterprises 2012-2014 (China Centre of SME Cooperation Development & Promotion, 2012; 2013; 2014); China Industry Economy Statistical Yearbook 2015 (NBS, 2015a). Report on SMEs in China 2016-2017 (NBS, 2017g; 2018d).

Regional disparity in China is also reflected in the development of private enterprises and SMEs (Liu & Yu, 2008; Liu, 2008). The encouraging policies for private enterprises since the early 1990s, such as flexibility of employment and tax preferences, were firstly and mainly implemented in the eastern Special Economic Zones (SEZs) and Economic and Technological Development Zones (ETDZs) (Sun, 2013; Miao, 2014). The higher level of openness in the eastern regions also created more opportunities, thus attracting more private enterprises, especially SMEs, to be established in these provinces (Zhang & Zou, 2012). Therefore, the emergence of private SMEs began and developed rapidly in the most developed coastal areas of China and SME clusters are mainly located in eastern coastal towns, especially in Jiangsu, Zhejiang and Guangdong provinces, under strong support by provincial governments in these provinces (Liu, 2008). Despite efforts at promoting inland regions, the development of SMEs in these less-developed regions is still at an early stage with only a small number of SMEs (Zhang, 2007; Liu, 2008). According to NBS (2017c), there were 10,500,697 private enterprises in China in 2016, 68.66 per cent of them located in twelve eastern provinces while the other nineteen

provinces shared only 31.34 per cent of them. The same regional difference is also evident in the number of SMEs. According to Table 3.14, in 2011 some 213,014, or 67.30 per cent of total, industrial SMEs were in the eastern provinces of China. Due to the development of the central and western provinces, the number of industrial SMEs located in these two regions grew to 103,740 and 43,239 respectively in 2017. But the gap between the number of SMEs in eastern and non-eastern provinces is still significant, with only 39.11 per cent of the total industrial SMEs in China located in non-eastern regions.

Besides the regional difference in the number of SMEs, the performance of SMEs in China also exhibits a big disparity across regions. According to the development report of growth-oriented SMEs (Joint Research Group on the Development of SMEs, 2005), there were 16,958 SMEs evaluated as growth-oriented enterprises in China and 72.32 per cent of them were in eastern provinces in 2004. The share of the developed eastern Guangdong province alone reached 14.77 per cent, larger than the combined share of ten western provinces. The performance difference between SMEs in the eastern, central and western regions of China is also shown in terms of their job creation, industrial output, exports, non-domestic fund usage and innovation, as demonstrated in Tables 3.15 and 3.16. SMEs in the most developed eastern provinces dominate all of these indicators.

As shown in Table 3.15, employment by SMEs varies across regions with different development levels. In 2016, SMEs in the most developed eastern coastal provinces employed 39.05 million workers, making up 52.64 per cent of total employment by industrial SMEs. The share of industrial SMEs in the central and western provinces in total employment was only 22.91 per cent and 24.46 per cent respectively. The development difference of SMEs in different regions also leads to a regional disparity in terms of industrial output by SMEs. Industrial SMEs in the eastern provinces produced more than sixty percent (60.39 per cent) of total industrial output by SMEs in 2016, reaching 44.25 trillion RMB (see Table 3.15). The industrial outputs by SMEs in central and western provinces were 21.21 trillion RMB and 7.82 trillion RMB respectively, contributing only 28.94 per cent and 10.67 per cent to the total industrial output created by SMEs. Due to geographic factors and preferential policies by the Chinese government, the regional disparity in the exports and foreign fund usage of SMEs was even larger than that in employment and industrial output (Liu, 2008). As shown in Table 3.15 the export

value of industrial SMEs in eastern provinces reached 4487.07 billion RMB, forming 86.11 per cent of total industrial exports by China's SMEs in 2016. They also acquired 87.51 per cent (2070.72 billion RMB) of total foreign investment received by industrial SMEs in China. However, industrial SMEs in central and western regions only exported 527.58 billion RMB and 195.91 billion RMB respectively and attracted 196.52 billion RMB and 98.98 billion RMB in foreign capital. In fact, some of the poorest provinces in these two regions, such as Xinjiang, Inner Mongolia and Heilongjiang, are border provinces of China and have significant potential in terms of exports and attracting FDI. However, the lower development of SMEs in these provinces has restricted their potential.

**Table 3.15 Number and performance of industrial SMEs by province in 2016**

Region	Employment (million persons)	Industrial output (trillion RMB)	Export (billion RMB)	Foreign capital (billion RMB)
<b>Total value</b>	<b>74.19</b>	<b>73.28</b>	<b>5,210.56</b>	<b>2,366.22</b>
Eastern	39.05	44.25	4,487.07	2,070.72
Central	16.99	21.21	527.58	196.52
Western	18.15	7.82	195.91	98.98
<b>Share by region (%)</b>				
Eastern	52.64	60.39	86.11	87.51
Central	22.91	28.94	10.13	8.31
Western	24.46	10.67	3.76	4.18

Source: China Industry Economy Statistical Yearbook 2017 (NBS, 2017a).

**Table 3.16 R&D activities and outcomes of high-tech SMEs by region in 2016**

Region	Number of firms with R&D activities	R&D personnel (persons)	R&D expenditure (billion RMB)	New product (units)	Patent application (units)
<b>Total value</b>	13,434	480,513	108.69	72,144	97,496
Eastern	9,772	352,150	81.64	55,425	73,097
Central	2,491	82,043	17.43	10,517	15,416
Western	1,171	46,320	9.62	6,202	8,983
<b>Share (%)</b>					
Eastern	72.74	73.29	75.11	76.83	74.97
Central	18.54	17.07	16.03	14.58	15.81
Western	8.72	9.64	8.86	8.60	9.21

Source: China Statistics Yearbook on High Technology Industry 2017 (Department of Social Science and Technology & Culture Statistics of National Bureau of Statistics, 2017).

The innovation capability of SMEs also varies across regions at different development levels (Cheng & Sun, 2006; Gan, 2011; Wu & Xu, 2013). Because of uneven human resources and FDI inflows, technological innovation in most developed eastern provinces has enabled them to be China's R&D hubs for decades (Meckl *et al.*, 2008). As shown in

Table 3.16 most (72.74 per cent) high-tech SMEs with R&D activities were located in eastern provinces, while ten western provinces only had 1,171 high-tech SMEs involved in R&D activities in 2016. Eastern provinces contributed 73.29 per cent and 75.11 per cent to total R&D employment and expenditure by high-tech SMEs respectively. The big R&D input enabled them to create 76.83 per cent of new products and 74.97 per cent of patent applications by SMEs in high-tech industries in 2016. However, the western provinces only had a very small share (below 10 per cent) of R&D personnel, R&D expenditure, new products and patent applications by high-tech SMEs. In general, China's SMEs in eastern regions have higher innovation capability (Cheng & Sun, 2006; Wu & Xu, 2013). SMEs in non-eastern provinces have great potential for technological innovation, but they need more support from government for this to happen.

As discussed, until 2016, the share of the less developed central and western regions of China in employment, industrial output, exports, foreign capital usage and innovation by SMEs remained extremely low. The development of SMEs in these provinces still requires more support by government. Due to the regional disparity in economic development, and SME performance in particular, the government needs to adopt regional differential policies in the 'Innovation-driven Country 2020', 'Manufacturing 2025' and 'Mass Entrepreneurship and Innovation' strategies to more effectively support SMEs in the more developed eastern provinces and non-eastern regions respectively. This requires evaluating the performance of SMEs and identifying determinants of SMEs' performance at the regional level, which is the main objective of this research.

### **3.6 Summary**

This Chapter reviewed different viewpoints on the definition of entrepreneurship from an economic perspective, including risk-takers (Cantillon, 1755), uncertainty bearers (Knight, 1921; Von Mises, 1949), opportunity seizers (Kirzner, 1973), innovators (Schumpeter, 1934) and new business creators (Drucker, 1985; Gartner, 1985). Based on data availability on entrepreneurial activities, this study defines entrepreneurs as new business creators and uses the owners of private SMEs as a proxy for entrepreneurs in line with many other studies (e.g. Carland *et al.*, 1984; Bates, 1990; Ensley *et al.*, 2000; Burns, 2010). The private sector is a significant part of China's economy and

entrepreneurship is regarded as a new driving force for the country's economic growth (Audretsch & Keilbach, 2004; Acs, 2006; Garnaut *et al.*, 2012; Lardy, 2014). Based on the foundations provided by the CBEs and TVEs, China's entrepreneurship and private sector experienced rapid growth following legalisation of private businesses in 1988 (Liao & Sohmen, 2001; Tsai, 2007). In 2017 there were 27.26 million private enterprises, accounting for 84.26 per cent of total enterprises in China (NBS, 2018b). Due to its dramatic development, the private sector has been playing a vital role in China's economy (Tsai, 2007; Lardy, 2014). It created 35.91 per cent of industrial output in 2016 and 43.92 per cent of employment and 46.60 per cent of exports in 2017 (see Table 3.2, Figure 3.2 and Figure 3.3), becoming the biggest industrial output producer, employer and exporter across all ownership types in China. It also contributed 27.10 per cent of R&D employees and 25.59 per cent of R&D expenditure, resulting in 37.04 per cent of new products and 33.24 per cent of patent applications in China in 2016, thus contributing greatly to China's innovation activity (see Table 3.3). Moreover, most of the disadvantaged groups in China, including laid-off, female and less educated workers, were absorbed by the private sector (Li, 2012; Li & Hendrischke, 2014; Shah *et al.*, 2014). Therefore, private enterprises and entrepreneurship can help to reduce the income inequality between different social layers, enabling inclusive economic growth in China (ADB, 2014; Li & Hendrischke, 2014).

The characteristics of entrepreneurs in China have undergone significant changes. Due to economic reform there has been a change in attitude to the private sector and entrepreneurs and enhancement of the social status of entrepreneurs. China's entrepreneurship activities have embraced more older, female, highly educated and experienced individuals with more political connections (All-China Federation of Industry and Commerce & Chinese Private Economy Research Association, 2013). Although this leads to a more balanced structure of the characteristics of China's entrepreneurs, they are still dominated by middle-aged people and males, and still lack the participation of highly-educated individuals. Also, entrepreneurial activities in China are mainly driven by the necessity for income due to a lack of labour market opportunities (Braunerhjelm *et al.*, 2016).

To promote entrepreneurship and to improve the innovation level, in order to move up the manufacturing value chain and transition to an innovation-driven country, China



established a new ‘Mass Entrepreneurship and Innovation’ program in 2015. In this program, entrepreneurs and innovations are being supported through the creation of a better business and innovation environment, the provision of subsidies and financial support and the provision of tax preferences (State Council, 2015c). Scientific researchers, enrolled and graduated college students and those studying or working abroad are especially supported to engage in entrepreneurial activities in order to promote more innovation (opportunity)-driven entrepreneurs (State Council, 2015c). However, current policies are still focusing on improving entrepreneur numbers in China. China also needs to promote entrepreneur quality in order to generate more contributions to economic development (Shane, 2009). To implement appropriate and effective policy it is important to find out what entrepreneurial characteristics can lead to more efficient production. This is the main aim of this research.

Since most entrepreneurial enterprises are SMEs, the growth of the private sector in China has gone hand in hand with the growth of SMEs (Chen, 2006; Lin & Zhu, 2007; Zhu *et al.*, 2012). Defined as enterprises with fewer than 1,000 employees or less than 400 million RMB in operating revenue, SMEs dominate the number of enterprises in China, accounting for 97.46 per cent of total industrial enterprises in 2016 (see Table 3.9). Due to their significant number, SMEs contributed more than 60 per cent of industrial output, employment and foreign capital usage, new products and patent applications, and nearly half of exports in China (see Tables 3.10 and 3.11). Their contribution to the private sector is even greater. Accounting for 99.16 per cent of private industrial enterprises, they contributed 89 per cent of employment in 2011 (see Figure 3.6) and 88.05 per cent of industrial output and 82.92 per cent of exports by private industrial enterprises in 2013 (see Table 3.12). Therefore, developing SMEs is significant for the promotion of entrepreneurship (State Council, 2015e).

Although they are significant, SMEs in China are performing poorly and have difficulties surviving in the market (Zhu *et al.*, 2012). They are even driving the recession of China’s manufacturing sector with a low manufacturing PMI (NBS, 2017e). SMEs face many barriers that are restricting their development. They have difficulties in accessing bank loans and finance from the equity market because they lack a credit rating due to an undeveloped credit rating system in China, have low credit rating or lack collateral and

guarantees due to their poor performance, and are small scale and cannot meet the requirements for an IPO (Mu & Zhang, 2007; OECD, 2010; Li, 2012; Sham & Pang, 2014). They also have fewer capabilities to export because they cannot afford the extra cost related to the export process, lack personnel with specific knowledge needed in exporting, and lack innovative products to compete in foreign markets (Zhang *et al.*, 2008; Mok *et al.*, 2010; Bell, 2012; Liang *et al.*, 2014; Zhang & Xia, 2014). Moreover, the innovation ability of SMEs in China is also inadequate due to the lack of technical expertise, capital input for R&D activities and a still unfriendly innovation environment in China (Zhu & Wu, 2009; Xie *et al.*, 2010; Zhu *et al.*, 2012; Zhang & Xia, 2014). Thus, SMEs in China still need special support to improve their performance, such as by encouraging more high-quality entrepreneurial activities.

Also, policies aimed at promoting SMEs need to take into consideration a significant regional disparity in the development of SMEs between the eastern and non-eastern regions (China Center of SME Cooperation Development & Promotion, 2014). This is a legacy of the regional preferential policy during the earlier period of the reform and openness process, in which eastern coastal provinces were preferentially developed first (Démurger *et al.*, 2002; Sun, 2013). Currently, most SMEs are located in the twelve more developed eastern provinces, and they contributed more than half of employment, more than 60 per cent of industrial output and more than 85 per cent of exports and foreign capital usage by industrial SMEs in 2016 (see Table 3.15). High-tech SMEs in eastern provinces also contributed more than 70 per cent of R&D expenditure and employees, resulting in 76.83 per cent of new products and 74.97 per cent of patent applications in high-tech industry in China in 2016 (see Table 3.16). Therefore, SMEs located in poorer central and western provinces need special support by the Chinese government. This research aims to estimate the relationship of entrepreneurial factors with SMEs' technical efficiency in the eastern and non-eastern provinces respectively, in order to provide evidence about how to promote higher quality entrepreneurial activities and more efficient SMEs in different regions of China. Literature on the importance of high-quality entrepreneurship to economic growth, technical efficiency estimation and factors influencing firm performance is reviewed in the next chapter.

## Chapter 4 Literature review

### 4.1 Introduction

This chapter reviews the literature on the contribution of entrepreneurial activities and SMEs to economic development, the importance of the quality of entrepreneurial activities to transitional economies, such as China, and the potential relationship of entrepreneurial, external and internal firm-specific factors with the technical efficiency levels of SMEs in the Chinese manufacturing sector. The significant role of entrepreneurship, especially in the context of SMEs, as a key driver of economic development and employment generation through various channels is commonly agreed upon by researchers (Acs, 1999; Wennekers & Thurik, 1999; Harvie & Lee, 2002; Acs, 2006; Carree & Thurik, 2010). However, the concern of modern views on entrepreneurial activities has changed from quantity to quality (Piergiovanni & Santarelli, 2006; Santarelli & Vivarelli, 2007; Shane, 2009). While low quality entrepreneurial activities can only influence employment and the economy in the short-term due to their inadequate innovation and survival capability, it is the high quality entrepreneurial activities with better post-entry performance that can generate innovation and make a significant contribution to sustainable economic development (Shane, 2009; Fritsch & Schroeter, 2011; Vivarelli, 2013). This implies the necessity to improve the quality of entrepreneurs and the performance of entrepreneurial activities, especially in the context of SMEs. This is especially necessary in emerging economies like China, where the economy is in transition to an innovation-driven stage of development, but the entrepreneurial quality and SME performance are at a low level (Valliere & Peterson, 2009; Vivarelli, 2013; GEM, 2017). However, studies on entrepreneurial activities in the context of emerging economies remain limited (Naudé, 2010), requiring more empirical research on the characteristics of successful entrepreneurs and how the quality of entrepreneurs can be best improved with the aim of improving the performance of private SMEs in China. As a significant indicator of firm economic performance, the firm-level technical efficiency of SMEs has been estimated in many developing countries (e.g. Lundvall & Battese, 2000; Mini & Rodriguez, 2000; Minh *et al.*, 2007; Charoenrat & Harvie, 2014), which have mostly indicated SME inefficiency. But studies on the firm-level technical efficiency of Chinese SMEs in all regions of China is still absent. Considering the determinants of

private SMEs' technical efficiency, entrepreneurial factors, including the entrepreneur's start-up motivation, age, gender, education level and experiences, are expected to have a significant relationship with SMEs' technical efficiency. (Vivarelli, 2007; 2013; Stam *et al.*, 2014). An entrepreneur's political and business connections should also be considered as a determinant of firm performance in the special context of China, where having a network is important in doing business (Luo *et al.*, 2012). External factors, as represented by location and internal firm-specific factors such as a firm's size, age, employee training, R&D effort, export orientation, foreign capital participation and finance access, also have a potential relationship with the technical efficiency level of China's SMEs (Caves & Barton, 1990; Caves, 1992; Alvarez & Crespi, 2003; Charoenrat & Harvie, 2014). This chapter provides a comprehensive framework for identifying the determinants of the technical efficiency of private SMEs in China.

This chapter proceeds as follows. Section 4.2 shows the evolution of economic growth into an entrepreneurial economy, the channels through which entrepreneurship contributes to economic development and the significance of entrepreneurial activities and SMEs to an economy. Section 4.3 shows the contributions of entrepreneurship to economic growth across economic development level and the importance of entrepreneurial quality in emerging economies. The various firm performance measures and technical efficiency performance of SMEs in China are discussed in Section 4.4. Section 4.5 introduces the theoretical basis for the determinants of technical efficiency. Section 4.6 shows the relationships of each entrepreneurial factor with a firm's technical efficiency in detail based on results from existing studies. Section 4.7 overviews the relationships of external and internal firm-specific factors with firm performance. Finally, Section 4.8 summarises the main conclusions from this chapter.

## **4.2 Significance of entrepreneurial SMEs for economic growth**

### **4.2.1 Economic growth evolution: From a capital-driven economy to a knowledge- and entrepreneurial-driven economy**

Although the definition of entrepreneurship is multidimensional, the significance of entrepreneurship and entrepreneurial activities to economic growth have been identified

nowadays through various means, such as by creating competition and diversity in the market or spilling over knowledge to introduce new technology and products. However, the view on the importance of entrepreneurship for economic growth has experienced a significant change. Table 4.1 shows the evolution of economic growth theory and attitudes to entrepreneurship and small business.

**Table 4.1 Summary of economic growth theory evolution**

<b>Economy type</b>	<b>Capital-based economy</b>	<b>Knowledge-based economy</b>	<b>Entrepreneurial economy</b>
<b>Representative economist</b>	Solow (1956)	Romer (1986) Lucas (1988)	Audretsch and Thurik (2001)
<b>Production function</b>	$Y = F(K, L)$	$Y = F(K, L, R);$ $Y = F(K, H)$	$Y = F(K, L, R, E)$
<b>Growth base</b>	Capital accumulation	Investment in knowledge	Knowledge/entrepreneurial capital
<b>Entrepreneurship/small businesses' importance</b>	Weak	Medium	Strong

Source: Author's summary.

Note: Y, K, L, R, H and E denote aggregate output, capital, labour, R&D investment, human capital and entrepreneurial capital respectively.

In the neoclassic growth theory proposed by Solow (1956), the production of output is a function of labour and capital, while technological change is considered as an exogenously determined unexplained residual (Solow, 1999; Dowrick & Rogers, 2002; Audretsch *et al.*, 2006). In Solow's model, economic growth is mainly contributed to by capital and labour accumulation, and this gives rise to the importance of economic scale (Swan, 1956; Audretsch *et al.*, 2006). Large enterprises and large volume of production are the key sources of competitiveness, while entrepreneurial small businesses are regarded as having a limited role in economic growth (Chandler, 1990; Audretsch *et al.*, 2006). Economic growth in Solow's model cannot be sustainable in the long-run. The diminishing marginal productivity of capital and labour will eventually reduce productive efficiency, leading to a slowing down in economic growth in the long term. In this way poorer countries should catch up with rich countries in economic development, but this convergence has failed to be observed (Audretsch *et al.*, 2006). This required a new approach to explain sustained economic growth.

In response to this, Romer (1986) and Lucas (1988) developed endogenous growth models in which economic growth is determined by human capital accumulation or technological change represented by research and development (R&D) activities, respectively. Different from neoclassic growth theory, knowledge or technological progress can be endogenously improved by government policy and a firm's investment in improving human capital and innovation. In this knowledge-based economy, economic scale, and hence firm size, becomes less important. Entrepreneurs and their small businesses that can create knowledge via 'creative destruction' are given more attention. But large enterprises are still considered to be more significant for economic growth because they have a better capability to invest in R&D activities and human capital improvement (Audretsch *et al.*, 2006). However, Romer and Lucas' theory failed to explain how knowledge can be spilled over to drive economic growth (Acs *et al.*, 2004; Acs *et al.*, 2013). In their theory, knowledge can spill over merely because of its existence.

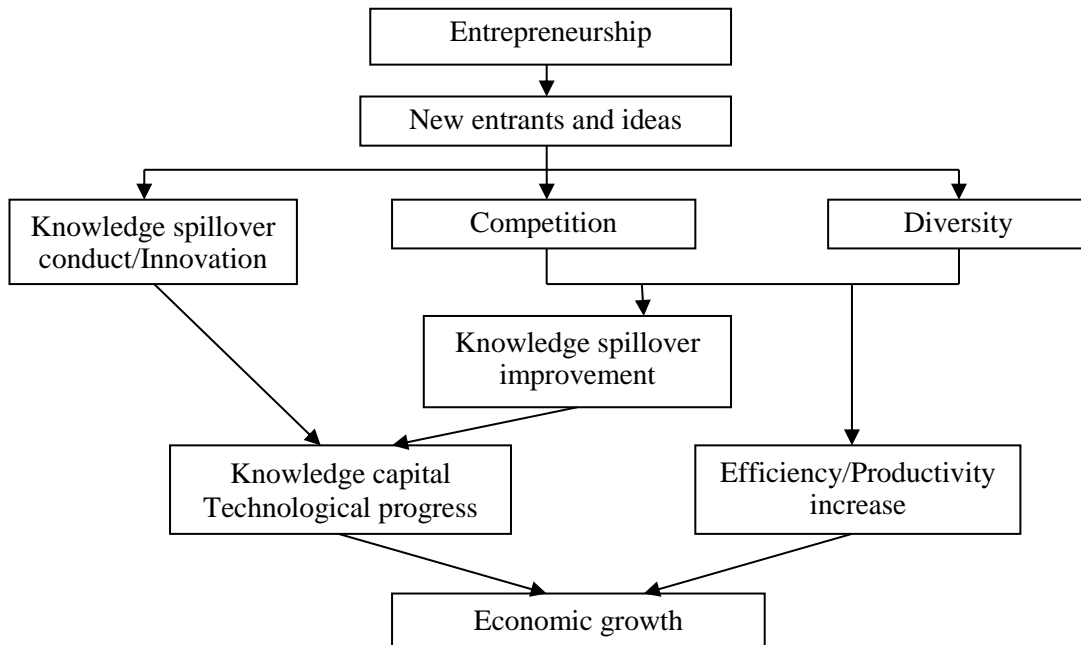
To address this problem, Audretsch and Thurik (2001; 2004) argued that entrepreneurial small businesses could facilitate the spillover of knowledge created by large enterprises and research institutes and, therefore, generate innovation without as much R&D investment (Acs *et al.*, 2013). In this viewpoint, it is believed that entrepreneurship is the missing link between knowledge and economic growth (Audretsch & Thurik, 2001; Acs *et al.*, 2004; Acs *et al.*, 2013). Therefore, in an entrepreneurial economy, the production function should also include entrepreneurial capital, as well as capital, labour and human capital as shown in Table 4.1. Entrepreneurial capital is essential because its marginal return is not diminishing. Thus, a country or a region can enjoy a long-run comparative advantage based on its well-developed entrepreneurship (Acs *et al.*, 2004; Audretsch & Keilbach, 2004; Audretsch *et al.*, 2006). Besides, entrepreneurial activities can also lead to economic growth by increasing competition and varieties of products in the market because they can create new entrants into the market. The various channels linking entrepreneurship to economic growth are introduced in the following section.

#### **4.2.2 Contribution of entrepreneurship to economic growth**

In an entrepreneurial economy entrepreneurship has been placed at the heart of economic development and national advantage (Porter, 1990; Carree & Thurik, 2003). As summarised by Audretsch and Keilbach (2004), entrepreneurship can drive economic

growth via three channels: (1) spillover and commercialisation of knowledge to generate technological progress (Acs *et al.*, 2004; Baumol, 2004; Acs *et al.*, 2013) (2) creating competition, and (3) diversity in the market to improve economic efficiency (Wennekers & Thurik, 1999). Figure 4.1 summarises these channels from the literature.

**Figure 4.1 Linking entrepreneurship to economic growth**



Source: Author's summary.

***Knowledge spillover process***

Tacit knowledge (know-how) and codified knowledge (know-what) exist simultaneously in the economy. In endogenous economic growth driven by innovations, it is tacit knowledge rather than codified knowledge which plays the key role (Howells, 2002; Gertler, 2003; Senker, 2008). However, in contrast to publicly accessible codified knowledge, tacit knowledge needs an intermediary to spill over in order to drive economic growth (Nelson & Winter, 1982; Hodgson, 1988; Gertler, 2003). As pointed out by Acs *et al.* (2004) in their knowledge spillover theory, there is a missing link between knowledge (tacit) spillover and economic growth, which is entrepreneurship. Usually, incumbent large enterprises and research institutes can have more R&D activities and create more innovation. However, the nature of knowledge and innovation is uncertainty including technical uncertainty, market uncertainty, and economic and political uncertainty, and, thus, results in the future may or may not be successful (Freeman &

Soete, 1997; Acs *et al.*, 2004; Wang *et al.*, 2008). Under this circumstance, firm managers and other employees endowed with this new knowledge may have different beliefs regarding the value of the created new product, idea or production mode. Once an incumbent firm invests in R&D activities and generates new knowledge but decides not to commercialise it, there emerges an opportunity for other employees endowed with this new knowledge, who believe it has a higher value and better prospects, to commercialise it (McMullen *et al.*, 2007; Acs *et al.*, 2013). If their voice for commercialising this innovation is ignored, they may choose to seize this opportunity, leave (exit) the incumbent enterprises to start new firms and commercialise the innovation themselves, thereby becoming entrepreneurs (Acs *et al.*, 2013). This kind of labour mobility created by leaving an incumbent enterprise to become an entrepreneur is a significant means of intra-temporal knowledge spillover. According to knowledge spillover theory, the creators of new knowledge and the persons who can really commercialise it may be different as discussed above. It is the commercialisation that really matters for converting new tacit knowledge into new economic knowledge and creating technological progress (Acs *et al.*, 2013; Block *et al.*, 2013). Therefore, entrepreneurship works as a mechanism for knowledge to spill over from the sources from which it is created to the new firms, where it is commercialised, and then to the whole economy. This leads to technological progress and efficiency improvement and, thus, economic growth, which is consistent with the definition of entrepreneurship emphasised by Schumpeter (see Section 3.2).

### ***Creating competition and diversity in the market***

Besides being the conduit effect for knowledge spillover, entrepreneurship also plays a central role in competitive capitalism and, therefore, can generate more efficient resource allocation (Wennekers & Thurik, 1999; Audretsch & Keilbach, 2004). Bringing new firms to the market, entrepreneurship can help to increase the degree of competition. This breaks the market equilibrium, leading to ‘creative destruction’ and an outward shift of the production frontier arising from the stimulation of productivity by competition (Schumpeter, 1934; Geroski, 1994; Ahn, 2002; Friis *et al.*, 2006). This is because the competition between various new firms leads the selection process to identify the most productive, efficient and valuable firms (Aghion & Howitt, 1998; Wennekers & Thurik, 1999; Aghion *et al.*, 2009). Thus, in a more competitive market, businesses are forced to increase their efficiency, adopt new technology or develop innovation in order to become



more competitive and thereby avoid being weeded out. Moreover, the increased competition generated by entrepreneurship can also enhance economic efficiency through greater demand stimulation, higher capital input quality, and lower monitoring costs (Hay & Liu, 1997; Porter, 2000; Motta, 2004). The greater competition level driven by entrepreneurship can lead to efficient knowledge spillover. As stated in the knowledge spillover theory proposed by Jacobs (1969), local competition is more conducive to knowledge externalities than is monopoly. This view has been supported by Porter (1990) who claimed that local competition was more important than monopoly for the transmission of knowledge and growth. Therefore, in addition to being the conduit for knowledge spillover, entrepreneurship can also provide a better environment for knowledge spillover by increasing competition level, leading to growth in knowledge capital, and thus economic growth (Audretsch, 2003). Therefore, entrepreneurial activities, bringing new entries and competition, are believed to bring higher efficiency, innovation and knowledge capital level, and then drive long-run economic growth.

Entrepreneurial activities not only generate a greater number of firms, they can also create higher levels of market diversity (Wennekers & Thurik, 1999; Audretsch & Keilbach, 2004). As pointed out by Cohen and Klepper (1992), a degree of diversity, other than homogeneity, is crucial for technological progress. Entrepreneurship can give rise to new entry, new ideas and innovation to the market, leading to the growth of products, organisational forms, industry structures and knowledge diversity. A higher level of variety in the market generates a selection process in which inefficient and outmoded routines will be weeded out, leading to an economic evolution to a higher efficiency level (Nelson & Winter, 1982; Knudsen, 2002). Also, the variety of sectors or technologies can drive economic development by spilling over between sectors, acting as a portfolio strategy to reduce the effects of external shocks in demand and preventing structural unemployment (Frenken *et al.*, 2007; Hartog *et al.*, 2012).

Moreover, with a higher level of diversity, the newly created tacit knowledge can be better spilled over and transmitted into economic knowledge (Jacobs, 1969; Audretsch, 1998; Audretsch, 2003). This is different from the view that knowledge externalities mainly happen between firms within an industry because knowledge is industry specialised. The knowledge spillover theory of Jacobs (1969) argued that diversity of industry in a region

would be more efficient. This is because knowledge is different from information, which can spill over efficiently between individuals with similar backgrounds or from the same industry. The most significant source of knowledge is from other related industries. It is the exchange of complementary knowledge between industries, rather than intra-industry exchange, that leads to a higher return to R&D activities and innovation (Van der Panne, 2004). Therefore, the diversity created by entrepreneurship can also generate a more efficient knowledge spillover process, leading to further economic development (Feldman & Audretsch, 1999; Audretsch & Keilbach, 2008; Berliant & Fujita, 2011).

There have been many empirical studies focusing upon the contribution of entrepreneurship to economic growth in a country or a region, using new start-ups as proxies for entrepreneurial activities. Applying European data from 1990 to 1994, Audretsch and Thurik (2001) found entrepreneurial activities, represented by the number of business owners to labour force ratio, had a positive effect on the growth of GNP. A later study conducted by Audretsch and Keilbach (2004) found that one additional start-up per thousand people (a proxy for entrepreneurial capital) could result in a 0.12 million GDP increase in Germany from 1989 to 1992. These studies all confirm that entrepreneurial activities can be a key driving force for economic growth. Although entrepreneurial enterprises are not necessarily SMEs, it is commonly agreed that SMEs are the main vehicle through which entrepreneurial activities can take place because most new entrants are small-sized enterprises, and much smaller than incumbent enterprises (Mata & Machado, 1996; Acs *et al.*, 1999; Audretsch *et al.*, 1999). Paralleling the research on the contribution of entrepreneurial activities to economic growth, the significance of SMEs in an economy has also been increasingly identified. Acting as the main manifestation of entrepreneurial enterprises, SMEs were found to contribute greatly to value-added output and GDP in many countries, such as America (Acs, 1999) and OECD countries (OECD, 2005). Besides economic growth, many studies also emphasise the contribution of SMEs to the creation of new job opportunities. Although some argue that the job opportunities created by small firms are of a lower quality, because some of them are unstable, part-time, low-skilled and with low wages (Brown *et al.*, 1990; Wagner, 1997), SMEs still play a significant role in employment, especially for low-educated, low-skilled, laid-off and female labour (see Chapter 3). Empirical studies have found that small firms have a positive relationship with subsequent employment growth in the U.S.

(Shaffer, 2006) and Australia (Harvie & Lee, 2002). They are also important sources of exports, investment and technology transfer (Acs, 1999; Charoenrat & Harvie, 2013).

Therefore, in general, entrepreneurship and entrepreneurial enterprises, most of which are SMEs, make important contributions to economic development by spilling over knowledge, creating competition and generating market diversity. However, in later studies using cross-country data, researchers have found that a significant effect of entrepreneurship on economic growth does not exist in all countries or regions because of different types of entrepreneurship, and different quality of entrepreneurs across development stages (Fritsch, 1997; Wong *et al.*, 2005; Mueller *et al.*, 2008). Thus, instead of only focusing on the quantity of entrepreneurs, the quality of entrepreneurs and performance of entrepreneurial SMEs needs to be considered in less developed countries, such as in China, in order to encourage more high quality entrepreneurial activities and efficiently generate economic development (Koster & Rai, 2008; Pfirrmann & Walter, 2012). This issue is discussed in detail in the next section.

### **4.3 Quality of entrepreneurship in developing countries like China**

As discussed above, entrepreneurship capital has been found to be positively related to a country or a region's economic development in empirical studies (e.g. Audretsch & Thurik, 2001; Audretsch & Keilbach, 2004). However, the significant contribution of entrepreneurial activities has been mainly found in highly developed countries as reviewed above, rather than in less developed countries. In OECD countries, Carree and Thurik (1999) found that a higher share of small firms to total firm numbers, which indicates the quantity of entrepreneurial activities, could only result in economic growth for European countries with a higher GDP per capita, such as Germany and France. Using Global Entrepreneurship Monitor data, both Van Stel *et al.* (2005) and Valliere and Peterson (2009) found that a positive relationship between total entrepreneurial activities (TEA) and GDP per capita only occurred in rich and developed countries, but was absent in relatively poorer developing and emerging countries. These results all suggested different impacts of entrepreneurship on an economy at different development stages due to different incentives and quality of entrepreneurial activities.

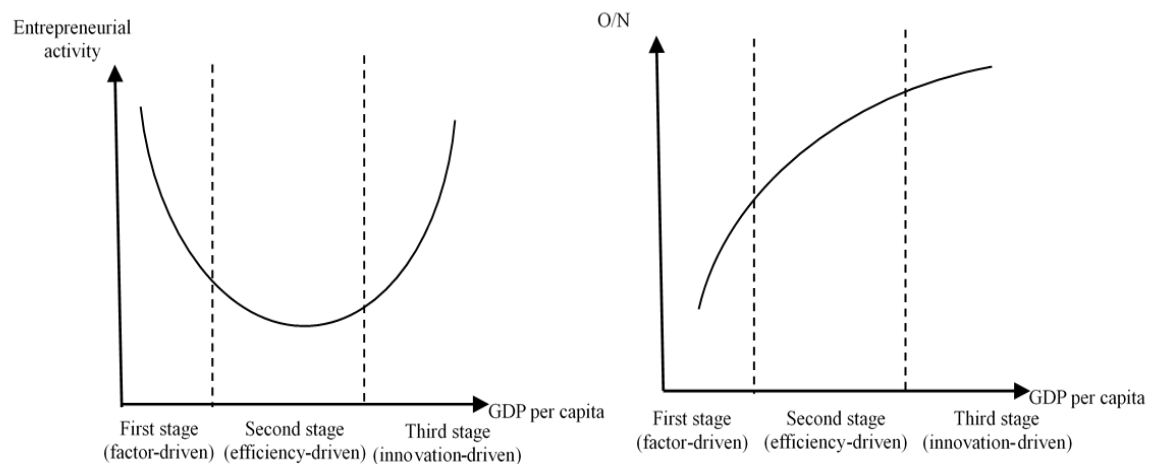
#### **4.3.1 Opportunity/necessity-driven entrepreneurs and economic development**

When considering entrepreneurship as being measurable by self-employment or business formation, entrepreneurial activities can be classified into different types based on their start-up motivations (Schjoedt & Shaver, 2007; Kirkwood, 2009). Gilad and Levine (1986) proposed, firstly, that there are two driving forces for entrepreneurial activity involvement: push and pull factors. Individuals can be pushed to be entrepreneurs by negative external factors such as being laid-off, having difficulty in finding a job, having insufficient pay for living expenditures or even experiencing a marriage break-up (Amit & Muller, 1995; Kirkwood, 2009). On the other hand, entrepreneurs can also be pulled into entrepreneurial activities by some positive internal factors including self-fulfillment and opportunity in the market (Delmar & Davidsson, 2000; Kirkwood, 2009). Based on the push and pull theory, in 2001 the Global Entrepreneurship Monitor (GEM) group officially differentiated between opportunity-driven entrepreneurship and necessity-driven entrepreneurship. An opportunity entrepreneur is motivated by exploring and exploiting new opportunities, while a necessity entrepreneur is driven by less opportunity in the waged sector (Reynolds *et al.*, 2002).

Because of differing starting motivations, these two kinds of entrepreneurship can have different impacts on economic growth. As stated by Wong *et al.* (2005), opportunity-driven entrepreneurship can drive economic growth because it implies the existence of economic rent to be derived in the market, resulting in more efficient resource allocation. These economic rents usually arise from a new market opportunity not identified by others or a new knowledge creation. Opportunity entrepreneurs can exploit these new opportunities, commercialise and spill over new knowledge by innovation through creating a new business and thus improve productivity. This is known as the ‘Schumpeter effect’ of entrepreneurial activities (Carree & Thurik, 2003; Abdesselam *et al.*, 2014). Moreover, with stronger entrepreneurial motivation, opportunity entrepreneurs can perform better and increase production efficiency (Audretsch *et al.*, 2001; Acs & Varga, 2005), driving economic growth. However, a high level of necessity-driven entrepreneurial activities can reflect a lack of job opportunities in the market (Audretsch *et al.*, 2001; Abdesselam *et al.*, 2014). Such unemployed labour may lead to involvement in self-employment and becoming a necessity entrepreneur, known as a ‘refugee effect’ (Audretsch *et al.*, 2001; Van Stel & Storey, 2004; Abdesselam *et al.*, 2014). Although

necessity entrepreneurship is much better than idle labour in the economy, a high level of it can imply a lower level of economic development than that of economies with more job opportunities and opportunity entrepreneurs. Moreover, unlike opportunity entrepreneurs, necessity entrepreneurs usually put their effort into producing income for their current living needs instead of into innovation. Although some of them can also innovate and become opportunity entrepreneurs (this will be discussed in detail in the next section), only a small portion do so (Shane, 2009). Most of them do not have new ideas and products to commercialise, and are unlikely to spill over new knowledge into the economy (Wong *et al.*, 2005; Acs, 2006). Therefore, even though necessity entrepreneurship has been encouraged in developing countries to reduce unemployment and address poverty<sup>18</sup>, it can make little contribution to sustainable economic development driven by technological progress. This has been identified by several empirical studies. In European Union countries, Acs and Varga (2005) found that only opportunity-driven entrepreneurial activity could positively affect technical change. The same result was also found by Shrivastava and Shrivastava (2013) using GEM data.

**Figure 4.2 Stylised relationship between entrepreneurial activity (measured by self-employment) and economic growth by development stage**



Source: Author's summary based on Acs (2006) and Wennekers *et al.* (2010).

Note: O/N denotes the ratio of opportunity-driven entrepreneurs to necessity-driven entrepreneurs

As pointed out by Acs (2006) and Wennekers *et al.* (2010), in economies at different development stages, there are different shares of opportunity and necessity entrepreneurs.

<sup>18</sup> For example, from 2002, China encouraged the unemployed and laid-off labour to become involved in self-employment and become necessity-driven entrepreneurs (State Council, 2002; 2005b).

As shown in Figure 4.2, entrepreneurial activities and economic development has been postulated to have a U-shaped relationship. As discussed in Chapter 2 an economy can experience three economic development stages in its transformation according to Porter (1990). The first stage is factor-driven, focusing on primary production of agricultural products and small-scale craft manufacturing with low productivity. In this pre-industrial stage, the low level of economic development leads to limited waged employment opportunities, and thus the self-employment rate can be at a high level (Acs, 2006). But most self-employment is necessity-driven, such that most entrepreneurial activities relate to lower economic development level activities. With movement towards an industrial society, an economy will transition gradually into the second efficiency-driven stage with more agriculture and basic crafts workers being employed by the waged sector due to rapid development of the industry sector. In this industrialising stage the technology is aimed at large volume production of standardised products. Competitiveness is based on economies of scale (large volume of production) to achieve low unit cost, and thus firm size will be large with intensive labour utilisation under standardised technology. There are more opportunities and higher rewards in waged employment due to mass production. Thus, those self-employed individuals in low productive activities move into waged employment in big factories, resulting in an improvement in labour productivity. Therefore, the number of necessity entrepreneurs decreases sharply, leading to a decrease in total entrepreneurial activities. Finally, the economy can transition into the third innovation-driven stage with a higher technology level, in which knowledge and innovation become a significant source of competitiveness rather than production scale. In this stage, there is a big increase in the share of opportunity-driven entrepreneurship generating technological progress, such that entrepreneurial activities make an important contribution to economic development. Acs (2006) proposed that it is the ratio of opportunity-driven entrepreneurs relative to necessity-driven entrepreneurs (O/N), rather than the total number of entrepreneurs, that can be a significant indicator for economic development. Therefore, the positive effect of entrepreneurial activities on economic growth is only found in developed countries with more opportunity entrepreneurs. In order to drive an economy into a more developed stage, encouraging more opportunity-driven entrepreneurs is essential, as well as restructuring the institutional and legal environments, rather than merely focusing on increasing the number of entrepreneurs.

### 4.3.2 Quality of entrepreneurs/entrepreneurship and economic development

Although the start-up motivation of entrepreneurs plays a significant role in the different impacts of entrepreneurship on economic growth, other researchers argue that it is important, but not the sole determinant. For example, Wong *et al.* (2005) showed that, in OECD countries, both opportunity-driven and necessity-driven entrepreneurial activities were insignificant for economic growth. The only key driving force is from high-expectation entrepreneurial activities<sup>19</sup>, in which not only start-up motivation but other entrepreneur characteristics such as skill, knowledge and networks are also of crucial importance. As emphasised by Shane (2009), even necessity-driven entrepreneurs (if only a small number of them) can build high-expectation enterprises with good performance if they have enough ability, while many opportunity-driven entrepreneurs are not interested in growing their businesses or cannot manage to do it because of a lack of capability. Therefore, start-up motivation is only one of the factors which can influence the contribution of entrepreneurial activities to economic development. From this viewpoint, the impact of entrepreneurship on economic growth depends on the microeconomic firm-level performance of entrepreneurial businesses.

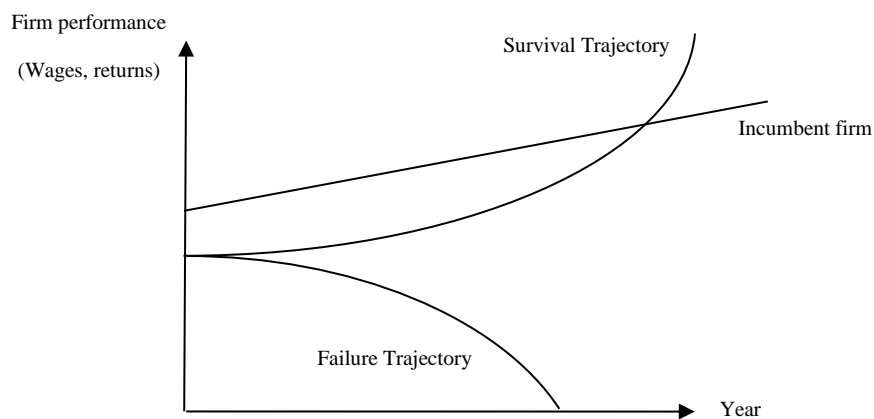
As discussed in the previous section, entrepreneurial activities, whether opportunity- or necessity-driven, can generate new start-ups in the market. However, although there are many new entrants every year, entrepreneurial activities can have a high exit rate (Audretsch, 1995; Honjo, 2000; Santarelli & Vivarelli, 2007; Vivarelli, 2013). Many entrepreneurs take a 'try to see' attitude. It seems that entry is a relatively easy movement for them, but survival and after-entry performance are challenging (Geroski, 1995; Strotmann, 2007). New entrants need to perform better, and thus grow at a faster speed, than incumbent firms in order to achieve the minimum efficiency scale level in their industries (Audretsch, 1991; Mata & Portugal, 1994; Vivarelli, 2007). With constrained resources, entrepreneurial new entrants, the majority of which are new SMEs, are forced to produce with higher productivity and efficiency in order to survive in the market selection process (Almus, 2000; Teruel-Carrizosa, 2010). The noisy (market) selection theories proposed by Jovanovic (1982) and Ericson and Pakes (1995) have explained the survival of new entrants, in which not only capital but also productive efficiency matters.

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<sup>19</sup> According to GEM, high-expectation entrepreneurship is defined as start-ups and newly formed businesses (less than 42 months old) which expect to employ at least 20 employees in five years.

Through post-entry operation, start-ups can uncover their real efficiency by a learning process (Jovanovic, 1982; Ericson & Pakes, 1995). In each stage of firm operation, entrepreneurs need to make a decision on whether to extend or contract their production scale or even exit the market based on their true efficiency level. Those with a better performance can enjoy a competitive advantage over their competitors. Therefore, in the market selection process, entrepreneurs who perform more efficiently survive and grow, while firms with a lower efficiency level will be forced to exit (Evans, 1987; Heshmati, 2001; Lotti *et al.*, 2009; Vivarelli, 2013). Audretsch (2012) summarised the process of exit and survival of entrepreneurial new entrants, as shown in Figure 4.3. New entrants are assumed to start from the same point, where their performance is lower than that of incumbent firms. However, the post-entry performance of these new entrants can be different. In the more competitive market created by entrepreneurship, only a small proportion of entrepreneurial new entrants with good performance can survive, grow and even surpass the performance of incumbent firms following the survival trajectory, while the others with poor performance have to exit the market following a failure trajectory.

**Figure 4.3 Exit and survival of entrepreneurial new entrants**



Source: Audretsch (2012).

The low survival rate of entrepreneurial new entrants has been investigated in many countries. For manufacturing start-ups in America, nearly 22.6 per cent of new entrants exited within two years of establishment and only 35.4 per cent survived after ten years (Audretsch, 1991; 1995). In Germany, only 25.9 per cent and 33.4 per cent of start-ups in the service and manufacturing sectors, respectively, survived after fifteen years (Fritsch *et al.*, 2006). Studying ten OECD countries, Bartelsman *et al.* (2005) found that around 20 to 40 per cent of newly entered firms failed within two years and only 40 to 50 per



cent were still surviving in the market after seven years. The high turbulence of entrepreneurial start-ups calls into question the capability of all kinds of entrepreneurship to create new entrants which can drive economic growth (Fritsch & Schroeter, 2009; Vivarelli, 2013). New entrants with a low level of productivity and efficiency cannot put much pressure on incumbent firms and are easily taken over by them. Thus, the market selection process, following the survival-of-the-fittest scenario, cannot generate much productivity improvement, because incumbent firms may not face much pressure to improve efficiency and innovate (Fritsch & Schroeter, 2011). It is the high-quality enterprises that can operate with higher than average levels of productivity and produce a competitive environment which contribute to economic growth (Mason & Brown, 2013).

Moreover, as concluded by van Praag and Versloot (2007), not all entrepreneurs can make a significant contribution to innovation. Those entrepreneurial activities with a low level of capability exit quickly from the market, usually because they fail to commercialise new ideas, products and technologies (Audretsch, 2012; Vivarelli, 2013). Only survivors with the motivation for expansion would try to make additional investments in innovation (Hay & Liu, 1997; Coad & Rao, 2008). As shown by Hölzl (2009), it is the high-expectation SMEs that are more R&D intensive and create more new products, generating knowledge capital and productivity growth from technological progress, especially in manufacturing sectors (Geroski, 1989; Disney *et al.*, 2003; Huergo & Jaumandreu, 2004a). Therefore, instead of having the motivation to innovate, whether opportunity-driven entrepreneurs can really generate the ‘Schumpeter effect’ with good capability and performance is more essential in driving economic growth (Vivarelli, 2013).

Also, although new entrants driven by entrepreneurship can create many job opportunities, the high exit rate of entrepreneurial new businesses with poor performance can make their contribution to net jobs growth questionable (Acs *et al.*, 1999; Audretsch & Fritsch, 2002; Carod *et al.*, 2008). Fritsch and Schroeter (2011) argued that the magnitude of the effect of new business formation on employment growth depends on the performance of the entrepreneur and this new entrant and it is the high-performance entrepreneurial activities that can have a larger positive effect on the net job creation of a region. As examined by Fritsch and Schroeter (2011), the relationship between entrepreneurial new businesses and employment growth is an inverse U-shape, implying that it is not the quantity of start-

ups that can benefit employment but, rather, their quality that matters. A number of studies indicate that net job growth is generated by only a small proportion of new businesses with good performance (Valliere & Peterson, 2009; Henrekson & Johansson, 2010).

Only a small proportion of entrepreneurial activities with better post-entry performance can, therefore, generate competition, innovation and also net employment growth, leading to economic growth, while others can only provide ‘turbulence’ in the market. The entrepreneurial firms’ post-entry performance and contribution to economic growth can vary because of the heterogeneous nature of entrepreneurs (Vivarelli, 2013). Entrepreneurs, who are responsible for a firm’s allocation of available resources play a key role in a firm’s performance (Storey, 1994; Casson, 2005; Ganotakis, 2012). Shane (2009) argued that it is possible to identify which start-ups are likely to have a good post-entry performance and make a larger contribution to economic growth based on certain information, such as the human capital, motivation, business ideas and strategies of the founders, as well as capital structure. Considering an entrepreneur’s human capital, firm-specific factors such as size and age, external factors relating to the market and government policies, Pena (2004) proposed a firm success model as follows:

$$S = f(HC, F, E, \varepsilon)$$

Where  $S$  denotes the success level, such as firm survival, growth, returns and efficiency, of new-start-ups,  $HC$  denotes the human capital of the entrepreneurs as measured by education and experience level,  $F$  denotes firm-specific factors, such as firm size, age, resources,  $E$  denotes external factors relating to the market, economic conditions and policies, and  $\varepsilon$  is an error item. Using this model, Pena (2004) found that entrepreneurs with a higher level of education and experience have a better firm survival and growth performance in Spain. This indicates the significance of the quality of entrepreneurs in generating good post-entry performance, and thus sustainable economic growth.

In order to achieve sustainable economic development, promoting high-quality entrepreneurs should be at the top of the agenda, instead of merely increasing the total number of entrepreneurs. This explains why, in recent years, the concern of researchers has moved from the quantity of entrepreneurs to the quality of entrepreneurs (Piergiovanni & Santarelli, 2006; Santarelli & Vivarelli, 2007; Fritsch & Schroeter, 2009; Shane, 2009). Under this circumstance, identifying what characteristics of entrepreneurs

can lead to good post-entry performance is of crucial importance in making policies which aim to stimulate economic development by entrepreneurship. This is important for emerging economies and sectors in transition to a higher development stage like China's manufacturing sector and is a key focus of this thesis.

### **4.3.3 Entrepreneurial quality in a transitional economy—China's manufacturing sector**

As discussed in Chapter 2, China is aiming to transition its economy from the efficiency-driven stage into the more sustainable innovation-driven stage and upgrade its manufacturing via more domestic innovation. In order to complete this transition, the significance of encouraging more entrepreneurial activities to increase productivity and innovation has been emphasised (see details in Chapter 2). However, as pointed out by many researchers, the impact of entrepreneurship in rich developed countries and emerging countries, such as China, could be different due to different types and quality of entrepreneurs (Valliere & Peterson, 2009; Naudé, 2010; Vivarelli, 2013).

Currently, there are limited studies on entrepreneurship in the context of developing economies (Naudé, 2010). Vivarelli (2013) is one of the few that have attempted to explain the special context of entrepreneurship in developing countries. The quality of these necessity entrepreneurs is relatively low because they are less capable of finding a formal job (Robichaud *et al.*, 2010; Verheul *et al.*, 2010). Vivarelli stated that in these countries necessity-driven entrepreneurship is more prevalent due to higher levels of poverty and lack of opportunities in the waged sector. Also, developing countries usually have many institutional constraints for doing business. For example, since most start-ups aiming to grow require external finance, the less developed capital markets of these countries limit the entry of high-quality entrepreneurial activities. The institutional environment in developing countries for labour market rules, contract enforcement, procedures for starting a business, taxation and property rights are usually poorly developed (or missing entirely) (Sleuwaegen & Goedhuys, 2002; Beck *et al.*, 2005; Chen & Puttitanun, 2005; Lee *et al.*, 2011). Moreover, the high corruption level in some developing countries, and the lack of an adequate infrastructural endowment in terms of transportation and communications, also generate constraints on high-quality entrepreneurial activities (Sleuwaegen & Goedhuys, 2002; Fisman & Svensson, 2007;

Ardagna & Lusardi, 2010). Therefore, although the entrepreneurial activity level is not necessarily low in developing countries (Naudé, 2010), a large proportion of this is driven only by necessity, is of low quality, and may have a high likelihood of quick failure and make little contribution to sustainable economic development (Vivarelli, 2013). High-quality entrepreneurs are of particular importance in these countries for catching up on knowledge capital and technology (Goedhuys & Sleuwaegen, 2010).

As a less developed economy, China also has these imperfections in its formal institutions and has a high corruption level, which can mean that entrepreneurial activities have low pay-offs, and can be unproductive and even destructive, and thus prevent the development of high-quality entrepreneurs who are capable of finding a job in the waged sector as an alternative career path (Baumol, 1990; Lu & Tao, 2010; Puffer *et al.*, 2010; Zhou, 2014). The *Global Entrepreneurship Monitor (GEM) 2017/2018 Report* (GEM, 2018) provided a sketch of the current development of entrepreneurial activities in China. Based on the data collected by GEM, in 2017, around 35.3 per cent of the population in the 18-64 age group in China could see good opportunities to start a firm in the area where they lived. But only 27.2 per cent of them believed they had the required skills and knowledge to start a business, ranking them bottom of the 52 researched countries. GEM (2018) data also shows that among the nascent entrepreneurial enterprises in China, more than half (53.0 per cent) are not expected to create any jobs in the next five years and around 75.5 per cent of them indicated that they have no innovative products or services. From this data it can be seen that the quality of entrepreneurial activities in China is still at a relatively low level. In encouraging entrepreneurial activities to achieve an innovation-driven country by 2020, promoting the quality of entrepreneurs to generate a better post-entry performance should not be ignored.

Also, as discussed in Chapter 2, the ‘Manufacturing 2025’ development strategy emphasised the role of entrepreneurial activities and SMEs in transitioning the competitiveness of China’s manufacturing from its basis on cheap labour to a higher efficiency and innovation level. But, like the ‘Innovation-driven Country 2020’ program, the ‘Manufacturing 2025’ policies generally focus on increasing the quantity of entrepreneurial activities and encouraging private enterprises to spill over knowledge and be more innovative in terms of new products and technologies. The quality of

entrepreneurs has been ignored which is particularly important in technology-intensive manufacturing sectors. As pointed out by Vivarelli (2013), new entrants with innovation can definitely play a more significant role in the advanced manufacturing and ICT sectors compared with those in other traditional sectors such as services. Patents make the protection of new knowledge easier in the manufacturing sector than that in the service sector; therefore knowledge spillover is much harder to achieve than in the service sector (Bosma *et al.*, 2011). Entrepreneurs with a better performance and innovation motivation are particularly needed to conduct the knowledge spillover process. Moreover, compared to service sectors, the manufacturing sector has higher entry barriers, a minimum efficient scale (MES) level and sunk costs (Audretsch *et al.*, 2004). Entrepreneurial new entrants need to perform much better than incumbent enterprises to achieve MES compared with those in the service sectors in order to survive in the market (Lotti *et al.*, 2009; Bosma *et al.*, 2011). Therefore, entrepreneurial quality is particularly significant for the entry and survival of entrepreneurial start-ups to create economic growth in the manufacturing sector. To achieve the goals outlined in ‘Manufacturing 2025’, the quality of entrepreneurs who can generate better post-entry performance needs to be promoted.

To ensure effective policy measures, the performance of Chinese entrepreneurial enterprises and the kinds of entrepreneurial factors that can be related to this performance need to be identified. While some researchers have emphasised the financial performance of entrepreneurial firms, such as profitability, sales and income (e.g. Sandberg & Hofer, 1987; Harada, 2003; Sambasivan *et al.*, 2009), others have focused on growth and survival (e.g. Cooper *et al.*, 1994; Honjo, 2004; Pena, 2004; Shrader & Siegel, 2007). However, studies seldom link entrepreneurial factors to entrepreneurial firms’ economic performance in terms of technical efficiency, which is regarded as the foundation for a firm’s survival and growth in the market selection process (Jacobs, 1969). Also, the studies listed above are mainly for advanced economies (e.g. America, European countries). As stated by Naudé (2010), we still have little knowledge about entrepreneurs and entrepreneurial performance in developing economies. In the special context of developing countries, some particular entrepreneurial characteristics should be considered, such as social networks. The social networks possessed by an entrepreneur can have a significant relationship to the performance of private enterprises in emerging economies, because they can work as informal institutions providing information and

resources in environments with less developed formal institutions and legal frameworks (Puffer *et al.*, 2010; Danis *et al.*, 2011). But, to date, there has been no research linking entrepreneurial factors, including start-up motivation, personal characteristics, human capital and social networks, to private enterprises' economic performance–technical efficiency, especially in developing countries. To address this gap this thesis evaluates the technical efficiency performance and relationships of comprehensive entrepreneurial factors with it for China's private manufacturing SMEs. This can give researchers a better understanding of entrepreneurs and their economic importance in a developing country and facilitate the implementation of effective policies promoting quality entrepreneurs and the performance of private SMEs.

China's special context, with extreme regional disparity between eastern and non-eastern regions as discussed in Chapter 3, needs to be considered in entrepreneurship studies. As pointed out by Bosma *et al.* (2011), it is more appropriate to link entrepreneurship to economic growth at the regional level than at the country level as entrepreneurial activities are sensitive to regional conditions, especially in countries with large regional development inequality like China (Feldman, 2001). In the more developed eastern regions, the share of necessity entrepreneurs may be relatively smaller than in non-eastern regions because of a higher income level and job opportunities (Fleisher & Chen, 1997; Schiere, 2009; Chen & Groenewold, 2010; Zhao, 2013). Also, eastern provinces have enjoyed a higher level of knowledge transfer as a result of greater access to FDI (Dahlman & Aubert, 2001; Zhao, 2013) and have a higher skilled-labour concentration due to better economic development (Fleisher *et al.*, 2010). These factors lead to more abundant knowledge and human capital endowments for high-quality opportunity-driven entrepreneurial activities. Furthermore, the legal and market institutions are much more developed in eastern provinces (Naughton, 2007; Zhou, 2011; 2014), resulting in a more conducive environment for high-quality entrepreneurial activities. Due to the large inequality in entrepreneurship development, policies promoting entrepreneurial quality and performance should be implemented at the regional level. Given these circumstances, this thesis evaluates the technical efficiency of private SMEs and the relationship of entrepreneurial factors with it in the eastern and non-eastern regions of China, respectively. The estimation of technical efficiency and the potential relationship of each entrepreneurial factor with firm performance are reviewed in the following sections.

## **4.4 Technical efficiency performance of SMEs**

### **4.4.1 Technical efficiency as an economic estimator of firm performance**

To estimate the performance of private SMEs it is necessary to choose an appropriate indicator for firm performance. Empirical researchers define and estimate firm performance using multidimensional perspectives (Snow & Hrebiniak, 1980). Specific estimators are chosen according to the research topic, data availability and the disciplinary nature of the study. Some of the most commonly used indicators in the context of SMEs are profitability estimators such as net operating profit or earnings before interest and tax (EBIT) in the finance and accounting disciplines (e.g. Majocchi & Zucchella, 2003; Keh *et al.*, 2007; Leitner & Guldenberg, 2010). Some researchers also use return-based estimators for SMEs including return on assets (ROA), equity (ROE), investment (ROI) and sales (ROS) (e.g. George *et al.*, 2001; Watson, 2007; De Massis *et al.*, 2015).

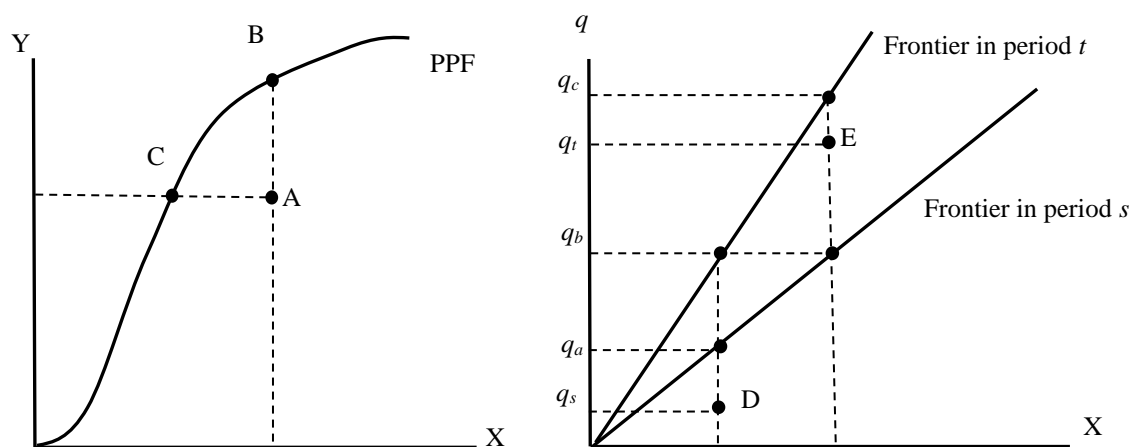
However, in the economics discipline, the survival and growth (in sales, employment or profit) of firms are commonly used in estimating small business performance (Robson & Bennett, 2000; Keh *et al.*, 2007), because the growth of SMEs is of concern to both policy makers for generating employment and entrepreneurs for business earnings (Robson & Bennett, 2000). However, since the central theme of economics concerns resource allocation and opportunity cost, efficiency has also been used as a critical estimator of firm performance in economic studies (Kopp & Diewert, 1982; Coelli *et al.*, 2005). Firm efficiency can be decomposed into technical and allocative efficiency. While allocative efficiency measures efficiency in choosing the inputs set in optimal proportions under given input prices, technical efficiency can authentically reflect the efficiency of a firm's production process of transferring inputs into output (Farrell, 1957). For SMEs that usually have limited resources, technical efficiency is especially significant, as it relates to the efficient use of limited inputs. Therefore, technical efficiency is chosen as the economic performance indicator for Chinese private SMEs in this thesis.

The definition of 'technical efficiency' was proposed by Koopmans (1951, p. 60):

A producer is technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output.

Technical efficiency can be derived from a production function as shown in the left panel of Figure 4.4. Firms producing at points B and C on the production possibility frontier (PPF) are technically efficient. They cannot produce any additional outputs without increasing at least one unit of inputs. However, production at point A is producing under the PPF. An increase in output to point B can occur without using any additional inputs or a decrease in inputs to point C is possible when producing the same level of output, implying that it is technically inefficient.

**Figure 4.4 Production frontier, technical efficiency and Malmquist Productivity Indices**



Source: Coelli *et al.* (2005, pp. 4, 55).

Moreover, productivity, as the most important economic index, can also illustrate firm performance in transforming inputs into outputs. Although productivity and efficiency both estimate the performance in real production, they are actually not the same because technical efficiency is only one component of productivity, which also depends upon technical change (Cooper *et al.*, 2000; Coelli *et al.*, 2005; Daraio & Simar, 2007). The productivity increase is shown in the right panel of Figure 4.4. If a firm improves its performance from production point D to point E, its production possibility frontier shifts up between period s and period t, implying significant technical change. Besides technical change, this firm also experiences a technical efficiency increase, which is shown by the fact that point E is closer to the frontier in period s than the proximity of point D is to the frontier in period t ( $|q_a q_s| < |q_c q_t|$ ). Therefore, productivity can be decomposed into static technical efficiency (relationship between inputs and output) under a given production frontier (technology) and dynamic technical change (shift of the production frontier). Productivity captures both static and dynamic changes in production and is a



better measure of firm performance. However, the measurement of productivity requires the use of panel data, which is unavailable for some studies. In identifying the relationship of entrepreneurial factors with firm performance, data for some entrepreneurial characteristics, such as start-up motivation and gender, age and experience when starting up, are all fixed across periods, thus only cross-sectional data is available. Therefore, this research adopts technical efficiency as the estimator for the performance of private manufacturing SMEs in China in an economic context. It has been used in many studies concerned with the performance of SMEs as reviewed in the following section.

#### **4.4.2 Technical efficiency estimation in other countries and China**

Following the definition of technical efficiency made by Koopmans, many researchers developed measures of technical efficiency using various techniques, such as Debreu (1951), Farrell (1957), Färe and Lovell (1978), Battese and Coelli (1995) and Battese *et al.* (2004). The details of different techniques used in technical efficiency measurement are introduced in Chapter 5. Many studies have empirically estimated the technical efficiency of SMEs utilising these techniques in emerging economies.

In studies of single countries, Mini and Rodriguez (2000) estimated the technical efficiency level of Philippine textile firms in 1994 by size. While small and medium enterprises (SMEs) were around 46 per cent technically efficient on average, the technical efficiency level of large enterprises was found to be 48 per cent. This implies a greater inefficiency of SMEs in the textile industry in the Philippines. A similar result was also found by Minh *et al.* (2007) in the manufacturing sector of Vietnam. The inefficiency of manufacturing SMEs in Vietnam was apparent since they only produced about half of their optimal output from given inputs and technology with around 50 per cent mean technical efficiency level (Minh *et al.*, 2007). Charoenrat and Harvie (2014) examined the technical efficiency level of manufacturing SMEs in Thailand in 1997 and 2007. The results showed that Thai SMEs produced with a low technical efficiency level in both years. In 1997, the mean technical efficiency score for small firms and medium firms were 58 per cent and 62 per cent respectively, while the scores for 2007 were 42 per cent and 65 per cent respectively. The overall average score for SMEs decreased from 57 per cent in 1997 to 50 per cent in 2007, indicating a deterioration in productive efficiency of manufacturing SMEs in Thailand. The technical inefficiency of SMEs has also been

identified for Kenya (Lundvall & Battese, 2000), Taiwan (Li & Hu, 2002; Yang & Chen, 2009), Tanzania (Admassie & Matambalya, 2002) and Turkey (Taymaz, 2005).

Besides single-country studies, Tan and Batra (1995) did a cross-national study using firm-level data for five developing countries—Malaysia, Indonesia, Mexico, Colombia and Taiwan—to estimate the technical efficiency of SMEs in these countries. The results of the study showed that, for Colombia in 1992, the average technical efficiency levels of micro, small, medium and large enterprises were all around 54 per cent. For Indonesian firms in 1992, large enterprises produced more technically efficiently at 43 per cent than small and medium enterprises at 36 per cent and 35 per cent, respectively. Similarly, for Malaysia in 1994, the technical efficiency level of large firms was 84 per cent, which was larger than that of micro, small and medium enterprises (73 per cent, 74 per cent and 79 per cent respectively). The estimated technical efficiency level for SMEs in Taiwan in 1986 also increased with firm size, ranging from 74 per cent for micro-sized enterprises to 82 per cent for large firms. But, for Mexico in 1992, the technical efficiency of medium-sized enterprises was 62 per cent, which was higher than that of large enterprises at 61 per cent, although the efficiency level of micro and small firms was much lower at 46 per cent and 58 per cent respectively. Batra and Tan (2003) extended this study to include another developing country, Guatemala. In 1999 the technical efficiency scores for micro, small, medium and large enterprises in Guatemala were 29 per cent, 37 per cent, 51 per cent and 67 per cent respectively, showing a more apparent increase in efficiency level with firm size. In all of these six countries SMEs were generally inefficient.

Although there have been numerous empirical studies estimating the technical efficiency of SMEs in developing countries, there have only been four studies in the context of mainland China. Among these four studies, three have estimated the firm-level technical efficiency of SMEs in a single province of China. In Hubei province, Fan (2009) found that the average technical efficiency score of SMEs in rural areas from 2002 to 2006 was only 59.6 per cent. Another study by Long *et al.* (2012) for Guangdong province, which is one of the most developed regions in China, also found that industrial SMEs only had a 30.7 per cent technical efficiency level from 2003 to 2007. In another developed region in China, Jiangsu province, Zhou and Peng (2014) conducted a survey of 345 rural SMEs in 2012 and obtained useable data for 197 of them. Utilising this dataset, they found that

the average technical efficiency of rural SMEs was only 25.3 per cent. Among 197 SMEs in the sample, only seven could produce with full technical efficiency, while 32.99 per cent of them could only achieve an efficiency level between 10 and 20 per cent. These three studies all concluded that SMEs in China are characterised by a low efficiency level, irrespective of whether they are located in developed or less developed regions. This is consistent with another study across regions conducted by Xu and Song (2013). Their research is the only one to estimate and compare the technical efficiency of SMEs at the regional level covering all provinces of China. They utilised aggregate province-level data between 2001 and 2010 and found that the technical efficiency of SMEs in China was at a low level in general but experienced an increasing trend during the study period. The average technical efficiency score for all regions and years was only 54.4 per cent. The score for eastern regions increased dramatically from 47.8 per cent in 2001 to 79.8 per cent in 2010, while that for central regions also grew from 32.3 per cent to 70.8 per cent during this period. SMEs in the least developed western regions produced with the lowest efficiency level, but also experienced an increase from 23.8 per cent to 64.7 per cent between 2001 and 2010. This implies that the technical efficiency of SMEs increased with economic development across these regions in China.

However, this sole regionally comprehensive study by Xu and Song (2013) has major weaknesses. It utilised aggregate province-level data instead of firm-level data without controlling for individual and firm specific characteristics, and thus ignored heterogeneity among firms, causing a clear biasness in estimation (Nucci & Pozzolo, 2001; Blasio, 2005; Claessens *et al.*, 2012). This could be a significant problem as technical efficiency can vary due to firm and entrepreneurial factors such as firm size, firm age, entrepreneur's education level and experiences. Another problem arising from using aggregate data to estimate technical efficiency is specific to the context of China. As stated by Rawski and Xiao (2001), the accuracy of the national, sectoral, provincial and local level data provided by China's statistical agencies is questionable due to the special administrative division system used. With a vertical system, China's administrative division has five levels including central government, provincial government, city government, county government and village government, from the highest level to the lowest level (Zhang & Wu, 2006). It is claimed that when reporting statistical data upward to a higher-level government, lower-level officials have an incentive to overstate the economic

performance of the local region under their jurisdiction in order to ensure a better political evaluation and thus a better future political career (Rawski & Xiao, 2001; Brandt *et al.*, 2014). Therefore, aggregate data in China produced by official statistics is usually viewed with suspicion, but firm-level data does not have this problem. Under this circumstance, estimating the technical efficiency of SMEs across regions by firm-level data is essential in China. This study fills this gap.

Another issue relating to current studies on the technical efficiency of SMEs in emerging economies, and especially China, is a lack of consideration of the different technology levels across regions. Regions across China can face different production opportunities due to differences in available physical, human, financial and knowledge capital, economic infrastructure and resource endowments that can result in different region-specific production frontiers (O'Donnell *et al.*, 2008). In the regional estimation of technical efficiency, a common mistake made by researchers is to compare mean efficiency scores estimated under region-specific technology. The cross-country estimation by Batra and Tan (2003) and the cross-province study in China by Xu and Song (2013) both compared technical efficiency scores estimated relative to the country or provincial-specific frontier.

But, as pointed out by O'Donnell *et al.* (2008), it is a general rule that comparing efficiency levels relative to one frontier with those relative to another frontier is meaningless. The technical efficiency of firms in regions with a different technology level should be compared using scores measured relative to a metafrontier, which is a potential technology that could be achieved by firms in all regions. Metafrontier technical efficiency has been estimated empirically by many studies, such as for firms in five different regions of Indonesia (Battese *et al.*, 2004), dairy farms in southern cone countries (Moreira & Bravo-Ureta, 2010) and agriculture in different regions of China (Chen & Song, 2008). To date, there has been no estimation of the metafrontier technical efficiency of SMEs in any country. This thesis utilises firm-level data to estimate the technical efficiency of SMEs relative to a regional frontier and also relative to a metafrontier in order to make an appropriate comparison of the technical efficiency performance of SMEs across regions of China.

## **4.5 Determinants of technical efficiency – General theoretical basis**

The results of empirical estimations of technical efficiency commonly support a large variation in efficiency scores among firms, industries and regions. This raises the question as to why some firms can produce more efficiently than others, requiring focus on the determinants of technical efficiency. This is important for both firms and policy makers, providing them with ways in which to improve the efficiency performance of firms, regions, industries and even countries. But unlike the definition and measurement of technical efficiency, the determinants of technical efficiency, as a framework, have not been developed in any economic theory to date. As stated by Caves (1992) and Lovell (1993), the identification of factors explaining differences in efficiency is essential for improving firm performance, but, unfortunately, current economic theory does not provide a compact model for identifying the key determinants of technical inefficiency.

Despite the lack of a theoretical framework, many researchers have provided strategies for choosing appropriate explanatory factors as determinants of technical efficiency. Caves and Barton (1990) summarised four categories of factors, including (1) organisation and relationships within the firm; (2) oligopoly bargains and competition within the industry; (3) effects of public policy; and (4) factors influencing the revenue-productivity level of firms, such as product differentiation. The first and last categories can be interpreted to be internal firm factors showing firm characteristics, while the second and third categories can be combined as external environmental factors reflecting market conditions and public policy (Caves, 1992). Empirical studies usually use a firm's age based on learning by doing theory, size based on scale economies theory, export activities based on learning by exporting theory, R&D activities based on absorptive capability theory and credit access that can improve financial capabilities for efficiency enhancing activities as internal factors in identifying determinants of technical efficiency (see Table 4.2). A firm's industry and location are usually utilised as external factors relating to the technical efficiency of a firm based on minimum efficient scale across industries and agglomeration economies, respectively, as shown in Table 4.2.

In the case of private-owned entrepreneurial enterprises, the internal firm factors should also capture the characteristics and capabilities of entrepreneurs (Storey, 1994; Pena, 2004). Some empirical studies examining the determinants of technical efficiency have

also included some entrepreneurial factors. For example, based on the *human capital theory*, Little *et al.* (1987) investigated the relationship between an entrepreneur's education and the technical efficiency of firms in India, Korea and Taiwan. Alvarez and Crespi (2003) also considered the entrepreneur's education when studying the technical efficiency of Chilean manufacturing SMEs. Mengistae (1996) included an entrepreneur's education level and experience as determinants of the technical efficiency of African SMEs. Some other research has also investigated the relationships of an entrepreneur's age and gender with firm performance using technical efficiency as a performance indicator (e.g., Hernández - Trillo *et al.* (2005), Bremmer *et al.* (2008) ) based on human capital theory and liberal feminist theory, respectively (see Table 4.2 for detail).

However, the empirical studies reviewed above did not consider the start-up motivation and networks of entrepreneurs. As indicated in Section 4.3, start-up motivation can play a significant role in entrepreneurial performance because it determines the entrepreneurs ambitious for firm growth and the effort take in efficient production according to the production theory proposed by Marschak and Andrews (1944) and X-efficiency theory developed by Leibenstein (1966). Also, the imperfection in formal institutions and legal forms for entrepreneurial businesses, especially private SMEs, in emerging economies makes entrepreneur networks an important factor for better firm performance (Luo & Chen, 1997; Zhou *et al.*, 2007; Li *et al.*, 2008). Because network is a significant social capital that help firms get scarce resources and information in an immature market based on the *Network Approach to Entrepreneurship* proposed by Aldrich and Zimmer (1986).

Therefore, this study is the first to consider more comprehensive entrepreneurial factors as potential determinants of technical efficiency, including start-up motivation, personal characteristics such as age, gender, education, and various experiences, as well as networks including business and political connections in the special context of China. Firm-specific factors including firm age, size, export intensity, credit access, R&D effort and the environmental factors represented by location are also considered in examining the determinants of firm technical efficiency. The industry of the firm is not considered because the objective of this research is manufacturing industry and the information about the sub-sector of the firm is not available.

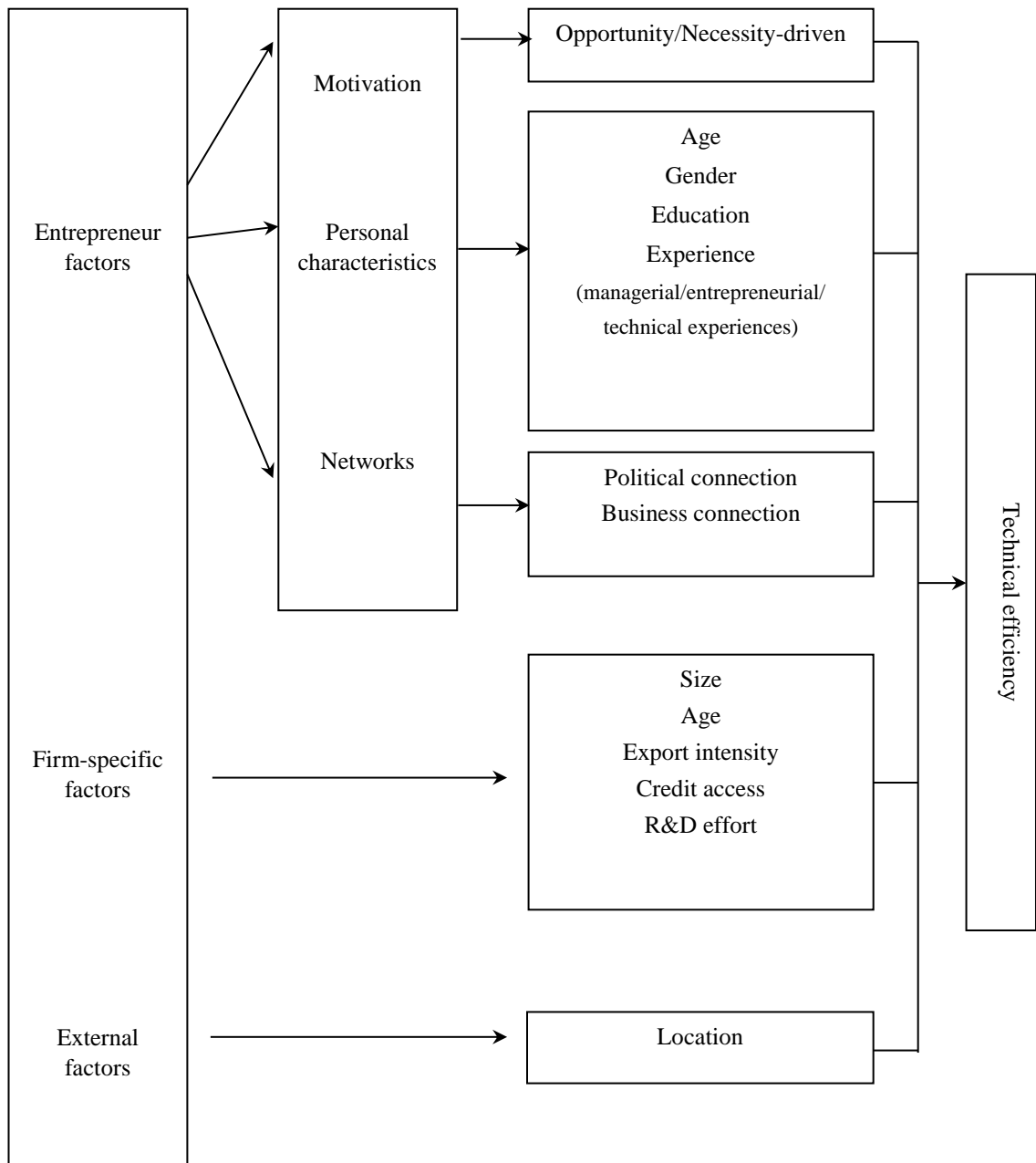
**Table 4. 2 Theretical basis for relationships of entrepreneurial, internal firm and external firm factors with technical efficiency of private enterprises.**

Factor	Supporting Theories	Literature	Expected relationship
<b>Entrepreneurial factors</b>			
Motivation	<b>Production theory:</b> It influences productive efficiency	Marschak & Andrews (1944)	Positive
	<b>X-efficiency theory:</b> It influences effort and knowledge usage in production and management	Leibenstein (1966)	Positive
Age	<b>Human capital theory:</b> Older ones have richer knowledge stock via learning by doing	Allaire & Marsiske (1999)	Positive
	<b>‘Old age phenomenon’:</b> Outdated knowledge; worse cognitive abilities; less effort	Bates (1990)	Negative
Gender	<b>Liberal feminist theory:</b> Gender discrimination in education, employment, financial market etc.	Fischer <i>et al.</i> (1993)	Negative
	<b>Gender attributes:</b> Work-family conflict Risk aversion	Aldrich & Cliff (2003)	Negative
Education	<b>Human capital theory (Generic):</b> Knowledge stock - know what	Becker (1964)	Positive
Experiences	<b>Human capital theory (Specific):</b> Knowledge stock – know how	Becker (1964)	Positive
Networks	<b>Network approach to entrepreneur:</b> It is an important social capital to obtain scarce resources and information	Aldrich & Zimmer (1986)	Positive
<b>Firm-specific factors</b>			
Size	Scale economies	Page (1984)	Positive
	Lack of flexibility	Yang & Chen (2009)	Negative
Age	Learning by doing	Mester (1996)	Positive
	Technology ‘locked in’	Admassie & Matambalys (2002)	Negative
Export	Learning by exporting	Clerides <i>et al.</i> (1998)	Positive
R&D	Absorptive capacity improvement	Griliches (1998)	Positive
Credit access	Financial capability to invest in efficiency enhancing activities	Levine (1997)	Positive
	Monitoring by banks	Agarwal & Elston (2001)	Positive
<b>External-specific factors</b>			
Industry	Minimum efficient scale	Wu (1995)	Positive
Location	Agglomeration economy	Marshall (1890)	Positive

Source: Author’s summary.

The theories supporting the rationales for choosing these factors as determinants of the technical efficiency of private enterprises has been summarised in Table 4.2. This forms the theoretical basis for the technical efficiency determinants identification framework of this research, which is presented in Figure 4.5. Literature on the potential relationship of each of these factors, explaining each supporting theory, is reviewed in the next section.

**Figure 4.5 Framework for identifying the technical efficiency determinants of private SMEs**



Source: Author's summary.



## 4.6 Relating entrepreneurial factors to a firm's technical efficiency

The earliest recognition of the relationship between entrepreneurial factors and the technical efficiency of a firm is in the production theory proposed by Marschak and Andrews (1944). They stated that, even within the same industry, the production function may alter across firms because of firm-specific 'technical efficiency' differences. The industry and firm-level production functions are shown as:

$$x_{0_{industry}} = \phi(x_1, x_2); x_{0_{firm}} = \phi(x_1, x_2, \varepsilon_f)$$

where  $x_0$ ,  $x_1$  and  $x_2$  denote net output, capital and labour respectively.  $\varepsilon_f$  represents firm-level 'technical efficiency' leading to inter-firm output differences using the same inputs. Although in a later study Strøm (1998) pointed out that  $\varepsilon_f$  should be the sum of left-out factors including real technical efficiency as defined by Koopmans (1951), functional-form discrepancies and errors of measurement, technical efficiency is still the most significant component of  $\varepsilon_f$ . The magnitude of this firm-specific disturbance factor  $\varepsilon_f$  depends on the technical knowledge, motivation, effort and luck of the entrepreneur (Marschak & Andrews, 1944), implying the significant relationship of entrepreneurial factors with the technical efficiency level of firms. This is further confirmed by Mundlak (1961) and Hoch (1962), who regard entrepreneurial skills as a significant factor for production variation among firms. Following their discussion, many empirical researchers have shown that entrepreneurial factors are important in determining firm performance (e.g. Shrader & Siegel, 2007; Blackburn *et al.*, 2013; Vivarelli, 2013; Stam *et al.*, 2014). The relationship of each entrepreneurial factor shown in Table 4.2 and Figure 4.5 is now discussed in detail, as are the hypotheses regarding their relationship with a firm's technical efficiency.

### 4.6.1 Entrepreneur's start-up motivation and firm technical efficiency

In order to understand the outcome of an entrepreneurial activity it is necessary to identify the role of start-up motivation (Shane *et al.*, 2003; Locke & Baum, 2007; Hessels *et al.*, 2008). It is commonly recognised that not all entrepreneurs have the same motivation for starting up their businesses and seeking ways to improve performance (Mochrie *et al.*, 2006; Hansen & Hamilton, 2011; Huggins *et al.*, 2017). Motivation can affect choices, effort level and perceptions of risk and opportunities (Kanfer, 1991; Palich & Bagby, 1995)

which can, in turn, influence an entrepreneur's decisions. As explained in the production theory of Marschak and Andrews (1944), theoretically an entrepreneur's will or motivation is significant in determining a firm's technical efficiency level. Entrepreneurs with a higher level of motivation would have a higher possibility of utilising their full technical knowledge and managerial skills to organise production more efficiently (Leibenstein, 1966).

Following these arguments, the relationship between start-up motivation and firm performance has been examined in many empirical studies. Table 4.3 shows selected literature on this topic. Using firm growth as an indicator of performance, Miner *et al.* (1994) found that a higher level of growth motivation by an entrepreneur could lead to faster employee numbers growth and sales growth for American small innovative firms. In Sweden, Delmar and Wiklund (2008) investigated the relationship of an entrepreneur's growth motivation with the real growth of a business and found a positive relationship for small firms. An empirical study of SMEs in Norway also confirmed that an owner's strong motivation led to high international orientation and revenue growth from 1999 to 2009 (Moen *et al.*, 2016). Besides the growth of a firm, Barkham (1994) showed that entrepreneurs with a high motivation level could be more confident to take the risks involved with investment, thus creating a higher turnover value and more jobs in Britain. Moreover, using data for Welsh businesses collected in 2001 and updated in 2012, Huggins *et al.* (2017) found that entrepreneurs with growth motivations had a significantly higher likelihood of surviving than their counterparts.

When classifying entrepreneurs into opportunity-driven entrepreneurs and necessity-driven entrepreneurs, the different firm performance of these two kinds of entrepreneurs has also been identified in empirical studies. While opportunity-driven entrepreneurs have greater ambitions to innovate, produce novel products and perform better in order to achieve growth, necessity-driven entrepreneurs usually do not set ambitious goals and are more likely to be content with current performance (Hayter, 2011; Verheul & Mil, 2011). Using survey data for 306 Vietnamese entrepreneurs, Swierczek and Thai (2003) found that most Vietnamese entrepreneurs were motivated by challenges or opportunities, rather than by economic and job necessity. The former kind of entrepreneur showed higher entrepreneurial orientation, which was essential for the firm's future performance.

Moreover, in a descriptive study of informal entrepreneurial firms in the manufacturing sector of three African countries, Amin (2010b) also showed that opportunity-driven entrepreneurial firms were often larger, used external finance more often and were more resilient to adverse economic shocks. The profit of opportunity-driven enterprises was three times that of necessity-driven enterprises on average. In another study conducted by Amin (2010a), a positive relationship was shown between the opportunity-driven motivation of entrepreneurs and firm performance estimated by labour productivity. This relationship was significant in the manufacturing sector but insignificant in the services sector. In Germany, Block and Sandner (2009) studied 606 entrepreneurs and concluded that opportunity-driven entrepreneurs could survive for a longer time, but this relationship became insignificant when controlling for the entrepreneur's education level. Using the same dataset, Block and Wagner (2010) also found opportunity entrepreneurs exploiting more profitable opportunities, implying that the firms built by these entrepreneurs earned more profit than necessity-driven firms.

**Table 4.3 Selected literature on the relationship of entrepreneur motivation and firm performance**

Performance indicator	Motivation indicator	Literature	Relationship
Firm growth	Growth motivation	Miner <i>et al.</i> (1994)	+*
		Delmar and Wiklund (2008)	+*
		Moen <i>et al.</i> (2016)	+*
Turnover, total assets, employee number	Growth motivation	Barkham (1994)	+*
Survival	Growth motivation	Huggins <i>et al.</i> (2017)	+*
Entrepreneurial orientation	Opportunity/Necessity	Swierczek and Thai (2003)	+*
Business duration	Opportunity/Necessity	Block and Sandner (2009)	+* but insig. if control for education
Labour productivity	Opportunity/Necessity	Amin (2010a)	+* (manufacturing) insig. (services)
Profit	Opportunity/Necessity	Block and Wagner (2010)	+*

Source: Author's summary.

Notes: +\* denotes a positive and significant relationship; insig. denotes an insignificant relationship.

So far there has been no empirical research linking an entrepreneur's motivation to a firm's economic performance as represented by technical efficiency. This research fills this gap by estimating the relationship between an entrepreneur's motivation (opportunity/necessity-driven) and a firm's technical efficiency for manufacturing SMEs in China. China provides a good context for studying this relationship because about a

third of Chinese entrepreneurial activities are necessity-driven (GEM, 2018). Based on empirical evidence for the relationship of an entrepreneur's motivation with firm performance, the following hypothesis is proposed and tested in Chapter 7:

*H<sub>1</sub>: Opportunity-driven entrepreneurs operate firms with a higher technical efficiency level compared to that of their necessity driven counterparts.*

#### **4.6.2 Entrepreneur's personal characteristics and firm technical efficiency**

Besides an entrepreneur's start-up motivation, the most commonly considered entrepreneurial factors in explaining firm performance are their personal characteristics, including the entrepreneur's age, gender and human capital (education and experience).

##### **4.6.2.1 Age**

The age of an entrepreneur can have a significant relationship with firm performance. As stated by Allaire and Marsiske (1999), the aging of individuals may help them to develop a rich domain-specific knowledge stock in the areas in which they frequently participate. Therefore, older entrepreneurs are expected to have more information stock and experience-based knowledge, such that they can obtain better intellectual power and make more efficient decisions with a higher level of human capital (Cressy, 1996; Shaw *et al.*, 2009). Many studies regard an entrepreneur's age as a component of their human capital and anticipate that it has a positive relationship with firm performance (e.g. Bates, 1990; Harada, 2003; Colombo & Grilli, 2005). However, an entrepreneur's age also has the potential to have a negative relationship with firm performance, which Bates (1990) called the 'old age phenomenon'. First, the knowledge and technology acquired by an older entrepreneur may be outdated. As emphasised by Roberts (1991b), older entrepreneurs are accustomed to using existing technology and are less likely to use new advanced ones, especially in high-technology industries. Second, the mental and cognitive abilities of humans, such as work speed, dexterity, learning and memory, decline with age (Giniger *et al.*, 1983; Sturman, 2003; Grund & Westergård-Nielsen, 2008). This can result in a disadvantage in terms of problem-solving and decision-making processes, which can consequently lead to worse firm performance (Skirbekk, 2008; Göbel & Zwick, 2012). Also, the aging of an entrepreneur can reduce their motivation to achieve a better firm performance because older individuals are more likely to accept the

status quo, and this could be a significant barrier for firm growth (Reijonen & Komppula, 2007; Verheul & Mil, 2011). This is exactly the case in China, as examined by Busenitz and Lau (2001), where older entrepreneurs have a lower need for achievement and commitment. Without high ambition for better firm performance, older entrepreneurs may spend less effort on the management and production of the firm (Bates, 1990).

Because an entrepreneur's age can have both potential negative and positive relationships with firm performance, empirical studies on this relationship have found inconsistent results. Some studies support the advantages brought about by the larger knowledge stock possessed by older entrepreneurs. For example, Arribas and Vila (2007) concluded that entrepreneurs in the oldest age group (45-64) had the highest survival time, which was 4.3 years, compared with 4.1 years for the 18-34 and 35-44 age groups in the Spanish service industry. However, a study by Singh *et al.* (2001) demonstrated negative relationships of an owner's age with firm growth, employment size and profit for female-owned SMEs in Java, Indonesia. This is consistent with the study of Harada (2004) examining the productivity of Japanese businesses and Kangasharju and Pekkala (2002) studying the survival and turnover growth of small businesses in Finland. An insignificant relationship of entrepreneur's age with firm performance was found in studies by Stuart and Abetti (1990), Bosma *et al.* (2004) and Cassar (2006). Bremmer *et al.* (2008) found that the technical efficiency of Dutch glasshouse firms operated by older entrepreneurs can be significantly less, while Amaechi *et al.* (2014) found an insignificant relationship of an entrepreneur's age with the technical efficiency of oil palm produce mills in Nigeria.

In China, the age structure of entrepreneurs is gradually becoming younger (Mao & Hua, 2010). Empirically, for private enterprises in China, younger entrepreneurs are found to achieve greater profitability (Fung *et al.*, 2007) and a higher level of revenue growth (Zhang *et al.*, 2010), especially in high-tech industries (Miu & Li, 2006). But how the age of entrepreneurs relates to firm technical efficiency in China has still not been identified. Based on the literature reviewed above, especially that dealing with the context of China, this thesis addresses this gap by testing the following hypothesis in Chapter 7:

*H<sub>2</sub>: Older entrepreneurs operate a firm with a lower technical efficiency level than their younger counterparts.*

#### 4.6.2.2 Gender

Another significant characteristic of entrepreneurs is their gender. Traditionally, enterprises owned by females were believed to be less successful than those owned by males and this was confirmed by many early empirical studies using quantitative economic and financial performance measures (e.g. Cuba *et al.*, 1983; Aldrich *et al.*, 1989; Brush, 1992; Rosa *et al.*, 1996; Fairlie & Robb, 2009). When explaining the reason for the observed underperformance of female entrepreneurs, some researchers pointed out the role of various forms of gender discrimination, such as in the financial market, in education and in the labour market, according to liberal feminist theory (Fischer *et al.*, 1993; Ahl, 2006; Robb & Watson, 2012). First, supply-side discrimination by bank officers and venture capitalists may exist in some less developed markets (Marlow & McAdam, 2013). Therefore, females may have less financial support or pay a higher interest rate, even though they have solvency and creditworthiness comparable to those of their male counterparts (Buttner & Rosen, 1992; Coleman, 2000; Marlow & McAdam, 2013). In China, female entrepreneurs also face larger barriers in terms of access to finance. As shown by the China Association of Women Entrepreneurs (2016), 48.13 per cent of Chinese women entrepreneurs use personal savings as the major source of their business capital while only 9.50 per cent accessed bank loans, which is much lower than the equivalent ratio for all entrepreneurs (26.1 per cent) in China (All-China Federation of Industry and Commerce, 2016). This presents a serious financial constraint on the performance of female-owned SMEs. Moreover, female entrepreneurs have less education and experience than male owners in some less developed economies due to societal attitudes (Boden & Nucci, 2000; Ahl, 2006). Even though gender discrimination has been eliminated in many countries, women are still shut out of high management decision-making positions (ILO, 2015). This is especially the case in China. Although China has established many policies aimed at eliminating gender discrimination and has relatively equal tertiary education enrolments between males and females, only 16.8 per cent of senior managers in China are women and about 40 per cent of Chinese companies have all male board members (Dasgupta *et al.*, 2015; ILO, 2015). This leads to a disadvantage in human capital accumulation for female entrepreneurs. With restricted access to financial resources and human capital, female entrepreneurs are commonly found to operate smaller sized firms concentrated in highly competitive services and retail industries, which require less financial capital and specific knowledge but are usually

related to low value-adding activities with less efficiency and profitability (Loscocco & Robinson, 1991; Rosa *et al.*, 1996; Bardasi *et al.*, 2011). In China, around half of female-owned enterprises have less than 5 million RMB in assets and only 21.5 per cent of them are involved in the manufacturing industry, compared with 64 per cent of male-owned firms (China Association of Women Entrepreneurs, 2016). This being the case, the underperformance of women entrepreneurs can be explained by their firm's industry sector and size and their limited access to financial capital and entrepreneur human capital. Many empirical studies have found that firm performance differences based on the gender of the entrepreneur disappear after controlling for these factors (e.g. Kalleberg & Leicht, 1991; Carter *et al.*, 1997; Brüderl & Preisendörfer, 1998; Du & Izumida, 2006; Robb & Watson, 2012). However, some studies have found that female entrepreneur underperformance still persists even after controlling for these factors (e.g. Robb, 2002; Bosma *et al.*, 2004; Fairlie & Robb, 2009), implying that the relationship of gender with firm performance can be caused by other gender attributes rather than only discrimination.

**Table 4.4 Selected literature on the underperformance of female entrepreneurs**

Performance indicator	Literature	Country	Female underperformance
Income	Loscocco and Robinson (1991)	U.S.	Significant
	Parker and van Praag (2006)	Netherlands	Insignificant
Sales	Rosa <i>et al.</i> (1996); Fairlie and Robb (2009)	U.K.; U.S.	Significant
	Loscocco and Robinson (1991)	U.S.	Insignificant
Survival	Robb (2002); Bosma <i>et al.</i> (2004); Fairlie and Robb (2009)	U.S.; Netherlands; U.S.	Significant
	Kalleberg and Leicht (1991); Cooper <i>et al.</i> (1994); Carter <i>et al.</i> (1997); Brüderl and Preisendörfer (1998); Robb and Watson (2012)	India; U.S.; U.S.; German; U.S.	Insignificant
Growth	Cooper <i>et al.</i> (1994);	U.S.; Germany	Significant
	Kalleberg and Leicht (1991); Rosa <i>et al.</i> (1996); Du Rietz and Henrekson (2000)	India; U.K.; Sweden	Insignificant
ROA	Robb and Watson (2012)	U.S.	Insignificant
Profit	Honig (1998); Bosma <i>et al.</i> (2004); Fairlie and Robb (2009)	Jamaica; Netherlands; U.S.	Significant
	Collins-Dodd <i>et al.</i> (2004)	British Columbia	Insignificant
Technical efficiency	Hernández-Trillo <i>et al.</i> (2005); Nordman and Vaillant (2014)	Mexico; Madagascar	Significant

Source: Author's summary.

Even in modern society females still face greater work-family conflict and have to allocate more time to domestic responsibilities because of the family perception of gender-specific roles, especially in Asian countries (Aldrich & Cliff, 2003; Shelton, 2006; Kepler & Shane, 2007). This is also the case in China where females are still given more responsibilities for family life and child care. They are found to work fewer hours and also manage their work time less effectively (Yu & Zhu, 2000; Kitching & Jackson, 2002). The reduced effort in terms of firm operation and production leads to the underperformance of female entrepreneurs after controlling for other personal characteristics and firm factors. This is also shown when using technical efficiency as a performance measure. Studying 10,332 microenterprises in Mexico, Hernández-Trillo *et al.* (2005) found that the technical efficiency score of women-owned businesses was 1.89 per cent less on average after controlling for the entrepreneur's education, experience, industry and credit access. Nordman and Vaillant (2014) also found significantly less technical efficiency for female-owned informal businesses in Madagascar after considering the entrepreneur's education, experience, financial capital and size.

To date, there are few empirical studies identifying whether female entrepreneurs underperform in China. This thesis fills this gap by examining the significance of an entrepreneur's gender on the technical efficiency of a firm after controlling for the entrepreneur's human capital and the industry sector of the firm, firm size and finance access by testing the following hypothesis in Chapter 7:

*H<sub>3</sub>: Female entrepreneurs operate a firm with a lower technical efficiency level than their male counterparts.*

#### 4.6.2.3 Human capital: Education and experience

According to human capital theory proposed by Becker (1964), the human capital level is a significant characteristic of entrepreneurial capability and a crucial source of firm performance because it can reveal the level of knowledge and skills embodied in the entrepreneur (Herron & Robinson, 1993; Cooper *et al.*, 1994; Gimeno *et al.*, 1997; Shrader & Siegel, 2007; Unger *et al.*, 2011). Besides education, Becker (1964) argued that information on the specific economic, political and social systems could also be a source of knowledge accumulation and lead to better firm performance. Therefore, human capital can be divided into generic human capital and specific human capital (Brüderl *et*



*al.*, 1992; Colombo *et al.*, 2004). While generic human capital refers to the general explicit knowledge obtained from education, specific human capital implies the tacit knowledge and skills that can be applied directly in a firm's production and management and which are usually acquired and accumulated from previous experience (Brüderl *et al.*, 1992; Davidsson & Honig, 2003).

The human capital of entrepreneurs can relate to firm performance in several ways. First, based on human capital theory, employees with a higher level of human capital can obtain higher salaries in the waged sector (Willis, 1985). Therefore, they face a larger opportunity cost through creating a new business instead of working in an incumbent enterprise (Cassar, 2006). The entrepreneurial opportunities exploited by them are, therefore, likely to be more productive, efficient and profitable, and, thereby, generate higher economic benefits in order to compensate for their higher opportunity cost (Bhidé, 2003; Davidsson & Honig, 2003; Cassar, 2006). In this way, entrepreneurs with higher human capital are expected to exploit more valuable opportunities and operate more technically efficient firms. Moreover, entrepreneur human capital also relates to an entrepreneur's cognitive ability to recognise an economically beneficial opportunity for the firm (Becker, 1964; Mincer, 1974; Lynch, 1991; Shane, 2000; Corbett, 2007). It is argued that, even under the same technological change, different people will discover different opportunities based on their cognitive ability brought about by prior knowledge (Venkataraman, 1997; Shane, 2000). Therefore, when an efficiency enhancing opportunity appears within the firm or in the market, an entrepreneur with more knowledge and human capital can discover, value and exploit it while others cannot (Shane & Venkataraman, 2000; Corbett, 2007). In addition, the cognitive ability obtained from previous knowledge can influence whether they can exploit the opportunity in an efficient way and also help entrepreneurs detect other resources, such as financial and physical capital, that can improve a firm's efficiency (Shane, 2000; Unger *et al.*, 2011). Thus, entrepreneur human capital that results in different cognitive ability can lead to differences in the efficiency level of firms.

In addition, generic human capital factors can also affect a firm's performance through compensation needs. As emphasised by Becker (1964), generic human capital needs to be acquired through investment in education, and people usually try to use their human

capital to obtain compensation for their investments (Honig, 1998). Therefore, once individuals with a higher level of education decide to begin entrepreneurial activities, they would have more motivation to make more effort in firm operation and production in order to generate more economic benefit to compensate their human capital investments, and, thus, lead to better firm performance (Unger *et al.*, 2011).

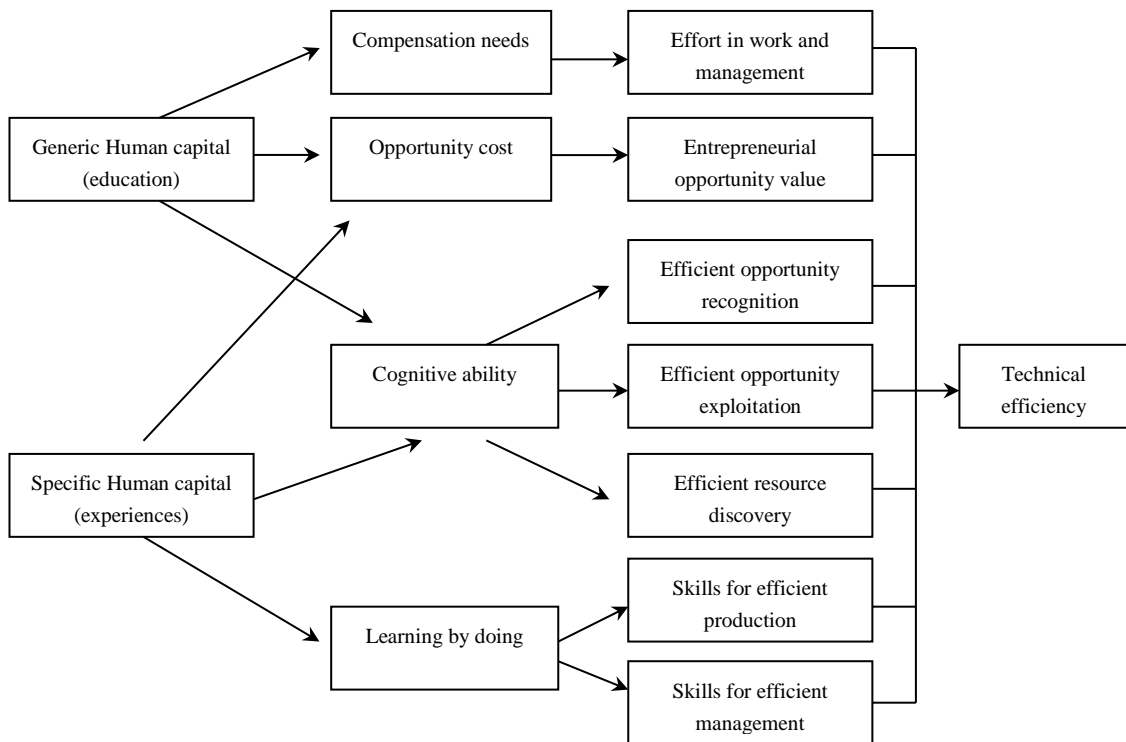
Unlike generic human capital, specific human capital is obtained from previous experience. It is argued that nearly every prospective entrepreneur starts a new business with a stock of experience reflecting their history or background (Reuber & Fischer, 1999). The specific knowledge of entrepreneurs accumulated from historical experiences can be directly used in the operation of new start-ups via a special 'learning by doing' process (Smilor, 1997; Minniti & Bygrave, 2001; Cope, 2005). In this process individuals try, make errors, and explicitly discover problem solutions, and transfer 'entrepreneurial experiences' into 'entrepreneurial knowledge' (Deakins & Freel, 1998; Cope, 2005; Politis, 2005). Utilising this explicit knowledge, entrepreneurs with a large experience stock can find better solutions regarding how to produce more efficiently and how to manage firms in order to increase labour productivity, and, thereby, operate a firm with a higher efficiency level.

Summarising the viewpoints of the literature discussed above, the influence process of human capital on a firm's technical efficiency is shown in Figure 4.6. Empirical studies linking entrepreneurial human capital to firm performance have been conducted over a number of decades. Analysing 70 empirical studies on the relationship between entrepreneurial human capital and firm performance, Unger *et al.* (2011) found a significant relationship in both high-technology and low-technology industries. Mayer-Haug *et al.* (2013) utilised data from 183 empirical studies and found that an entrepreneur's education, experience and skills positively and significantly relate to most SME performance indicators including growth, firm size, sales, profit, other financial indicators and qualitative indicators.

However, the results of specific studies on this relationship are mixed. As pointed out by Unger *et al.* (2011) and Mayer-Haug *et al.* (2013), the relationship of entrepreneurial human capital with firm performance depends on the research context, human capital

indicator and firm performance indicator used in the study. The relationship between each entrepreneurial human capital indicator (education and experiences) and different firm performance indicators are reviewed as follows.

**Figure 4.6 Influence process of entrepreneurial human capital on firm technical efficiency performance**



Source: Author's summary.

### *Education*

As a significant way of acquiring knowledge, the education received by an entrepreneur is the most commonly used factor representing entrepreneurial human capital. Most studies conclude the existence of a positive and significant relationship of the entrepreneurial education level with firm performance. Reviewing 299 empirical studies, Van der Sluis *et al.* (2008) found that, although an entrepreneur's education level did not significantly influence their entry into entrepreneurial activities, it did have a significant relationship with after-entry performance. This relationship has also been confirmed in a study of male entrepreneurs in the U.S. conducted by Bates (1990). The results showed that firms established by highly educated entrepreneurs were more likely to survive for a longer period. Using profit as a performance indicator, Honig (1998) studied 215 informal microenterprises in Jamaica and found all formal, non-formal and vocational education

could increase the firm's profit significantly. Many other studies also showed a positive and significant relationship of the entrepreneurial education level with various firm performance indicators, such as profitability (e.g. Robinson & Sexton, 1994; Parker & van Praag, 2006), survival (e.g. Brüderl & Preisendörfer, 1998; van Praag, 2003) and growth (e.g. Cooper *et al.*, 1994; Mengistae, 2006).

A small proportion of the literature, however, finds different results on the relationship between an entrepreneur's education level and firm performance. Storey and Wynarczyk (1996) found that the paper qualification of an entrepreneur had an insignificant relationship with the survival of 186 small firms in Britain. Studying 48 new start-ups in Korea, Jo and Lee (1996) found that an entrepreneur's education level was significant for a firm's return on assets and return on sales, but insignificant for employment and growth estimators. Similar to this study, Bosma *et al.* (2004) showed that Dutch firms created by entrepreneurs with a high education level could enjoy higher profitability, but the relationship of an entrepreneur's education with employment created by the firm and survival rate were shown to be insignificant. Moreover, in a study of 305 small tourism businesses, Haber and Reichel (2007) found an insignificant relationship of entrepreneur education with any of the firm performance measures including revenue, employee numbers and profitability in Israel. They explained these unexpected results by the possibility that the entry barriers in the tourism industry are lower than in other industries, especially high-technology industries, where a higher education level is required.

Relating an entrepreneur's education level to a firm's technical efficiency, the empirical results are also mixed. Most of the literature has shown that entrepreneurs with a higher education level are likely to use resources more efficiently. According to Burki and Terrell (1998), firms built by entrepreneurs with a primary school qualification could be 8.4 per cent more technically efficient than those without this qualification in Pakistan. When studying the technical efficiency of Ghana's microenterprises in the wood product industry, Gokcekus *et al.* (2001) found that the entrepreneur's education level had a positive and significant relationship since it would reflect an entrepreneur's knowledge stock. The same conclusion is also made by Hernández-Trillo *et al.* (2005) for SMEs in Mexico. They found that entrepreneurs with more education can enjoy a higher technical efficiency score for both formal and informal SMEs. However, an unexpected negative

relationship between an entrepreneur's education level and technical efficiency was found by Alvarez and Crespi (2003) for manufacturing SMEs in Chile. They explained this negative relationship on the premise that entrepreneurs who spend more time on education would have less time to manage a firm.

In general, an entrepreneur's education level, as a significant component of human capital, is supported as having a positive relationship with a firm's technical efficiency both theoretically and empirically in many countries. But in the special context of China there has been no empirical study explaining whether an entrepreneur's education has relationship with the technical efficiency level of SMEs. This paper will fill in this gap by testing the following hypothesis on this relationship in Chapter 7:

*H<sub>4</sub>: Entrepreneurs with a higher education level operate firms with a higher technical efficiency level than their less educated counterparts.*

### *Experience*

As the source for acquiring specific human capital, an entrepreneur's previous work experience is likely to be an essential determinant for business success. In general, entrepreneurs who have more experience are found to have a higher ability to use resources efficiently, achieve success and survive both business environment shocks and poor business decisions (Staw, 1991; Cooper *et al.*, 1994; Reuber & Fischer, 1999; Politis, 2005). Empirically, the study on German new business founders by Brüderl *et al.* (1992) revealed that one additional year of an entrepreneur's work experience could significantly reduce the failure rate of a new business by 5.1 per cent. A consistent positive and significant relationship between an entrepreneur's work experience and new business performance was also found on a firm's annual income (Parker & van Praag, 2006) or profitability (Chiliya & Roberts-Lombard, 2012).

However, Ramachandran and Shah (1999) found an insignificant relationship between the general work experience of entrepreneurs and the growth rate of new venture enterprises in Kenya, Zambia, Zimbabwe and Tanzania. Moreover, some researchers using several different firm performance indicators in a study found mixed results. A study by Brüderl and Preisendörfer (1998) showed that the work experience of an entrepreneur could have a positive and significant relationship with survival but a

negative relationship with employment growth and sales growth of German new business ventures. The inconsistent relationships of work experience of the entrepreneur with different firm performance indicators was also found by many other studies, such as studies on Dutch new start-ups (Bosma *et al.*, 2004), Ethiopian small businesses (Mengistae, 2006) and high-tech SMEs in China (Wright *et al.*, 2008). These inconsistent findings may be due to different model specifications, data quality, diversity of study design, differences in usage of firm performance indicators, omission of variables, sample differences and, most importantly, variety of experiences (Reuber & Fischer, 1999; Song *et al.*, 2008). As pointed out by Toohey (2009), experience comes in many guises. Therefore, studies on the relationship between an entrepreneur's experience and firm performance should investigate different specific experiences.

In this thesis, management, start-up and technical experiences are considered based on data availability. While an entrepreneur's management experience can provide information on the basic aspects of operating a business, such as finance, sales and organisation management (Shepherd *et al.*, 2000; Politis, 2005), entrepreneurs with prior start-up experience would have a higher stock of entrepreneurial tacit knowledge resulting in better decision-making capabilities and understanding of business routine (Duchesneau & Gartner, 1990; Westhead & Wright, 1998; Politis, 2005; Delmar & Shane, 2006). Moreover, technical staff experience with technical knowledge and expertise is significant for efficient use of technology in production (Stuart & Abetti, 1990; Jones-Evans, 1996), especially for private SMEs which have limited access to advanced technologies (Chen *et al.*, 2006). Although an entrepreneur's industry experience is also significant for firm performance (van Praag, 2003; Harada, 2004; Politis, 2005; Dahl & Reichstein, 2007) the data used in this research cannot provide information on this. The empirical results on the relationships of entrepreneur management, start-up and technical experiences with firm performance vary across different countries and different performance indicators as shown in Table 4.5. The relationships of these experiences with the technical efficiency of manufacturing SMEs in China needs to be identified.

Relating an entrepreneur's prior experiences to technical efficiency, Gokcekus *et al.* (2001) found that an owner's management experience resulted in a higher technical efficiency level for micro firms in Ghana's wood industry. However, this relationship was found to be insignificant by Alvarez and Crespi (2003) when studying Chilean

manufacturing SMEs. However, there has been no comprehensive empirical study investigating the relationships of an entrepreneur's management experience, start-up experience and technical experience with the technical efficiency of firms. This research fills this gap for the case of China by testing the following hypotheses:

*H<sub>5</sub>: Entrepreneurs with prior management experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.*

*H<sub>6</sub>: Entrepreneurs with prior start-up experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.*

*H<sub>7</sub>: Entrepreneurs with prior technical experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.*

#### **4.6.3 An entrepreneur's networks and firm technical efficiency: The significance of *guanxi* in China**

Besides start-up motivation and the general personal characteristics of entrepreneurs, networks have also been regarded as an important factor possessed by entrepreneurs (Brüderl & Preisendörfer, 1998; Hoang & Antoncic, 2003). According to Aldrich and Zimmer (1986) the personal networks of an entrepreneur can generate social capital and play a significant role in obtaining, organising and coordinating resources and are, therefore, important for firm performance and success (Brüderl & Preisendörfer, 1998; Watson, 2007; Stam *et al.*, 2014). For a firm's survival and development, valuable resources are often scarce and external to the firm (Pfeifer & Salancik, 1978). Entrepreneurs can usually obtain these scarce resources by being a part of a network with resource providers, such as creditors and suppliers, having family connections, knowing others and being recognised as having a good reputation (Nahapiet & Ghoshal, 1998). As proposed by Aldrich and Zimmer (1986), even if entrepreneurs have the same level of knowledge and skills, the performance of firms varies with their access to scarce and more productive resources in the external environment through an entrepreneur's social networks (Ostgaard & Birley, 1996; Jack *et al.*, 2010). Moreover, an entrepreneur's networks can provide intangible resources, such as information and advice that can contribute to a firm's performance. As pointed out by Sawyerr *et al.* (2003), the primary value of networks is the exchange of information. Advice and information on markets, production and policy obtained from networks are often useful, reliable and explicit

(Brüderl & Preisendörfer, 1998; Hoang & Antoncic, 2003; Koka & Prescott, 2008). Such information and advice are usually not easy to acquire via the market, and thus bring firms unique competitive advantages (Aldrich & Zimmer, 1986; Ostgaard & Birley, 1996; Sawyerr *et al.*, 2003; Witt, 2004).

In China, a network is embedded in Chinese culture. A network is referred to as '*guanxi*' in Chinese, which can be directly translated into 'relationships' or 'connections'. As a special Chinese form of social capital (Batjargal & Liu, 2004; Lee & Anderson, 2007), *guanxi* has been a part of Chinese life and philosophy and originated from ancient Confucianism some 5,000 years ago (Park & Luo, 2001; Luo *et al.*, 2012). *Guanxi* is a cultural phenomenon in China and basically exists everywhere in Chinese life, social interactions and, of course, economic activities due to its culturally embedded nature. As stated by Luo (2000), *guanxi* has become the lifeblood of economic activities in Chinese society. The relationships of networks with firm performance are expected to be more significant in emerging economies such as China, which is plagued by corruption, constraints in accessing resources and poorly developed legal and market systems (Biggs & Shah, 2006; Talavera *et al.*, 2012). As a result of its less developed formal institutional frameworks for businesses, such as the capital market and legal system, firms usually cannot get efficient institutional support and need to use informal networks (*guanxi*) as alternatives (Xin & Pearce, 1996; Li & Zhang, 2007; Stam *et al.*, 2014). Empirically, Zhao and Aram (1995) found that entrepreneurs in high-growth businesses used more and deeper networks than those in low-growth firms in China. The intensity and range of an entrepreneur's *guanxi* has also been confirmed to have a positive relationship with SMEs' profitability, growth and market performance in China's economic zones (Ge *et al.*, 2009).

In contrast to western studies which pay more attention to inter-firm *guanxi*, an entrepreneur's connections with government or the Communist Party are particularly important in China due to highly controlled markets (Qian *et al.*, 2010). In the special context of China, an entrepreneur's *guanxi* is commonly studied from two aspects: (1) political connections with the government and Communist Party, and (2) business connections with decision makers in other businesses and institutions (Luo & Chen, 1997; Park & Luo, 2001).



On the one hand, political connections represent a special social network with the state and its agents (Zhou, 2013), including local and state government and regulatory and supporting organisations (Peng & Luo, 2000; Li *et al.*, 2009). In less-developed transitional economies such as that of China, political connections could be a fundamental network and a common phenomenon because resource allocations are still constrained by a state regulatory regime (Faccio, 2006; Wu *et al.*, 2012), leading to an ‘institutional void’ (Khanna & Palepu, 1997; Miller *et al.*, 2009). As stated by Luo (2000), despite major reforms in the past thirty years, bureaucrats still occupy a central position in approving projects and allocating resources. In this context, political connection can help to secure property rights, access information on policies, scarce capital, land licenses and distribution channels, and to overcome the lending bias of China’s banks, heavy government regulations, and extra fees and reduce uncertainty in the market (Peng & Luo, 2000; Gu *et al.*, 2008; Li *et al.*, 2009; Du & Girma, 2010). It can enable firms to achieve an advantageous position or reduce existing barriers. This is especially the case for private SMEs in China because of the more serious barriers and more limited institutional support they face compared to their large state-owned counterparts (Li *et al.*, 2008b; Wu *et al.*, 2012). Hence, a large number of entrepreneurs running private enterprises would like to enter politics and wear a ‘red hat’ in order to link themselves with government officials to ensure better performance (Li *et al.*, 2006; Du & Girma, 2010). In a study of 400 private firms in China, Peng and Luo (2000) found that the political connections of an entrepreneur can significantly increase a firm’s market share and ROA. Using China private enterprises survey data, Li *et al.* (2008a) found that politically connected entrepreneurs accessed more loans and had higher ROE. Politically connected entrepreneurs were also found to enjoy a higher level of growth based on a study of 128 private firms in central China (Park & Luo, 2001), and a study of 106,000 private firms that entered the market between 1999 and 2004 in China (Du & Girma, 2010).

Moreover, compared with developed economies, business connections make a greater contribution to firm development in China (Peng & Luo, 2000). Because of the less-developed legal and market system an entrepreneur’s connections with entrepreneurs and managers in other businesses, including suppliers, customers and competitors, can play a significant role in accessing scarce productive resources. As stated by Lin *et al.* (2001), Chinese entrepreneurs with more outside business connections, especially connections

with suppliers, can occupy a larger number of channels through which to obtain scarce productive resources, quality materials and superior services which cannot be easily acquired in the market (Li *et al.*, 2009; Qian *et al.*, 2010; Luo *et al.*, 2012). Also, the impact of business connections on obtaining advice and faster access to ‘insider information’ through inter-personal information exchange is quite obvious in China (Carlisle & Flynn, 2005; Li *et al.*, 2009; Chang, 2011). Moreover, less-developed financial markets generate a barrier for SMEs to access finance. But an entrepreneur’s business connections can help firms to get access to scarce financial capital because of the credit worthiness and trust brought by them. According to Talavera *et al.* (2012), entrepreneurs who are business association members could enjoy a 9.6 per cent higher possibility of getting loans from commercial banks in the Chinese private sector. Due to these benefits brought by business connections, it is found that entrepreneurs with business connections can enjoy a better firm performance, as measured by market share and ROA (Peng & Luo, 2000), firm growth (Park & Luo, 2001) and return on asset value (Li *et al.*, 2009).

However, some authors have noted that the significance of *guanxi*, especially political connections, has been declining in China in recent years due to China’s continuous economic and institutional reforms (Guthrie, 1998; Law *et al.*, 2003; Gu *et al.*, 2008). As pointed out by Gold *et al.* (2002), China’s gradual institutional reforms in the last thirty years have led to a better business environment that has fundamentally changed the significance of *guanxi* in firm operations. At the 17<sup>th</sup> National Congress held in 2007, China decided to change the role of government from controlling the market to serving the market, which gives more power to the market in terms of resource allocation (State Council, 2015a). Moreover, the ‘Regulation of the People’s Republic of China on the Disclosure of Government Information’ was implemented in 2007 with the aim of opening government regulatory information to the public. Since then, individuals and firms have been able to gain access to government information easily through the internet instead of through social networks. With improved institutional functions and a gradually mature market, the significance of *guanxi* to firm performance is expected to decline and perhaps even eventually disappear, calling for evidence from empirical studies using data after 2007 (Zhang & Keh, 2010; Luo *et al.*, 2012). Moreover, to date, empirical studies on social networks (*guanxi*) and firm performance relationships have mainly focused on

a firm's growth and financial performance. Research on the relationship of social networks with a firm's economic performance, specifically technical efficiency, still remains absent. Stam *et al.* (2014) reviewed 61 studies and found that none of them linked an entrepreneur's social networks to small firm productivity or technical efficiency. Therefore, whether social networks can lead to a higher level of efficiency in using resources, or only increases the availability of scarce resources, remains an open question. This study will fill these gaps by testing the following hypotheses in Chapter 7 using the latest data available in China:

*H<sub>8</sub>: Politically connected entrepreneurs operate firms with a higher technical efficiency level than their non-connected counterparts.*

*H<sub>9</sub>: Business connected entrepreneurs operate firms with a higher technical efficiency level than their non-connected counterparts.*

**Table 4.5 Selected literature on the entrepreneur experience-firm performance relationship**

Experience	Relationship	Literature	Country	Indicators
Management	+*	Stuart and Abetti (1990)	U.S.	revenue growth, performance growth, profitability, productivity
		Bosma <i>et al.</i> (2004)	Netherlands	survival rate, profit, employment
		Gokcekus <i>et al.</i> (2001)	Ghana	technical efficiency
	insig.	Brüderl and Preisendörfer (1998)	German	survival, employment growth, sales growth
		Cooper <i>et al.</i> (1994)	U.S.	marginal survival, growth
		Alvarez and Crespi (2003)	Chile	technical efficiency
Start-up	+*	Dahlqvist <i>et al.</i> (2000)	Sweden	marginal survival, growth, profitability
		Bosma <i>et al.</i> (2004)	Netherlands	Profit
		Haber and Reichel (2007)	Israel	Revenues
	insig.	Brüderl <i>et al.</i> (1992)	German	Survival
		Haber and Reichel (2007)	Israel	profitability, employee numbers, growth
		Dahl and Reichstein (2007)	Denmark	Survival
Technical staff	+*	Bayus and Agarwal (2007)	U.S.	Survival
	insig.	Stuart and Abetti (1990)	U.S.	growth, profitability, productivity

Source: Author's summary.

Notes: +\* denotes a positive and significant relationship; insig. denotes an insignificant relationship.

In general, according to the literature reviewed in Section 4.6, entrepreneurial factors are expected to play significant roles in firm performance, but the relationships of comprehensive entrepreneurial factors with a firm's technical efficiency have not been studied comprehensively in the special context of China. This needs to be empirically estimated to identify what entrepreneurial factors can imply a good quality entrepreneur and improve a firm's efficiency performance. Providing empirical evidence on this can facilitate efficient policies to promote more quality entrepreneurs and an improvement in the performance of entrepreneurial SMEs in China's manufacturing sector. This is significant for the success of the 'Innovation-driven Country 2020', 'Manufacturing 2025' and 'Mass Entrepreneurship and Innovation' programs. In studying the relationship of entrepreneurial factors with technical efficiency, other factors must also be considered including firm factors and external factors, which are discussed in the following section.

## **4.7 Relationships of external and firm factors with firm technical efficiency**

Although this research focuses on studying the relationship between entrepreneurial factors and technical efficiency for private manufacturing SMEs in China, we should note that other firm-specific factors and external firm factors can also have significant relationship with the technical efficiency of SMEs as shown in Table 4.2 and Figure 4.5. The potential relationship of each factor with a firm's technical efficiency is briefly discussed in the following.

### **4.7.1 The relationships of internal firm factors with a firm's technical efficiency**

In post-entry technical efficiency performance, various firm-specific internal factors can have a big influence. Examples of these factors can include a firm's size, age, export intensity, credit access and R&D effort as listed in Figure 4.5.

#### **4.7.1.1 Size**

Firm size can have positive relationship with efficient production efficiency, mainly because larger firms can usually take advantage of scale economies in manufacturing sectors, leading to a higher technical efficiency level (Page, 1984; Alvarez & Crespi, 2003;

Diaz & Sanchez, 2008). Larger firms can also have more access to finance and ability to invest in efficiency increasing activities or updating to more efficient technology. According to Page (1984), smaller firms are found to apply older and cheaper equipment in production, which are less efficient. However, smaller firms can also have the potential to produce more efficiently than relatively larger ones. They can be more flexible in adjusting to more efficient activities and processes (Yang & Chen, 2009). Smaller firms may suffer less from bureaucratic problems, workers' lack of motivation and difficulty in monitoring employees (Diaz & Sanchez, 2008). Due to the potential of both positive and negative relationships with a firm's technical efficiency, empirical findings on the size-technical efficiency relationship of SMEs have produced mixed results. Most studies provide evidence of an advantage for larger firms in productive efficiency, such as for the cases of Chile (Alvarez & Crespi, 2003) and Thailand (Charoenrat & Harvie, 2014). But research on SMEs in Vietnam by Le and Harvie (2010) found that larger SMEs could actually produce less efficiently. In China, whether smaller SMEs produce with lower technical efficiency is questionable. This research will test the following hypothesis in Chapter 7:

*H<sub>10</sub>: Larger sized SMEs produce with a higher technical efficiency level than their smaller counterparts.*

#### 4.7.1.2 Age

The age of a firm can have a positive relationship with the technical efficiency level through a learning by doing process, because older firms can accumulate more knowledge, in daily production experiences, about their optimally efficient scale and how to produce more efficiently (Joskow & Rozanski, 1979; Mester, 1996; Admassie & Matambalya, 2002; Aggrey *et al.*, 2010). However, contrary to the view of a positive relationship of a firm's age, Tran *et al.* (2008) argued that older firms are more likely to employ older and less efficient equipment. This may be due to the fact that older firms with already marketed products over a long period would face higher costs to scrap their old production, such that they are more 'locked into' their technology and find it more difficult to adopt new technology than younger firms (Admassie & Matambalya, 2002). Accordingly, younger firms can adopt more advanced equipment and technology and thus produce more efficiently. Empirical results on SMEs have shown mixed results on the relationship of a firm's age with its technical efficiency. While Le and Harvie (2010) showed younger

SMEs in Vietnam can produce more efficiently, other studies have found higher technical efficiency levels for older SMEs (e.g. Tan & Batra, 1995; Charoenrat & Harvie, 2014). Nowadays, entrepreneurial new ventures are highly encouraged in China because they can generate more innovation and new technology. Therefore, whether the younger SMEs are necessarily less efficient should be examined in the current Chinese context, in order to make appropriate policies to support these new ventures. The following hypothesis is proposed and tested in Chapter 7:

*H<sub>11</sub>: Older SMEs produce with a higher technical efficiency level than their younger counterparts.*

#### 4.7.1.3 Exporting

Many researchers have found that exporting firms can be more productive and efficient than non-exporting ones (Clerides *et al.*, 1998; Liu *et al.*, 1999; Blalock & Gertler, 2004; Girma *et al.*, 2004; Van Biesebroeck, 2005; De Loecker, 2007; Cassiman *et al.*, 2010). Export orientation can potentially improve a firm's technical efficiency directly through a learning by exporting process from their foreign customers and indirectly from greater competition in foreign markets (Evenson & Westphal, 1995; Clerides *et al.*, 1998; Blalock & Gertler, 2004). Exporting firms can access the latest product designs, production knowledge and technologies transmitted from foreign customers and technical assistance provided from international buyers (Rhee *et al.*, 1984; Keesing & Lall, 1992; Tan & Batra, 1995; Salomon & Jin, 2008; Martins & Yang, 2009). In this way, firms can learn more about technology, skills and knowledge to produce more efficiently from exporting to foreign markets. Moreover, it is common that export markets are more competitive (Blalock & Gertler, 2004; Fu, 2005). Exporting firms which are exposed to intense competition in foreign markets may be forced to increase their product quality and production efficiency in order to catch up to international standards and survive and compete in foreign markets (Egan & Mody, 1992; Clerides *et al.*, 1998; Kimura & Kiyota, 2007). Empirically, the firm-level positive relationships of exporting with SME technical efficiency has been shown by Tan and Batra (1995) in all six countries in their sample. This is consistent with the study conducted by Charoenrat and Harvie (2014) on Thai SMEs. They found that SMEs with export activities have a significantly higher technical efficiency level than their non-export counterparts. Since the introduction of the reform and open-door economy policy, China has experienced a dramatic increase in exports. As

pointed out by Fu (2005), China is a special and valuable case to study the export activities of firms due to its transitional economy, increasing economic openness and export growth. But whether export involvement can have relationship with the technical efficiency level of SMEs has not been studied in China. This research fills this gap by testing the following hypothesis in Chapter 7:

*H<sub>12</sub>: SMEs with more export density produce with a higher level of technical efficiency than their counterparts with limited or no export activities.*

#### 4.7.1.4 Access to credit

Considering a firm's physical capital, access to finance can be another important factor in determining the technical efficiency of SMEs. In many countries, especially emerging economies, access to finance is the biggest constraint on the development of SMEs (Beck & Demirguc-Kunt, 2006; Beck, 2007). SMEs with more financial embodied capital can make investments in advanced technology and equipment and labour services aimed at improving productivity (Levine, 1997; Heino & Pagán, 2001; Bloom *et al.*, 2010). Moreover, when firms have access to finance from formal financial institutions, such as banks, the allocation of obtained bank loans and performance of the firm would be closely monitored, leading to a higher technical efficiency level (Agarwal & Elston, 2001; Levine, 2005). Also, formal institutions can offer longer term loans than informal sources such as family and friends, and, therefore, enable long-term investment in efficiency enhancing activities (Hernández-Trillo *et al.*, 2005). Therefore, SMEs with more access to finance, especially credit, are expected to produce more efficiently. As shown by Amornkitvikai and Harvie (2011), firms with more external finance will enjoy a significantly higher technical efficiency level in Thailand. In China, SMEs experience severe obstacles in gaining access to finance due to under-developed financial markets (Wang, 2004; Xiao, 2011), but the relationship of access to credit with the technical efficiency of SMEs has not been identified in China. Hence there is a lack of empirical evidence relating to the implementation of effective policies concerning SME financing. This research fills this gap by testing the following hypothesis in Chapter 7:

*H<sub>13</sub>: SMEs with more access to credit produce with a higher technical efficiency level than their credit constrained counterparts.*

#### 4.7.1.5 Research and Development (R&D) activities

Innovation activity has been widely regarded as the key source of firm success and survival (Gopalakrishnan & Damanpour, 1997; Jiménez-Jiménez & Sanz-Valle, 2011; Rosenbusch *et al.*, 2011). Innovativeness is a fundamental instrument of firms to gain sustainable growth and competitive advantage in an increasingly changing environment (Drucker, 1985; Artz *et al.*, 2010; Gunday *et al.*, 2011; Standing & Kiniti, 2011; Atalay *et al.*, 2013). There has been a vast number of empirical studies confirming the positive relationship of innovation with firm performance (Klomp & Van Leeuwen, 2001; Calantone *et al.*, 2002; Thornhill, 2006; Jiménez-Jiménez & Sanz-Valle, 2011; Rosenbusch *et al.*, 2011), especially technological innovations including product innovation and process innovation (Atalay *et al.*, 2013). The most important input into the innovation process is investment in R&D activities (Klomp & Van Leeuwen, 2001). R&D enables a firm to increase its stock of knowledge required in product and process innovation (Hall *et al.*, 1986; Kemp *et al.*, 2003; Huergo & Jaumandreu, 2004b; Artz *et al.*, 2010). Therefore, as shown by many empirical studies, R&D expenditure can have a positive relationship with a firm's innovative capability and thus is a key source of productivity and efficiency growth (Griliches, 1998; Artz *et al.*, 2010). Moreover, the related knowledge obtained by engaging in R&D improves the reorganisation and absorption of new tacit knowledge in a certain technological field, thereby improving a firm's absorptive capacity (Cohen & Levinthal, 1989; 1990; Griffith *et al.*, 2003; 2004; Leahy & Neary, 2007). With a higher absorptive capacity, firms can adopt externally created new technology/knowledge more easily, which helps them to enjoy a higher technical efficiency level (Jaffe, 1986; Geroski, 1993; Griffith *et al.*, 2004). A study by Li and Hu (2013) of SMEs in Taiwan showed that a significantly higher technical efficiency level can be achieved by SMEs with more R&D expenditure. A positive relationship between R&D expenditure and SMEs' technical efficiency is also found in some other developing countries, such as Malaysia (Noor *et al.*, 2014), Indonesia and Mexico (Tan & Batra, 1995). However, this relationship has not been identified in China as yet. Currently in China, transition in the manufacturing sector has resulted in SMEs placing a significantly higher importance on R&D than ever before. However, as pointed out by Tan and Batra (1995), SMEs in less developed countries usually lack the capability to invest in R&D activities, and thus need special support by government. This research



examines the relationship between R&D expenditure and SME technical efficiency in China's manufacturing sector based upon testing the following hypothesis in Chapter 7:

*H<sub>14</sub>: SMEs with more investment in R&D activities produce with a higher technical efficiency level than their less R&D intensive counterparts.*

#### **4.7.2 The relationship of external firm factors with a firm's technical efficiency**

Studies on the determinants of an SMEs' technical efficiency usually utilise a firm's location and industry as external factors to reflect the environment in which a firm is operating (Caves, 1992). The significant relationship of production location with the productive efficiency level of a firm has been identified by many researchers (e.g. Hill & Kalirajan, 1993; Gumbau-Albert & Maudos, 2002; Sherlund *et al.*, 2002; Söderbom & Teal, 2004; Romano & Guerrini, 2011). Based on the ideas of Marshall (1890), closely located firms can usually benefit from each other from better supply networks, supply of specialised labour, transport links, and spillover of information and knowledge, which can create agglomeration economies (Venables, 2010; Fujita & Thisse, 2013). Therefore, in a region with a higher agglomeration level, firms can enjoy these benefits and thus a higher technical efficiency level (Mitra, 1999; Gumbau-Albert & Maudos, 2002; Charoenrat & Harvie, 2014). Moreover, agglomeration also benefits the tacit knowledge transmission process. As pointed out by Audretsch (1998), tacit knowledge is difficult to codify and the marginal cost of transmitting tacit knowledge rises with distance. Therefore, firms in a region with more innovative and experienced firms can gain access to advanced technologies and valuable knowledge in order to produce more efficiently. As well, the development of infrastructure and services in a firm's located region can also influence the efficient use of inputs in production, especially in emerging economies with a large regional disparity (Mitra, 1999; Bhandari & Ray, 2012). Many studies have proved that SMEs located in more developed regions in emerging economies are more efficient because flourishing regions have more competition and great market opportunity, such as in Vietnam (Tran *et al.*, 2008; Le & Harvie, 2010) and Thailand (Charoenrat & Harvie, 2014). In China, the significant regional inequality in economic development levels implies the likely significance of location to firm performance. According to the All-China Federation of Industry and Commerce (2017), more than 60 per cent of private enterprises are located in the most developed eastern regions, providing a higher firm agglomeration level. Moreover, inter-provincial skilled-labour migration has led to a

higher human capital agglomeration level in eastern regions because of more job opportunities and higher wage levels in these areas (Fu & Gabriel, 2012). This study examines the technical efficiency difference of private manufacturing SMEs in eastern and non-eastern regions of China by testing the following hypothesis in Chapter 7:

*H<sub>15</sub>: Entrepreneurial SMEs located in the eastern regions of China produce with a higher technical efficiency level than their non-eastern counterparts.*

The relationship of industry sector with the firm-level technical efficiency of SMEs has also been shown to be significant because every industry sector or sub-sector has its own minimum efficient scale and different policy preferences for each industry (Wu, 1995; Alvarez & Crespi, 2003; Le & Harvie, 2010). This thesis focuses on SMEs in the manufacturing sector of China, but, unfortunately, information on the subsectors of SMEs in the sample are not available. Therefore, the industry sector is not included as a potential determinant in this study, which results in a limitation of this research. Based on the hypotheses proposed in this chapter, this thesis provides empirical evidence concerning the relationships of entrepreneurial, internal firm-specific and external factors with private SMEs' technical efficiency in the Chinese manufacturing sector. It aims to give a comprehensive picture of the determinants of private SMEs' technical efficiency. This will assist the Chinese government in making effective policies to support the development of entrepreneurial activities and SMEs, in order to obtain a sustainable competitive advantage for China's manufacturing sector. The methodology utilised to estimate technical efficiency scores and identify the determinants of technical efficiency in eastern and non-eastern regions is introduced in the next chapter.

## **4.8 Summary**

This chapter has, firstly, reviewed the significance of entrepreneurial activities to economic growth. By introducing new entrants and new ideas into the market, entrepreneurs can spill over knowledge and commercialise innovation, and also create competition and diversity in the market and thus lead to sustainable economic growth (Wennekers & Thurik, 1999; Acs *et al.*, 2004; Audretsch & Keilbach, 2004; Carree & Thurik, 2010; Acs *et al.*, 2013). As the majority of entrepreneurial firms are SMEs (Acs

*et al.*, 1999; Taymaz, 2005), the significance of SMEs has also been identified, especially from employing disadvantaged groups and, thus, contributing to inclusive economic growth (Acs, 1999; OECD, 2005; ADB, 2012; Charoenrat *et al.*, 2013). Therefore, entrepreneurship and SMEs are regarded as being at the heart of economic development (Porter, 1990; Carree & Thurik, 2003; Carayannis & von Zedtwitz, 2005).

However, cross-country studies have found that entrepreneurial activities do not lead to economic growth in some less developed countries because of their necessity-driven nature and low quality (Van Stel *et al.*, 2005; Wong *et al.*, 2005; Valliere & Peterson, 2009; Wennekers *et al.*, 2010; Mason & Brown, 2013). Due to the low survival rate of new entrants (Hall, 1987; Honjo, 2000; Santarelli & Vivarelli, 2007), entrepreneurs with less motivation and capability cannot have a good post-entry performance and exit the market quickly (Fritsch & Schroeter, 2009; Shane, 2009; Fritsch & Schroeter, 2011; Mason & Brown, 2013; Vivarelli, 2013). Only a small number of new SME entrants that are created by high-quality entrepreneurs have a better post-entry performance, especially efficiency performance, which enables them to survive and develop (Jovanovic, 1982; Evans, 1987; Almus, 2000; Lotti *et al.*, 2009; Teruel-Carrizosa, 2010; Audretsch, 2012; Vivarelli, 2013). It is these SMEs that generate real innovation, competition and diversity and thus lead to sustainable economic growth (Vivarelli, 2007; 2013). In determining the post-entry performance of entrepreneurial new entrants, the quality characteristics of entrepreneurs can play a significant role (Storey, 1994; Pena, 2004; Vivarelli, 2007; Ganotakis, 2012). Thus, recent studies linking entrepreneurial activities to economic growth have changed focus from quantity to quality (Piergiovanni & Santarelli, 2006; Shane, 2009). In emerging economies like China, the less developed institutional environment has restricted the development of high-quality entrepreneurial activities (Ardagna & Lusardi, 2010; Lu & Tao, 2010; Puffer *et al.*, 2010). Therefore, in the current transitional stage of China's manufacturing sector, improving the performance of entrepreneurial enterprises and the quality of entrepreneurs is now of crucial importance in order to drive sustainable economic development by better performed entrepreneurial activities.

In estimating firm performance in the context of SMEs, technical efficiency, reflecting the efficiency in transferring output into inputs (Farrell, 1957), has become a contemporary economic firm performance measure. It is the foundation of a firm's

survival and growth, especially for SMEs with limited resources in less-developed countries, and can also reflect static productivity growth (Jovanovic, 1982; Cooper et al., 2000; Coelli et al., 2005). The firm-level technical efficiency performance of SMEs has been estimated in many emerging economies, such as Thailand (Charoenrat & Harvie, 2014), Vietnam (Minh *et al.*, 2007) and Kenya (Lundvall & Battese, 2000), showing the inefficiency of SMEs in these countries. However, a firm-level technical efficiency estimation for SMEs located in the whole of China is still absent. The only study covering SMEs in all regions of China, by Xu and Song (2013), utilised provincial data, which is believed to be less accurate in China's statistical system (Rawski & Xiao, 2001; Brandt *et al.*, 2014). Also, the large regional disparity between China's eastern and non-eastern regions requires the estimation of technical efficiency relative to a metafrontier to enable a regional comparison (Battese *et al.*, 2004; O'Donnell *et al.*, 2008), which has not been applied before in the context of SMEs.

With insufficient estimation of the technical efficiency level of SMEs in China, its determinants have not yet been studied. In identifying the determinants of technical efficiency of entrepreneurial firms, entrepreneurial factors, together with external factors and internal firm-specific factors, need to be considered (Caves & Barton, 1990; Caves, 1992; Lovell, 1993; Pena, 2004; Vivarelli, 2013). But the existing literature has not built a comprehensive framework incorporating entrepreneurial factors, including start-up motivation, personal characteristics such as age, gender, education level, experience and personal networks including political and business connections, which is particularly significant in emerging economies with poor formal institutions such China (Park & Luo, 2001; Stam *et al.*, 2014). The start-up motivation of entrepreneurs can influence their innovation level and working effort (Leibenstein, 1966; Block & Wagner, 2010).

The age of the entrepreneur can also have both positive and negative relationships with a firm's technical efficiency as older entrepreneurs can have more knowledge through learning by doing (Bates, 1990; Shaw *et al.*, 2009), but have a lower level of advanced knowledge, cognitive ability and achievement motivation (Bates, 1990; Kropp *et al.*, 2008; Verheul & Mil, 2011). Female entrepreneurs are usually found to underperform arising from persistent discrimination in the labour market and financial capital access, and their potential for less work effort due to family-work conflicts in developing

countries (Kepler & Shane, 2007; Robb & Watson, 2012; Marlow & McAdam, 2013). Moreover, the education level and various experiences reflecting human capital accumulation can affect an entrepreneur's knowledge stock and skills level for producing efficiently (Becker, 1964; Cooper *et al.*, 1994; Shrader & Siegel, 2007; Unger *et al.*, 2011). Also, in the special context of China, the *guanxi* (network) of an entrepreneur, including business and political connections, can play a significant role in post-entry performance because it brings firms greater access to scarce resources, information and advice under a poorly developed legal and market system (Gu *et al.*, 2008; Li *et al.*, 2008; Qian *et al.*, 2010). In contemporary China, a large share of entrepreneurs are necessity-driven with a low motivation level and quality, and there are more younger and female entrepreneurs (GEM, 2018). Also, due to continuing market and government reforms the significance of *guanxi* in China has been declining (Gu *et al.*, 2008). These developments require more empirical evidence to identify the relationships of various entrepreneurial factors with private SMEs' technical efficiency in China using recent data, and this forms the focus of this thesis.

Besides entrepreneurial factors, this chapter also reviewed the relationship of internal firm factors including a firm's size, age, export intensity, access to credit and R&D effort and external firm factors as represented by location with the technical efficiency level of SMEs. Combining entrepreneurial, internal and external factors, this thesis provides a comprehensive framework for identifying the determinants of private SME technical efficiency in China's manufacturing sector as summarised in Figure 4.5. The empirical evidence obtained will assist the Chinese government to implement efficient policies aimed at improving entrepreneur quality and the technical efficiency performance of private SMEs, in order to achieve economic transition into the innovation-driven stage via entrepreneurial activities. Hypotheses on the relationship between each factor and SMEs' technical efficiency have been proposed in this chapter. The methodology used to empirically estimate the technical efficiency of private manufacturing SMEs and test these hypotheses in this research will be introduced in the next chapter.

## Chapter 5 Methodology

### 5.1 Introduction

This chapter provides an overview of the research methodology and analytical processes used for the purpose of estimating the scores and determinants of technical efficiency relative to a group-specific frontier, technology gap ratio and technical efficiency relative to the metafrontier for private manufacturing SMEs in both eastern and non-eastern regions of China. Based on Farrell's traditional production frontier and efficiency type measures, a metafrontier technique is proposed in order to allow a comparison of the technical efficiency level between groups using different technologies or in different business environments (Sharma & Leung, 2000; O'Donnell *et al.*, 2008). In China, private manufacturing SMEs in the more developed eastern regions are expected to have more advanced technology and a more developed business environment than SMEs in non-eastern regions. Thus, the metafrontier technique needs to be used to compare the technical efficiency level for SMEs located in eastern and non-eastern regions. Although the metafrontier technical efficiency has been estimated in different research areas (e.g. Battese *et al.*, 2004; Chen & Song, 2008; O'Donnell *et al.*, 2008; Lin & Du, 2013; Yao *et al.*, 2015), there are still no empirical studies applying the metafrontier technique to SMEs until now. This research fills this gap.

This chapter also introduces both parametric (SFA) and non-parametric approaches (DEA) to empirically estimate technical efficiency. Although both approaches have strengths and weaknesses (Hjalmarsson *et al.*, 1996; Mortimer & Peacock, 2002; Fried *et al.*, 2008; Andor & Hesse, 2014), the consideration of a random error, the estimation of marginal products, the appropriateness of output-orientation for the measurement of SME technical efficiency and the well-developed fully parametric stochastic metafrontier model, mean that the advantages of SFA outweigh its disadvantages in this research context (Murillo-Zamorano, 2004; Coelli *et al.*, 2005; Kumbhakar *et al.*, 2007; Fried *et al.*, 2008; Huang *et al.*, 2014). Therefore, the parametric SFA approach is chosen for estimating the metafrontier technical efficiency of private manufacturing SMEs in China. As a modification of the half-parametric stochastic meta-production function (SMF) model by Battese *et al.* (2004), Huang *et al.* (2014) developed a fully parametric SMF model by

constructing both group-specific frontiers and a metafrontier using a stochastic production function. Therefore, the group-specific technical efficiency, technology gap ratio, and metafrontier technical efficiency can be estimated with consideration of statistical noise (Chang *et al.*, 2015; Huang *et al.*, 2015). Another aim of this research is to identify the relationship of entrepreneurial, internal and external firm-specific factors with the variation of technical efficiency scores and technology gap ratios across firms. The technical efficiency effects model and technology gap effects model based on the one-stage SFA by Battese and Coelli (1995) are utilised to estimate the determinants of group-specific technical efficiency and technology gap ratio, while a Tobit regression is applied to estimate the determinants of metafrontier technical efficiency. This combined SMF-one-stage SFA-Tobit model has not been utilised in empirical estimation before. This research fills this gap.

This chapter is structured as follows. Section 5.2 introduces the Shephard distance function as the theoretical foundation for technical efficiency measurement, Farrell's traditional technical efficiency type measures, and measures for returns to scale and scale efficiency. The rationale behind the metafrontier estimations of group-specific technical efficiency, technology gap ratio and the metafrontier technical efficiency are discussed in Section 5.3. Section 5.4 introduces the traditional DEA and SFA models, their strengths and weaknesses and the reasons for choosing SFA in this research, while Section 5.5 introduces the fully parametric SMF model. Section 5.6 discusses the one stage-approach SFA technique and Tobit regression used for estimating determinants of technical efficiency and technology gap ratio levels. The summarised analytical process to be used in this research is shown at the end of this section. Section 5.7 provides a summary of the key findings from this chapter.

## **5.2 Traditional technical efficiency measurement**

Following the definition of technical efficiency given by Koopmans (1951), different techniques for its measurement have been subsequently developed. Farrell (1957), however, produced the most significant cornerstone work based on input and output distance functions initially proposed by Shephard (1953).

### 5.2.1 Shephard's input and output distance functions

The distance function technique was first proposed by Debreu (1951) and further developed by Shephard (1953; 1970). In the production process every decision-making unit uses a given technology to transform inputs into outputs. Let  $x \in R_+^N$  and  $y \in R_+^M$  denote the input sets with  $N \times 1$  input vectors and output sets with  $M \times 1$  output vectors respectively. The technology set used by a firm can be expressed by:

$$T = \{(x, y) : x \geq 0; y \geq 0; x \text{ can produce } y\} \quad (5.1)$$

Technology set  $T$  is assumed to be a closed set that contains all input-output combinations. The output set of all output vectors  $y$  and the input set of all input vectors associated with  $T$  are defined respectively as:

$$\text{For any input vector } x, P(x) = \{y : (x, y) \in T\} \quad (5.2)$$

$$\text{For any output vector } y, L(y) = \{x : (x, y) \in T\} \quad (5.3)$$

Then the output and input distance functions introduced by Shephard (1970) are defined on the output set  $P(x)$  and input set  $L(y)$  respectively as:

$$D_{output}(x, y) = \inf_{\theta} \{\theta > 0 : (y/\theta) \in P(x)\}; \quad (5.4)$$

$$D_{input}(x, y) = \sup_{\lambda} \{\lambda > 0 : (x/\lambda) \in L(y)\}. \quad (5.5)$$

Shephard's input and output distance functions allow the characterisation of all kinds of multi-input, multi-output technologies that can be used by firms, and show the distance of each producer to the optimal resource utilisation level (efficient technology) and, thereby, provide the conceptual underpinning for productivity and efficiency measures development (Färe *et al.*, 1994; Coelli *et al.*, 2005; Daraio & Simar, 2007; Fried *et al.*, 2008). Within these measures, the most significant development was made by Farrell (1957) based on Shepard's distance function.

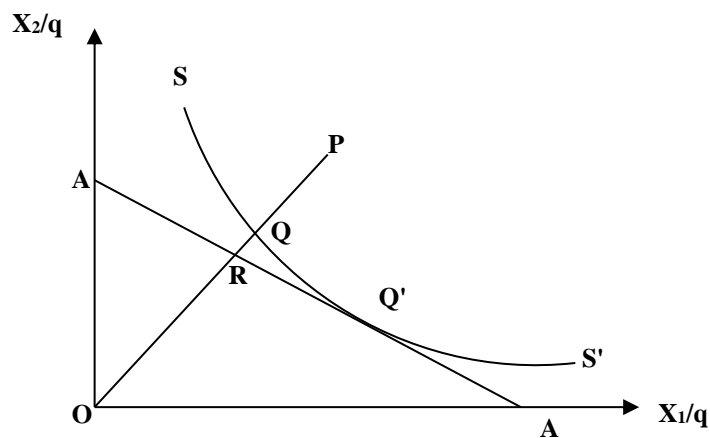
### 5.2.2 Farrell's efficiency measure by input- and output-orientation

After the efficiency definition given by Koopmans (1951), a later study by Debreu (1951) proposed a measure of technical efficiency based on the producer's coefficient of resource utilisation (Briec, 1997). Following Koopmans (1951) and Debreu (1951), Farrell (1957) proposed that the efficiency of a decision-making unit can be decomposed into technical



efficiency and allocative efficiency (Coelli *et al.*, 2005; Fried *et al.*, 2008; Färe *et al.*, 2013). While technical efficiency shows the capability of a firm to transfer inputs into outputs, allocative efficiency reflects the ability of a firm to use optimal proportions of inputs given technology and the prices of inputs (Coelli *et al.*, 2005). The original technical efficiency measure proposed by Farrell (1957) was input-orientated. Assuming constant returns to scale (CRS), input-orientated technical efficiency with two inputs can be shown as in Figure 5.1.

**Figure 5.1 Farrell’s technical efficiency measure (input-orientation)**



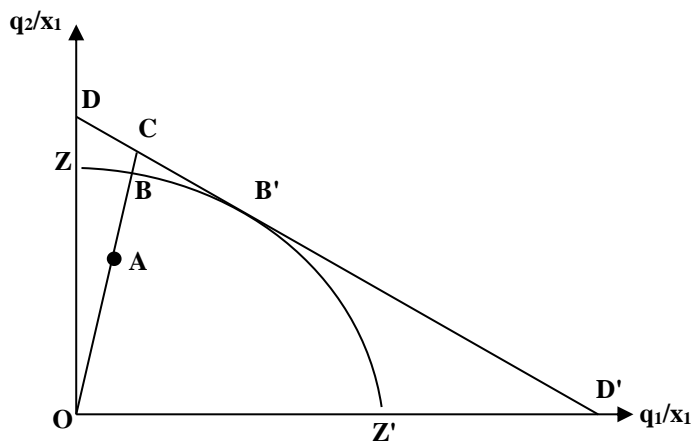
Source: Coelli *et al.* (2005, p. 52).

Figure 5.1 shows a firm producing at point  $P$  using two factors  $x_1$  and  $x_2$  to produce a single output  $q$ . The minimum combination of inputs that can produce  $q$  is represented by the isoquant-line  $SS'$ . All production points on  $SS'$  are considered to be technically efficient, such as at point  $Q$  and  $Q'$  in Figure 5.1, while the production points located above  $SS'$  are technically inefficient because they can reduce their inputs to produce the same amount of outputs. For example, a firm producing at point  $P$  can reduce its inputs  $OP$  to  $OQ$  without changing its output level. The input-oriented technical efficiency of point  $P$  can be defined as  $TE_{input} = OQ/OP = 1 - QP/OP$ .

This input-oriented technical efficiency is equivalent to the reciprocal of Shephard’s input distance function:  $TE_{input} = OQ/OP = 1/D_{input}(x, y)$  (Färe & Lovell, 1978). Besides input-orientation the technical efficiency of a firm can also be estimated using output-orientation. Farrell suggested that the technical efficiency of a firm can be defined in two ways: ‘as the ratio of technically minimal to actual inputs, given output and the input mix,

or as the ratio of actual to technically maximum output, given inputs' (Färe & Lovell, 1978, p. 150). The Farrell type output-orientated efficiency measure with two outputs and a single input is shown in Figure 5.2, in which  $ZZ'$  and  $DD'$  denote the unit production possibility curve and output price line respectively. Point  $A$ , producing below  $ZZ'$ , is defined to be technically inefficient while points  $B$  and  $B'$  are technically efficient. The output-orientated technical efficiency at point  $A$  is defined as  $TE_{output} = OA/OB = D_{output}(x, y)$  (Färe & Lovell, 1978).

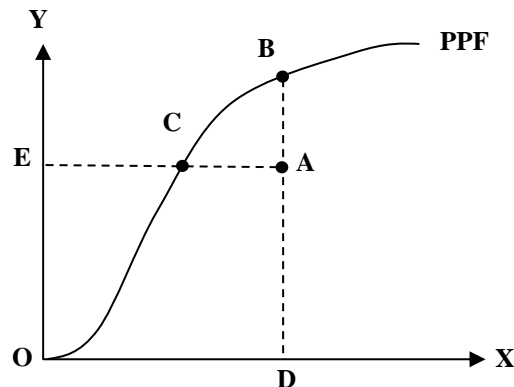
**Figure 5.2 Farrell's technical efficiency measure (output-orientation)**



Source: Coelli *et al.* (2005, p. 52).

The input-orientated and output-orientated technical efficiencies can be estimated simultaneously using a production possibility frontier (PPF), which is shown in Figure 5.3 for the case of single-input and single-output production.

**Figure 5.3 Production possibility frontier and technical efficiency**



Source: Coelli *et al.* (2005, p. 4).

The PPF illustrates the maximum output that can be produced from given inputs or the minimum input that is possible to produce a given output. All the production points on

the PPF are defined to be technically efficient (e.g.  $B$  and  $C$ ), while points lying below the PPF (e.g.  $A$ ) are producing technically inefficiently. The input-orientated and output-orientated technical efficiencies of a firm producing at point  $A$  can be estimated as (see Coelli *et al.*, 2005):

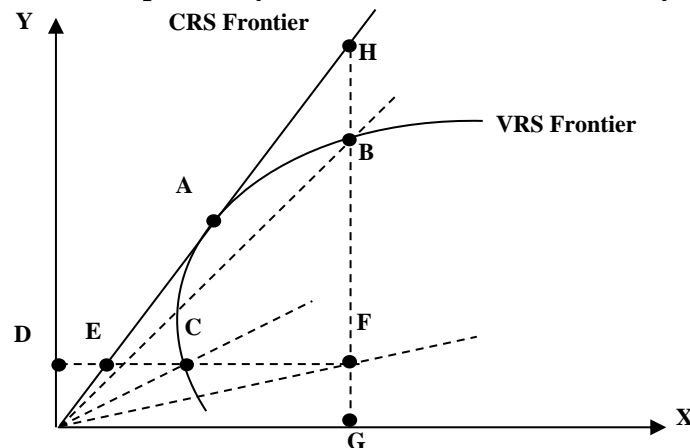
$$TE_{input} = EC / EA = 1 / D_{input}(x_A, y_A) \text{ and} \quad (5.6)$$

$$TE_{output} = DA / DB = D_{output}(x_A, y_A). \quad (5.7)$$

### 5.2.3 Return to scale and scale efficiency

Farrell's original technical efficiency measure was developed assuming constant returns to scale (CRS) technology. However, in real production, it is possible that a firm is technically efficient but still not at the most optimal size of operation, which is referred to as scale inefficiency (Coelli *et al.*, 2005; Amornkitvikai & Harvie, 2011). A firm may adopt an inefficient small scale, such that it is operating with increasing returns to scale (IRS), or operate with decreasing return to scale (DRS) if its production scale is too large (Färe *et al.*, 1994). This implies that technical efficiency can be estimated assuming either CRS or variable returns to scale (VRS), relaxing Farrell's CRS assumption. A simple single-input and single-output case is shown in Figure 5.4.

**Figure 5.4 Production possibility frontier and technical efficiency**



Source: Balk (2001) ; Coelli *et al.* (2005, pp. 55, 59, 61).

A firm producing on the CRS frontier (at either point  $A$  or point  $E$  in Figure 5.4) is both technically and scale efficient. Production on the VRS frontier (at points  $A$ ,  $B$  and  $C$ ) is productive efficient but scale inefficient. Point  $F$ , which is producing below the CRS and VRS frontiers, is both productive and scale inefficient. The input-orientated technical

efficiency levels of  $F$  with respect to the CRS and VRS frontiers are defined as  $TE_{input,CRS} = DE / DF$  and  $TE_{input,VRS} = DC / DF$  respectively. The input-orientated scale efficiency of  $F$  can be calculated by (see Coelli *et al.*, 2005; Fried *et al.*, 2008):

$$SE_{input} = \frac{D_{input}(x, y|CRS)}{D_{input}(x, y|VRS)} = \frac{TE_{input,CRS}}{TE_{input,VRS}} = \frac{DE}{DF} / \frac{DC}{DF} = \frac{DE}{DC} \quad (5.8)$$

Alternatively, the output-orientated technical efficiency levels of  $F$  with respect to the CRS and VRS frontiers are  $TE_{output,CRS} = GF / GH$  and  $TE_{output,VRS} = GF / GB$ . In this case, the output-orientated scale efficiency is defined as (Färe *et al.*, 1994; Balk, 2001):

$$SE_{output} = \frac{D_{output}(x, y|CRS)}{D_{output}(x, y|VRS)} = \frac{TE_{output,CRS}}{TE_{output,VRS}} = \frac{GF}{GH} / \frac{GF}{GB} = \frac{GB}{GH} \quad (5.9)$$

Equations (5.8) and (5.9) show that input and output-orientated technical efficiency measures are only equivalent when the technology has constant returns to scale.

Based on the traditional technical efficiency measure proposed by Farrell (1957), many new measures have been developed such as graph-oriented technical efficiency relaxing the input and output orientation assumption (Briec, 1997; Färe *et al.*, 2002; Cuesta & Zofío, 2005) and technical efficiency relative to a metafrontier allowing a comparison between production units under different technology sets (Battese *et al.*, 2004; O'Donnell *et al.*, 2008). The metafrontier technical efficiency measure is particularly applicable in estimation across industries and across regions with uneven development. As discussed in Chapter 2, China still experiences severe regional disparity between eastern and non-eastern provinces, requiring an estimation of metafrontier technical efficiency to enable a regional comparison. The metafrontier technique has been utilised to estimate and compare regional technical efficiency for China's agriculture (Chen & Song, 2008) and energy consumption (e.g. Lin & Du, 2013; Yao *et al.*, 2015), but has not been applied for an analysis of SMEs. Therefore, this research estimates technical efficiency relative to group frontiers and the metafrontier for China's SMEs located in eastern and non-eastern provinces, respectively, to fill this gap. The methodology of technical efficiency relative to a metafrontier is discussed in the following section.

### 5.3 Technical efficiency estimation under the metafrontier

Traditional technical efficiency measures assume that firms in the sample are all using the same technology and have the same production possibility frontier. However, firms operating in different business environments may use different technologies. Although firms can choose any input-output combination freely, many factors can force them to produce under restricted technologies due to the availability and quality of physical, human and financial capital, resource endowments, ownership type and infrastructures (Sharma & Leung, 2000; O'Donnell *et al.*, 2008). In the case where firms in the sample are using different technologies, inchoate research has commonly estimated the technical efficiency levels of different groups respectively and then compared these across groups (e.g. Batra & Tan, 2003; McMillan & Chan, 2006; Worthington & Lee, 2008; Le & Harvie, 2010; Charoenrat & Harvie, 2013). However, as stated by O'Donnell *et al.* (2008), it is a general rule that comparing efficiency levels measured relative to different frontiers is meaningless. Therefore, although the traditional technical efficiency estimation technique can measure the relative technical efficiency performance of firms within the group, to enable comparison between groups requires a new technique. Metafrontier estimation is commonly used to address this.

The metafrontier technique was first proposed by Hayami (1969) and then Hayami and Ruttan (1970). As defined by Hayami and Ruttan (1971, p. 82), 'the meta-production function can be regarded as the envelope of commonly conceived neoclassical production functions'. The meta-production function was developed assuming that, potentially, all production units in different groups (e.g. countries/regions, ownership types, industries) can gain access to the same technology, but each of them may operate on a different portion of the envelope because of differences in business environments and resource endowments (Sharma & Leung, 2000; Moreira & Bravo-Ureta, 2010).

As discussed by Lau and Yotopoulos (1989) the meta-production function has several advantages compared with the traditional production function. It is theoretically attractive because it is based on a simple hypothesis that all producers in different groups have the potential to gain access to the same technology. It is also empirically attractive because it can justify the pooling of data from different groups. This process increases the range of variation of independent variables and the total number of observations rather than

estimating technical efficiencies in different groups separately, thereby reducing multicollinearity and biasness in order to obtain a more reliable technical efficiency level. Moreover, O'Donnell *et al.* (2008) proposed another advantage of the metafrontier technique from a policy application perspective. By enveloping group frontiers, the estimated efficiencies relative to the metafrontier can be decomposed into two components: (1) the distance from the production point to the group frontier, which is the technical efficiency relative to the group-specific frontier, and (2) the distance between the group-frontier and the metafrontier. Therefore, the estimated results can show not only firm performance within the group, but also the technology gaps across groups. Based on the estimated results, the government can make policies or design programs for promoting the performance of firms and make appropriate efforts to narrow the technological gaps across groups.

Because of its advantages, the meta-production function technique has been utilised by researchers of technical efficiency estimation for decades, but mainly in the agriculture sector. However, there has been no study estimating the technical efficiency of SMEs using the metafrontier technique. In developing countries with significant regional development disparity such as China, SMEs in regions with a different development levels are likely to use different technology. SMEs in less-developed non-eastern regions are expected to use lagged technology compared to those located in developed eastern provinces. Estimating and comparing the technical efficiency levels of SMEs in eastern and non-eastern provinces using the metafrontier technique is highly appropriate.

Metafrontier construction usually follows three steps (see Wang *et al.*, 2013): (1) all production units are divided into different groups according to the different sources of technological heterogeneity; (2) each group forms a production frontier, which is the group-specific frontier; (3) the metafrontier is obtained through enveloping all the group-specific frontiers. The metafrontier approach discussed below follows O'Donnell *et al.* (2008).  $y$  and  $x$  are assumed as the output and input vectors and meta-technology set  $T$  contains all production points with all input-output combinations, which is the same as Equation (5.1). Then the meta-output set  $P(x)$  and meta-input set  $L(y)$  can be shown to be the same as Equations (5.2) and (5.3) respectively. The output- and input-orientated meta-distance functions are defined as:

$$D_{output}(x, y) = \inf_{\theta} \{ \theta > 0 : (y / \theta) \in P(x) \} \text{ and} \quad (5.10)$$

$$D_{input}(x, y) = \sup_{\lambda} \{ \lambda > 0 : (x / \lambda) \in L(y) \} \text{ respectively.} \quad (5.11)$$

A firm is input-orientated or output-orientated technically efficient with respect to the metafrontier if and only if  $D_{input}(x, y) = 1$  or  $D_{output}(x, y) = 1$ . If the firms in the sample are restricted to using the full range of technologically feasible input-output combinations in meta-technology set  $T$ , thereby producing under different  $K$  sub-technologies, the input-output combinations for the  $k^{th}$  group are contained in the group-specific technology set:

$$T^k = \{ (x, y) : x \geq 0; y \geq 0; x \text{ can be used by firms in group } k \text{ to produce } y \} \quad (5.12)$$

The group-specific output sets  $P^k(x)$ , input sets  $L^k(y)$ , output distance function  $D_{output}^k(x, y)$  and input distance functions  $D_{input}^k(x, y)$  can be computed by:

$$P^k(x) = \{ y : (x, y) \in T^k \}; L^k(y) = \{ x : (x, y) \in T^k \}; \quad (5.13)$$

$$D_{output}^k(x, y) = \inf_{\theta} \{ \theta > 0 : (y / \theta) \in P^k(x) \} \text{ and} \quad (5.14)$$

$$D_{input}^k(x, y) = \sup_{\lambda} \{ \lambda > 0 : (x / \lambda) \in L^k(y) \}, \quad k = 1, 2, \dots, K. \quad (5.15)$$

Due to the fact that the group-specific output and input sets  $(P^k(x), L^k(y), k = 1, 2, \dots, K)$ , are subsets of the unrestricted output set  $(P(x), L(y))$ , the group-specific frontiers and metafrontier satisfy all the properties listed by O'Donnell *et al.* (2008). The most significant property is  $D_{output}^k(x, y) \geq D_{output}(x, y)$  or alternatively,  $D_{input}^k(x, y) \leq D_{input}(x, y)$  for all  $k = 1, 2, \dots, K$ . Then the output-orientated<sup>20</sup> technical efficiencies of a production unit at point  $A$  in Figure 5.5 with respect to meta-technology and with respect to group technology are:

$$MTE_{output}(A) = D_{output}(x, y); TE_{output}(x, y) = D_{output}^k(x, y). \quad (5.16)$$

The difference between the group-specific distance function and the meta-distance function is used to measure the gap between the group and the metafrontier, which is defined as the technology gap ratio:

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<sup>20</sup> The input-orientated technical efficiencies relative to the group-specific frontier and metafrontier and meta-technology ratio can also be estimated in an analogous manner.

$$TGR_{output}(x, y) = \frac{D_{output}(x, y)}{D_{output}^k(x, y)} = \frac{MTE_{output}(x, y)}{TE_{output}(x, y)}. \quad (5.17)$$

Therefore, the technical efficiency of a firm with respect to a metafrontier can be decomposed into efficiency relative to the group frontier and the technology gap ratio:

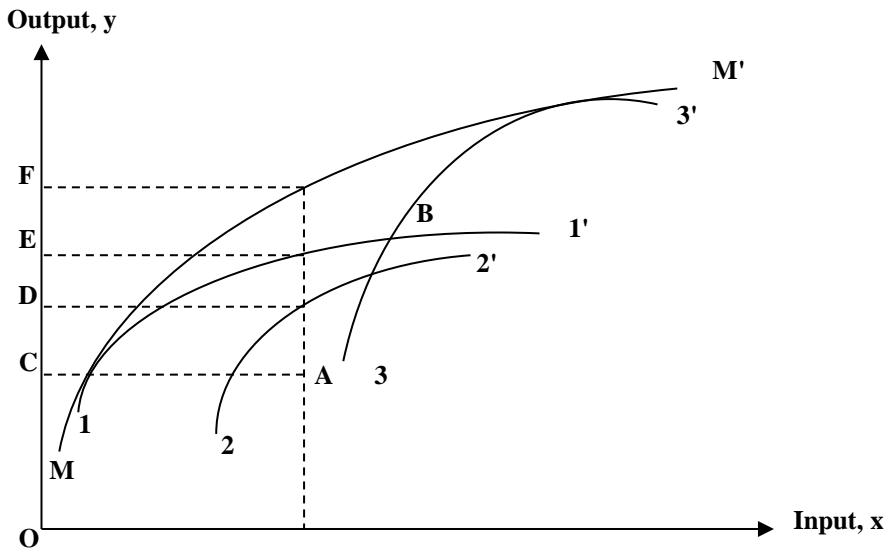
$$MTE_{output}(x, y) = TE_{output}(x, y) \times TGR_{output}(x, y). \quad (5.18)$$

Figure 5.5 shows an example of the group-specific frontiers and metafrontier assuming three different groups in the case of single input and single output. Under the convexity assumption,  $1-1'$ ,  $2-2'$  and  $3-3'$  are group-specific frontiers, while  $M-M'$  is the metafrontier enveloping these three group-specific frontiers. Assuming output-orientation, the output distance between technically inefficient point A producing under  $2-2'$  to its own group frontier is  $CD$ . The output distance of point A to metafrontier  $M-M'$  is  $CF$ . Therefore, the technical efficiency relative to the metafrontier, technical efficiency relative to the group frontier and technology gap ratio are:

$$MTE_{output}(A) = \frac{OC}{OF}; TE_{output}(A) = \frac{OC}{OD};$$

$$TGR_{output}(A) = \frac{MTE(A)}{TE(A)} = \frac{OC/OF}{OC/OD} = \frac{OD}{OF} \quad (5.19)$$

**Figure 5.5 Technical efficiencies and meta-technology ratios**



Source: O'Donnell *et al.* (2008, p. 236).



Based on the theoretical definition and model for technical efficiency measurement introduced above, the empirical estimation techniques for traditional and metafrontier technical efficiency scores have been developed gradually. These techniques follow two approaches, the parametric technique and the non-parametric technique. These techniques are introduced in the next section.

## **5.4 Approaches to technical efficiency estimation: Parametric and non-parametric techniques**

As discussed previously the estimation of technical efficiency needs to capture the difference between a firm's real performance and the optimal performance on the relevant production possibility frontier. Over the past six decades many techniques have been introduced with the objective of estimating technology frontiers and then technical efficiency levels, which can be classified into two approaches: parametric and non-parametric. The most commonly used non-parametric approach is Data Envelopment Analysis (DEA), while Stochastic Frontier Analysis (SFA) is the most representative of the parametric approach. This section introduces traditional DEA and SFA models for estimating technical efficiency and compares their strengths and weaknesses.

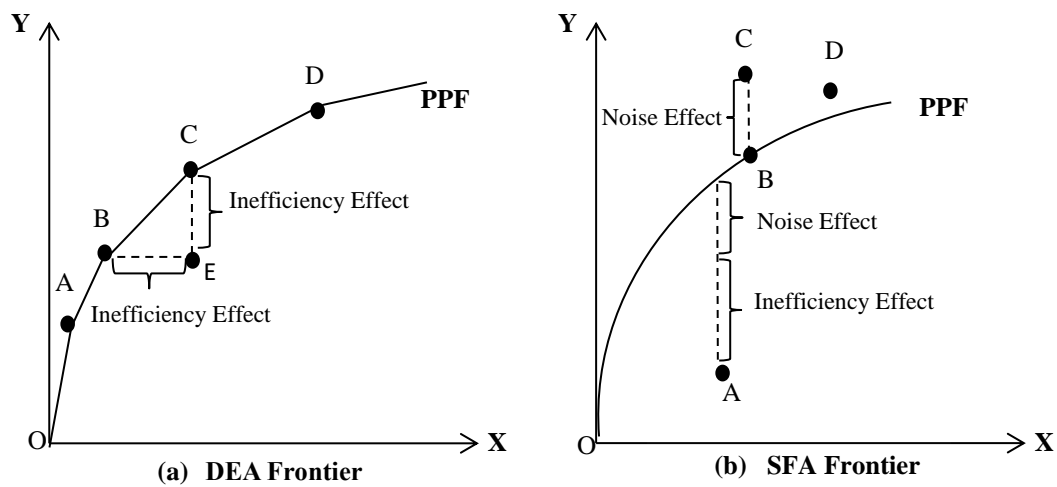
### **5.4.1 Introduction to parametric/non-parametric approaches**

Parametric SFA and non-parametric DEA approaches use quite different methods to envelop data and make different accommodations for random noise and flexibility of technology (Lovell, 1993; Mahadevan, 2004; Fried *et al.*, 2008). An illustration of the difference between SFA and DEA is shown in Figure 5.6.

DEA envelops all input-output combinations in the data set and constructs the production frontier using best practice production units (*A*, *B*, *C* and *D* in Figure 5.6 (a)) using a mathematical linear programming technique (Coelli *et al.*, 2005; Fried *et al.*, 2008). Hence the DEA frontier is a piece-wise linear interpolation between those observations with the highest efficiency levels (Smith & Street, 2005). The DEA technique is a non-parametric estimation because it utilises flexible, non-parametric methods to construct a production frontier without assuming a specific production functional form (Cooper *et al.*,

2000; Mortimer & Peacock, 2002; Murillo-Zamorano, 2004; Coelli *et al.*, 2005; Cooper *et al.*, 2011). After constructing the production frontier the technical efficiency scores are obtained by comparing each production unit relative to the best performing firms instead of the pre-assumed technology (Cooper *et al.*, 2011). The DEA technique assumes that all deviations from the best-practice frontier (*EB* and *EC* in Figure 5.6 (a)) are entirely due to inefficiency effects without considering possible random error (Mortimer & Peacock, 2002). In this sense the DEA technique is a deterministic model.

**Figure 5.6 Production frontiers in DEA and SFA**



Source: Coelli *et al.* (2005, pp. 175; 244); Smith and Street (2005, p. 406).

In contrast to the DEA model, SFA constructs the production frontier by pre-assuming the production function form and distribution of the error items in SFA. Under these assumptions the specific production function and inefficiency scores are then estimated using observed inputs and outputs by a regression technique, which is usually the maximum likelihood method (Mortimer & Peacock, 2002; Coelli *et al.*, 2005). Moreover, SFA is called stochastic because it regards the deviations of production units from the production frontier as comprising both inefficiency effects and random errors (as shown in Figure 5.6(b) for point A), such that it distinguishes noisy effects from firm inefficiency (Mortimer & Peacock, 2002; Fried *et al.*, 2008). Allowing for random errors, it is not necessary for the SFA frontier to envelop all the production units. For example, points C and D in Figure 5.6 (b) are lying above the production frontier due to idiosyncratic random error.

Under the different methodological frameworks in the parametric and non-parametric approaches, models have been developed using both the SFA and DEA techniques to estimate technical efficiency as discussed in the following section.

#### 5.4.2 Traditional data envelopment analysis (DEA) model

Based on Farrell's theory on technical efficiency measurement, the non-parametric DEA model was introduced by Charnes, Cooper and Rhodes (CCR) (1978; 1981). The original model proposed by Charnes *et al.* (1978) was assumed to be input-orientated and under constant returns to scale (CRS), in which all firms are operating at optimal scale. Assuming a vector of outputs  $y$ , inputs  $x$ , weights on outputs  $u$  and weights on inputs  $v$ , the DEA model can be expressed in ratio form, which is the ratio of all outputs over all inputs:  $u'y_i / v'x_i$ . The optimal weights  $u$  and  $v$  can be obtained by solving the linear programming problem (Coelli *et al.*, 2005; Cooper *et al.*, 2011):

$$\begin{aligned}
 & \text{Max}_{u,v} (u'y_i / v'x_i) \\
 & \text{s. t. } u'y_j / v'x_j \leq 1, \quad j = 1, 2, \dots, I \\
 & \quad u \geq 0, v \geq 0
 \end{aligned} \tag{5.20}$$

The solution to this mathematical linear programming problem is the values of the weights  $u$  and  $v$  that can maximise the ratio of all outputs to all inputs ( $u'y_i / v'x_i$ ), representing the efficiency of firm  $i$ . The constraints for the solution are that the estimated efficiency score must be no larger than one and the values of  $u$  and  $v$  must be non-negative (Coelli *et al.*, 2005). However, Equation (5.20) cannot be utilised in empirical estimation for technical efficiency because it has infinite solutions. This problem was solved by imposing a constraint  $v'x_i = 1$  in this equation, leading to the multiplier form of the DEA model (Coelli *et al.*, 2005; Charnes *et al.*, 2013):

$$\begin{aligned}
 & \text{Max}_{u,v} (u'y_i) \\
 & \text{s. t. } v'x_j = 1 \\
 & \quad u'y_j / v'x_j \leq 1, \quad j = 1, 2, \dots, I \\
 & \quad u \geq 0, v \geq 0
 \end{aligned} \tag{5.21}$$

Inspired by the CCR model many researchers began to extend the DEA technique. Among these, Banker, Charnes and Cooper (BCC) (1984) made a significant contribution by proposing a DEA model under variable returns to scale and output orientation (Coelli, 1996; Briec, 1997; Coelli *et al.*, 2005). Allowing variable return to scale (VRS), the BCC model has modified the CCR model by adding a convexity constraint to the linear programming problem, illustrating that an inefficient firm is only ‘benchmarked’ against firms of a similar size. Using duality in linear programming, the input-orientated CCR and BCC models can be expressed equivalently in an envelopment form:

$$\begin{array}{ll}
 \textbf{CCR-I model:} & \textbf{BCC-I model:} \\
 \\
 \textit{Min}_{\theta, \lambda} \theta & \textit{Min}_{\theta, \lambda} \theta \\
 \\
 \text{s. t. } -y_i + Y\lambda \geq 0 & \text{s. t. } -y_i + Y\lambda \geq 0 \\
 \\
 \theta x_i - X\lambda \geq 0 & \theta x_i - X\lambda \geq 0 \\
 \\
 \lambda \geq 0 & I1'\lambda = 1 \text{ (Convexity constraint)} \\
 & \lambda \geq 0
 \end{array} \tag{5.22}$$

where  $y_i$ ,  $x_i$  denotes the vectors of outputs and inputs of the  $i^{\text{th}}$  firm ( $i = 1, 2, \dots, I$ ),  $Y$  and  $X$  represent the vectors of outputs and inputs of all  $I$  firms,  $\theta$  is a scalar representing the efficiency parameter and  $\lambda$  is a  $I \times 1$  vector of constants. Representing the technical efficiency score the value of  $\theta$  is constrained to be no larger than one. While a production unit with  $\theta = 1$  is defined as technically efficient and lying on the production frontier constructed by DEA, a firm which has  $\theta < 1$  is technically inefficient and is located below the DEA efficient production frontier. Alternatively, the output-oriented CCR and BCC models are shown as:

$$\begin{array}{ll}
 \textbf{CCR-O model:} & \textbf{BCC-O model:} \\
 \\
 \textit{Max}_{\phi, \lambda} \phi & \textit{Max}_{\phi, \lambda} \phi \\
 \\
 \text{s. t. } -\phi y_i + Y\lambda \geq 0 & \text{s. t. } -\phi y_i + Y\lambda \geq 0 \\
 \\
 x_i - X\lambda \geq 0 & x_i - X\lambda \geq 0 \\
 \\
 \lambda \geq 0 & I1'\lambda = 1 \text{ (Convexity constraint)} \\
 & \lambda \geq 0
 \end{array} \tag{5.23}$$

where  $1 \leq \phi < \infty$  and  $\phi - 1$  represent the proportional increase in outputs with given inputs to reach the production frontier. The technical efficiency score is defined as  $TE = 1/\phi$ , which is between zero and one.

Since the production frontier estimated by DEA is a piece-wise linear interpolation of best-practice observations (as shown in Figure 5.6 (a)), there may exist output slacks when applying output-orientated DEA due to the parallax of part of the frontier to the y-axis. Some technically efficient points may also increase their output by given inputs to reach another technically efficient point. These output slacks can be solved by the later developed two-stage and multi-stage DEA in estimating technical efficiency (Coelli, 1998; Coelli *et al.*, 2005; Alexander *et al.*, 2010; Romano & Guerrini, 2011). With the continuing development of DEA models, many empirical studies have utilised the DEA technique to estimate technical efficiency levels, such as for airlines (e.g. Arjomandi & Seufert, 2014; Arjomandi *et al.*, 2018), banks (e.g. Chen *et al.*, 2005; Arjomandi *et al.*, 2012; Thilakaweera *et al.*, 2016; Le *et al.*, 2017; Salim *et al.*, 2017), schools (e.g. Kirjavainen & Loikkanen, 1998; Mizala *et al.*, 2002; Haelermans & Ruggiero, 2013) and enterprises (e.g. Zheng *et al.*, 1998; Bozec & Dia, 2007), and especially SMEs (e.g. Alvarez & Crespi, 2003; Önüt & Soner, 2007; Halkos & Tzeremes, 2010).

### 5.4.3 Traditional stochastic frontier analysis (SFA) model

Along with the development of the DEA model the stochastic frontier production technique was put forward by Aigner *et al.* (1977) and Meeusen and van Den Broeck (1977) simultaneously but independently two decades after Farrell's (1957) contribution (Jondrow *et al.*, 1982; Kalirajan & Shand, 1999; Coelli *et al.*, 2005; Fried *et al.*, 2008; Tecles & Tabak, 2010). The SFA technique begins by introducing both the technical inefficiency effect and random errors into the production function as follows:

$$y_i = f(x_i, \beta) \exp(v_i - u_i) \quad (5.24)$$

It can also be reformulated by taking a logarithmic form as follows:

$$\ln y_i = \ln f(x_i, \beta) + v_i - u_i \quad (5.25)$$

where  $y_i$  and  $x_i$  are the output and a vector of  $N$  inputs for firm  $i$ ,  $f(x_i, \beta)$  is the production function (frontier) and  $\beta$  is a vector of parameters to be estimated;  $v_i$  is a

two-sided random error item, which can be both positive and negative, representing the statistical errors out of the firm's control such as misspecification of the model and errors in measurement (Jondrow *et al.*, 1982; Coelli *et al.*, 2005; Fried *et al.*, 2008). According to the Half-Normal Model (Aigner *et al.*, 1977),  $v_i$  is assumed to be independently and identically distributed (*iid*) with zero means and  $\delta_v^2$  variance:  $v_i \sim iidN(0, \delta_v^2)$ , while  $u_i$  is the technical inefficiency item with a non-negative value.  $u_i$  is assumed to be half-normal *iid* distributed with zero means and variance  $\delta_u^2$ , which is a truncated normal distribution at zero:  $u_i \sim iidN^+(0, \delta_u^2)$ .

Before building a stochastic production function, a specific functional form for  $f(x_i)$  needs to be assumed (Lovell, 1993; Admassie & Matambalya, 2002; Kumbhakar & Lovell, 2003; Fried *et al.*, 2008). According to (Coelli *et al.*, 2005) the production functional forms include: (1) linear, (2) Cobb-Douglas, (3) quadratic, (4) normalised quadratic, (5) Translog, (6) generalised Leontief and (7) constant elasticity of substitution. Among these the most commonly utilised two functional forms in empirical studies are the Cobb-Douglas and Translog production functions (Chambers, 1988; Kuosmanen *et al.*, 2013) shown as follows<sup>21</sup> (see Coelli *et al.*, 2005):

$$\text{Cobb-Douglas: } y = \beta_0 + \prod_{n=1}^N x_n^{\beta_n} \quad (5.26)$$

$$\text{Translog: } y = \exp\left(\beta_0 + \sum_{n=1}^N \beta_n \ln x_n + \frac{1}{2} \sum_{n=1}^N \sum_{m=1}^N \beta_{nm} \ln x_n \ln x_m\right) \quad (5.27)$$

The Cobb-Douglas functional form is first-order flexible and has enough parameters to estimate first-order differential approximation, but the Translog production function has enough parameters to provide a second-order approximation and thereby enjoys second-order flexibility (Coelli *et al.*, 2005; De Vries, 2010). Therefore, although the Cobb-Douglas is a simpler functional form, it has a significant drawback because it has less flexibility, and, therefore places more restrictions. It restricts returns to scale to be constant and also constrains the elasticity of substitution between any two inputs to be

---

<sup>21</sup> The Cobb-Douglas production function can be regarded as a special case of the Translog functional form. The Translog function can be reduced to a Cobb-Douglas function when all  $\beta_{nm} = 0$  (Karlaftis & Tsamboulas, 2012).

equal to one (Chambers, 1988). However, the higher flexibility of the Translog production function requires a more complex computation which is hard to manipulate due to more parameters having to be estimated (Coelli *et al.*, 2005). At the same time, more explanatory variables in the Translog production function can also increase the possibility of multicollinearity in the regression which may lead to biased results (Morikawa, 2011; Charoenrat & Harvie, 2013). Second, the Cobb-Douglas function is linear in the parameters while the Translog form is not, making the latter harder to estimate using a linear regression technique. This problem can be solved by taking the logarithms of both sides of the functions. The Stochastic frontier production technique using the logarithmic Cobb-Douglas and Translog functional forms are:

$$\text{Cobb-Douglas: } \ln y_i = \beta_0 + \sum_{n=1}^N \beta_n \ln x_{ni} + v_i - u_i \quad (5.28)$$

$$\text{Translog: } \ln y_i = \beta_0 + \sum_{n=1}^N \beta_n \ln x_{ni} + \frac{1}{2} \sum_{n=1}^N \sum_{m=1}^N \beta_{nm} \ln x_{ni} \ln x_{mi} + v_i - u_i \quad (5.29)$$

In empirical estimations the likelihood ratio (LR) test is usually utilised to identify which functional form is more appropriate to use for the sample (e.g. Hjalmarsson *et al.*, 1996; Kneller & Stevens, 2003; Diaz & Sanchez, 2008). After identifying the adequate production function, the technical efficiency of a firm ( $TE_i$ ) can be estimated by the ratio of observed to maximum output on the production frontier:

$$TE_i = \frac{y_i}{f(x_i, \beta)e^{v_i}} = \exp(-u_i) \quad (5.30)$$

where  $TE_i$  takes a value between 0 and 1. While a firm with  $TE_i = 1$  is defined as technically efficient, the value of  $TE_i$  for an inefficient firm is less than 1.

Clearly, the estimation of  $TE_i$  is based on the estimation on parameters ( $\beta$ ) in the stochastic production function. The original parametric method used for estimating  $\beta$  was the ordinary least squares method (OLS). However, the estimated intercept coefficients by OLS are inconsistent and biased downward (Coelli *et al.*, 2005; Fried *et al.*, 2008). In order to correct for this biasness, some researchers choose to use the corrected ordinary least squares method (COLS), shifting the OLS regression towards the most efficient producer. Alternatively, another technique, which is regarded as being more efficient than COLS, is maximum likelihood estimation (MLE). It can provide more

unbiased estimators because ML estimators have asymptotic properties. The outperforming of MLE compared to COLS is more obvious when the technical inefficiency effect accounts for a larger part of the total variance of output (Coelli, 1995). Compared with OLS and COLS, MLE can yield more consistent intercept and variance results (Cordeiro *et al.*, 2012). Therefore, researchers commonly utilise MLE to estimate stochastic production functions and then efficiency scores.

As a parametric technique, SFA has been widely utilised in empirical estimation of technical efficiency in various areas, like the DEA technique, such as for banks (e.g. Cavallo & Rossi, 2002; Mokhtar *et al.*, 2006; Tahir & Haron, 2008), farms (e.g. Idiong, 2007; Chen *et al.*, 2009; Zhu & Lansink, 2010), hospitals (e.g. Herr, 2008; Rosko & Mutter, 2008) and SMEs in particular (e.g. Amornkitvikai & Harvie, 2011; Charoenrat *et al.*, 2013; Charoenrat & Harvie, 2014). Although both DEA and SFA are common in estimating technical efficiency scores, they both have their own advantages and disadvantages, which are discussed in the following section.

#### **5.4.4 Strengths and weaknesses of DEA and SFA**

The non-parametric DEA and parametric SFA techniques have their own strengths and weaknesses. Thus, there is a trade-off in the choice between the DEA and SFA techniques (Hjalmarsson *et al.*, 1996; Mortimer & Peacock, 2002). The main advantage of DEA derives from the flexibility it affords because of its non-parametric nature (Andor & Hesse, 2014). DEA constructs the efficiency frontier with observed inputs and outputs. It does not have restrictive assumptions about the specific production technology and the distribution of the efficiency items (Hjalmarsson *et al.*, 1996; Murillo-Zamorano, 2004; Coelli *et al.*, 2005; Charoenrat *et al.*, 2013). Therefore, DEA allows the data to ‘speak for itself’ (Bates *et al.*, 1996; Mortimer & Peacock, 2002; Fried *et al.*, 2008), which makes the DEA method appealing. Without specific functional form it can relax the assumptions of orientation and returns to scale as shown in Equation (5.22) and Equation (5.23). It also enables the effects of misspecification of the functional form to be avoided (Fried *et al.*, 2008). This makes DEA insensitive to production technology and it can be easily adjusted to samples with different technology form. Moreover, the DEA technique is much simpler in its computation than the parametric technique and can easily handle multiple outputs (Coelli *et al.*, 2005).



**Table 5.1 A comparison of the strengths of DEA and SFA**

<b>Advantage</b>	<b>Non-parametric DEA</b>	<b>Parametric SFA</b>
Random error consideration	×	✓
Provide confidence interval	×	✓
No large sample size requirement	✓	×
No pre-assumption on functional form	✓	×
Easy computation	✓	×
Allows both input and output orientation	✓	×
Provides the marginal product for each input	×	✓

Source: Author's summary.

Although these advantages make the DEA technique popular in empirical efficiency measurement studies, it still has some significant weaknesses (Simar & Wilson, 1998; 2000; 2007; Alexander *et al.*, 2010; Wijesiri *et al.*, 2015). As discussed above, DEA constructs a production frontier by a data-generating process (DGP) on the observed data set. Thus, in most cases, technical efficiency estimation utilising the DEA technique is influenced by uncertainty surrounding the estimated point due to the variation in the observed data set (sample), which is represented by a statistical error (Simar & Wilson, 2000; Wijesiri *et al.*, 2015). However, DEA assumes the nonexistence of random errors and all variations between the production units and production possibility frontier are interpreted as the effect of inefficiency (Hjalmarsson *et al.*, 1996). Without considering statistical errors, DEA cannot distinguish noisy effects from the effect of inefficiency (Murillo-Zamorano, 2004; Coelli *et al.*, 2005; Fried *et al.*, 2008; Andor & Hesse, 2014). Therefore, the technical efficiency scores estimated by the DEA technique are sensitive to noisy data, variable selection and other random errors (Coelli *et al.*, 2005), and especially to extreme observations (Kalirajan & Shand, 1999; Minh *et al.*, 2007). This problem prevents the performing of statistical analysis on estimated efficiency results, leads to biased results and limits the application of DEA estimated efficiency scores for decision makers (Ferrier & Hirschberg, 1997; Wijesiri *et al.*, 2015). Moreover, without considering statistical errors, DEA cannot provide statistical properties on the estimated efficiency scores (Simar & Wilson, 2000; Assaf & Matawie, 2010). Thus, it is not possible to utilise traditional statistical hypothesis tests and provide confidence intervals for estimated efficiencies (Minh *et al.*, 2007; Odeck & Brathen, 2012). Moreover, without the pre-assumption of a specific production function form, DEA cannot estimate the marginal products and elasticity of substitution of productive inputs (Ray, 2004).

Like the DEA technique, the SFA technique has its own advantages and disadvantages. First, the strength of SFA arises from its stochastic nature. Because it distinguishes the random error and inefficiency effect in the model and estimates them respectively, the estimated efficiency scores considering statistical noise would be less sensitive to data noise and other random shocks (Andor & Hesse, 2014). Second, the estimated random error provides the basis for the formal statistical testing of hypotheses and the construction of confidence intervals (Hjalmarsson *et al.*, 1996; Coelli *et al.*, 2005; Fried *et al.*, 2008). Also, with an estimated production function, SFA allows the estimation of marginal products for each input, such as for capital and labour (Charoenrat & Harvie, 2013; 2014).

However, distinguishing the noise effect and inefficiency effect terms requires the SFA technique to have a more complex computing process than the DEA technique (Coelli *et al.*, 2005; Amornkitvikai & Harvie, 2011). Moreover, SFA requires strong assumptions on production technology and the distributions of the statistical noise and inefficiency effect terms. With empirical estimation, it is hard to make an accurate assumption on a single technology used by all firms in the sample (Coelli, 1996; Murillo-Zamorano, 2004; Coelli *et al.*, 2005). If the production function form is misspecified it may provide biased results. Therefore, although the technical efficiency scores estimated by SFA are not sensitive to noisy data and variable selection, it appears to be sensitive to functional form selection. Also, the production function used by the SFA technique is estimated by means of regression, which makes the results obtained sensitive to sample size. If the sample size is small the SFA technique would give a biased result so the DEA technique is more appropriate (Murillo-Zamorano, 2004; Coelli *et al.*, 2005). Furthermore, because of the presumed functional form, SFA can only estimate technical efficiency by means of output-orientation and fixed assumptions on returns to scale. This is different from DEA which can construct the production frontier under both input and output orientation and different returns to scale can be assumed.

#### **5.4.5 Choice between DEA and SFA in this research**

Many new SFA and DEA techniques have been developed trying to solve the weaknesses of each. However, a lack of robustness persists in both techniques. To date, there is still no single superior method because each approach has its own pros and cons (Andor & Hesse, 2014). Even studies using Monte Carlo simulations to estimate the performance

of these two approaches cannot conclude that either of them has an absolute advantage compared to the other (Resti, 2000; Mortimer & Peacock, 2002). The choice between DEA and SFA should be based on the study context and data available (Fried *et al.*, 2008).

In this research the disadvantages associated with DEA can be very significant. The data utilised in this thesis is firm-level data from a survey (see details in Chapter 6). Many empirical studies using firm-level data have found the existence of extreme outliers due to reporting or recording error and have suggested the use of techniques that can minimise the influence of outliers (e.g. Forbes, 2004; Fisman & Svensson, 2007; Haller & Siedschlag, 2011; Claessens *et al.*, 2012). The efficiency score estimation is significantly sensitive to the extreme observations in the DEA model. Thus, the DEA model's omission of statistical error can lead to seriously biased results when using firm-level data. In traditional technical efficiency estimation, this problem has been minimised by using the bootstrapping technique developed by Simar and Wilson (1998). Utilising repeated resampling from the original sample to mimic the unknown distribution of efficiency scores, the statistical property of efficiency estimates and biasness corrected efficiency scores can be obtained by bootstrapping DEA (Simar & Wilson, 1998; Wijesiri *et al.*, 2015). However, in estimating metafrontier technical efficiency using DEA, the bootstrapping technique has not been well developed yet.

In contrast to DEA techniques, the drawbacks in using SFA in this research are not significant. Because SFA requires a large sample size to give unbiased results, some empirical researchers have found that it is not possible to apply SFA due to their small sample size (e.g. Sufian, 2007; Speelman *et al.*, 2008; Barros *et al.*, 2010; Curi *et al.*, 2011). But the sample size used in this study is more than 600 private SMEs (see details in Chapter 6), providing an appropriate sample for utilising SFA. Moreover, the inability of SFA to estimate input-oriented technical efficiency would not be important for SMEs. This is because the choice between using input-orientation and output-orientation should be based on the production process:

If output is endogenous (e.g. revenue maximization case) but inputs are exogenous, the proper measure would be the output-orientated measure...On the other hand, if inputs are endogenous (e.g. cost minimization case) but output is exogenous, the appropriate measure of technical efficiency is the input-orientated measure (Kumbhakar *et al.*, 2007, p. 87).

For some industries, identification of the endogeneity and exogeneity of inputs and outputs is quite clear. For example, in the electricity and water industries the input-orientated estimation is more appropriate because they have more control over inputs than outputs (e.g. Cullmann & von Hirschhausen, 2008; Corton & Berg, 2009; Romano & Guerrini, 2011). But in some other industries such as public schools and universities, the inputs, student entrants for example, are exogenously fixed, and it is more appropriate for these production units to expand their outputs in order to achieve technical efficiency. In such cases output-orientation is more applicable (e.g. McCarty & Yaisawarng, 1993; Johnes, 2006). For firms in the manufacturing industry which can control both input and output levels in their production, either input or output orientation can be utilised. However, for SMEs in China, especially private-owned ones, there are significant obstacles to accessing resources as discussed in Chapter 3. Given the constraint on the input side, an output-orientated approach seems more appropriate in estimating the technical efficiency of private SMEs in China, which can be measured by SFA. Most importantly, the stochastic parametric approach for metafrontier technical efficiency estimation has been well developed by Huang *et al.* (2014), providing unbiased results with a large sample size. Therefore, this research utilises parametric SFA to estimate the metafrontier technical efficiency of private SMEs in China's manufacturing sector. The stochastic metafrontier production function (SMF) model proposed by Huang *et al.* (2014) is introduced in detail in the following section.

## **5.5 Parametric approach for estimating metafrontier efficiency**

### **5.5.1 Half parametric SMF model by Battese *et al.* (2004)**

Based on the metafrontier production theory proposed by Hayami (1969) and Hayami and Ruttan (1970; 1971) discussed in Section 5.3, Battese and Rao (2002) introduced a stochastic metafrontier production function (SMF) model. This SMF model allows for the capture of the technical efficiency of firms using different technologies due to different regions, industries, policy registrations and other factors (Battese *et al.*, 2004; O'Donnell *et al.*, 2008; Moreira & Bravo-Ureta, 2010; Huang *et al.*, 2014). This model contains two steps. In the first step the group frontiers are estimated respectively by the stochastic production function using sub-samples and the technical efficiency relative to the group frontier ( $TE$ ) can be estimated. This step is a fully stochastic technique as for

traditional SFA. In the second step the metafrontier is constructed by enveloping all group frontiers utilising a two-step data generation mechanism (Battese *et al.*, 2004; Lin & Du, 2013). Then the technical efficiency relative to the metafrontier (*MTE*) can be estimated by a pooled sample of all groups.

However, the SMF model proposed by Battese and Rao (2002) has a significant drawback. As they themselves point out, it is not guaranteed that the estimated metafrontier will envelop all of the estimated group-specific stochastic frontiers due to the existence of statistical noise. For some groups the value of the estimated metafrontier function could be less than that of the estimated group-specific frontier, such that the technology gap ratio (*TGR*) obtained using this model may be larger than one (Battese & Rao, 2002; O'Donnell *et al.*, 2008; Lin & Du, 2013). This problem was resolved by Battese *et al.* (2004). They proposed a linear programming model to estimate a metafrontier which contains only a one-stage data generation process. In this modified model the metafrontier is defined as a deterministic parametric function best enveloping all the group frontiers, such that its values are constrained to be no smaller than the deterministic components of the group-specific stochastic production function (Battese *et al.*, 2004). Two criteria are considered by them to judge what is the 'best envelope'. The first criterion is minimising the sum of absolute deviations assigning the same weight to the distance of all firms in the sample, which leads to the following linear programming (LP) problem:

$$\begin{aligned} \min_{\beta^*} L^* &= \sum_{i=1}^N |(\ln f(x_i \beta^*) - \ln f(x_i \hat{\beta}_{(j)}))| \\ \text{s. t. } \ln(x_i \beta^*) &\geq \ln f(x_i \hat{\beta}_{(j)}), \quad j = 1, 2, \dots, J. \end{aligned} \quad (5.31)$$

Alternatively, the second criterion assigned higher weights to the distance of firms with a larger meta-technology ratio, which minimises the sum of squared deviations following the quadratic programming (QP) problem:

$$\begin{aligned} \min_{\beta^*} L^* &= \sum_{i=1}^N (x_i \beta^* - x_i \hat{\beta}_{(j)})^2 \\ \text{s. t. } x_i \beta^* &\geq x_i \hat{\beta}_{(j)}, \quad j = 1, 2, \dots, J. \end{aligned} \quad (5.32)$$

However, the SMF model modified by Battese *et al.* (2004) still has a significant limitation because it utilises a programming technique to construct the metafrontier. This model is, therefore, not a strict parametric approach but a two-stage mixed approach

combining both parametric and non-parametric techniques (Huang *et al.*, 2014; Chang *et al.*, 2015; Zhang & Wang, 2015; Nguyen *et al.*, 2016). By applying deterministic mathematical programming in the second step, it is difficult to give a reasonable statistical interpretation of the estimated metafrontier function and random errors in the estimation cannot be considered. The technical efficiency relative to the metafrontier (*MTE*) and the technological gap ratio (*TGR*) estimated by this model are easily affected by random shocks, and are therefore sensitive to data noise, measurement and variable errors (Huang *et al.*, 2014; Chang *et al.*, 2015; Huang *et al.*, 2015). Moreover, due to the lack of random errors, this half parametric model cannot provide statistical properties of the *MTE* and *TGR* (Chen *et al.*, 2014; Huang *et al.*, 2014; Huang *et al.*, 2015; Nguyen *et al.*, 2016). As pointed out by Battese *et al.* (2004) the variance and confidence interval of *MTE* needs to be constructed by a bootstrapping technique. Also, without an estimated meta-production function, the marginal product of labour and capital under the metafrontier cannot be captured. To resolve the problems discussed above, Huang *et al.* (2014) proposed a fully parametric stochastic meta-production function (SMF) model.

### **5.5.2 Fully parametric SMF model by Huang *et al.* (2014)**

The fully parametric SMF model proposed by Huang *et al.* (2014) is a significant modification of the half parametric SMF model by Battese *et al.* (2004). The main modification is that, in the second step, the metafrontier is also estimated by parametric SFA using maximum likelihood as the first step, instead of the mathematical programming technique. Huang *et al.* (2014) listed several merits of this modified SMF model. First, in the stochastic metafrontier production function, the technological gap ratio (*TGR*) is treated as a conventional one-sided error term and is separated from the random error such that the *TGR* can be directly estimated, and these estimates are less sensitive to random shocks. Second, using SFA in the second step the parameter estimates in the metafrontier production function and estimated *TGR* can have desirable statistical properties, such that the statistical inference can be performed without bootstrapping or simulation. Moreover, this SMF model has another strength which is significant in the context of this research. Utilising a traditional stochastic frontier regression model in the second stage, the estimated technology gaps represented by one-sided error in the SFA model can be further specified as a function of explanatory variables that is out of the control of firms. Therefore, the technological gap ratio scores and the determinants of the

technological gap ratio (i.e., the relationship of entrepreneurial factors with the technological gap ratios in this research) can also be estimated simultaneously utilising the one-stage SFA approach proposed by Battese and Coelli (1995). This technique is introduced in the next section.

This modified fully parametric SMF model can be shown as follows. In the first stage, it is assumed that the total number of  $N$  firms in the sample can be classified into  $J$  groups, and there are  $N_j$  firms in the  $j^{th}$  production group. Following the traditional SFA model as shown in Equation (5.24) the stochastic production function of the  $i^{th}$  firm in the  $j^{th}$  group is modeled as (in the cross-sectional case):

$$y_{ji} = f^j(x_{ji}, \beta_j) \exp(v_{ji} - u_{ji}), \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N \quad (5.33)$$

where  $y_{ji}$  and  $x_{ji}$  denote the scalar output and input vector of the  $i^{th}$  firm in the  $j^{th}$  production group;  $f^j(\cdot)$  is the production technology of group  $J$ , which is commonly specified as being in a Cobb-Douglas or Translog form as shown in Equations (5.28) and (5.29) respectively;  $\beta_j$  is a vector of parameters to be estimated in the group-specific production function;  $v_{ji}$  represents statistical noise and is assumed to be *iid* distributed ( $v_{ji} \sim N(0, \sigma_v^2)$ ). The non-negative  $u_{ji}$  is the group technical inefficiency term. Then a firm's technical efficiency relative to the group frontier is defined as:

$$TE_i^j = \frac{y_{ji}}{f^j(x_{ji}, \beta_j) e^{v_{ji}}} = \exp(-u_{ji}) \quad (5.34)$$

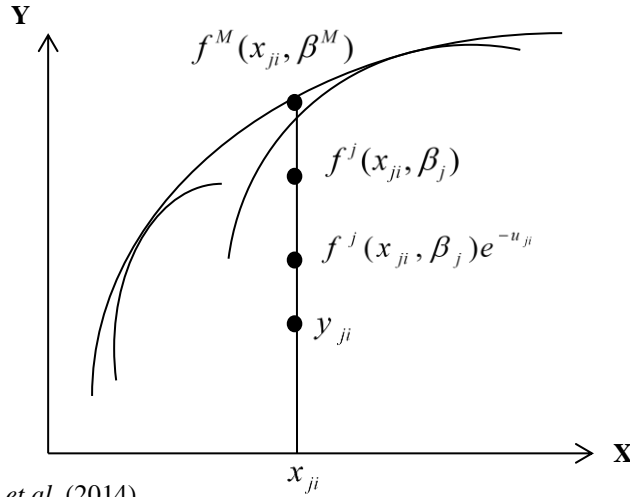
In the second step the metafrontier production function for all groups is defined as  $f^M(x_{ji}, \beta^M)$ , which envelops all group-specific frontiers  $f^j(x_{ji}, \beta_j)$ :

$$f^j(x_{ji}, \beta_j) = f^M(x_{ji}, \beta^M) e^{-u_{ji}^M} \quad \forall j, i \quad (5.35)$$

where  $f^M(\cdot)$  is the metafrontier production function specified as being in a Cobb-Douglas or Translog form and  $\beta^M$  is a vector of parameters to be estimated in the meta-production function.  $u_{ji}^M$  represents the non-negative technological gap term ( $u_{ji}^M \geq 0$ ), such that  $f^M(x_{ji}, \beta^M) \geq f^j(x_{ji}, \beta_j)$ . The ratio of the  $j^{th}$  group's production frontier to the metafrontier is defined as the technology gap ratio:

$$TGR_i^j = \frac{f^j(x_{ji}, \beta_j)}{f^M(x_{ji}, \beta^M)} = e^{-u_{ji}^M} \leq 1 \quad (5.36)$$

**Figure 5.7 Fully parametric stochastic metafrontier model (SMF)**



Source: Huang *et al.* (2014).

Figure 5.7 illustrates the stochastic metafrontier production model. At any given input  $x_{ji}$ , the observed output  $y_{ji}$  relative to its potential maximum output on the metafrontier  $f^M(x_{ji}, \beta^M)$  can be decomposed into three components: (1) the technology gap ratio ( $TGR_i^j$ ); (2) efficiency relative to the group frontier ( $TE_i^j$ ) and; (3) a random noise component ( $e^{v_{ji}}$ ) shown as:

$$\begin{aligned} (1) \quad TGR_i^j &= f^j(x_{ji}, \beta_j) / f^M(x_{ji}, \beta^M); \\ (2) \quad TE_i^j &= y_{ji} / f^j(x_{ji}, \beta_j)e^{v_{ji}} = e^{-u_{ji}}; \\ (3) \quad e^{v_{ji}} &= y_{ji} / f^j(x_{ji}, \beta_j)e^{-u_{ji}} \text{ respectively.} \end{aligned} \quad (5.37)$$

$$\text{Thus, } \frac{y_{ji}}{f^M(x_{ji}, \beta^M)} = TGR_i^j \times TE_i^j \times e^{v_{ji}}. \quad (5.38)$$

Equation (5.38) distinguishes this SMF model from the DEA model because it considers a random error item. Then, the technical efficiency with respect to the metafrontier ( $f^M(\cdot)$ )  $MTE_{ji}$  considering random noise can be expressed as:

$$MTE_{ji} = \frac{y_{ji}}{f^M(x_{ji}, \beta^M)e^{v_{ji}}} = TGR_i^j \times TE_i^j \quad (5.39)$$



In empirical estimation for this model, Huang *et al.* (2014) showed the logarithmic form of group-specific frontiers Equation (5.33) as:

$$\ln y_{ji} = \ln f^j(x_{ji}, \beta_j) + v_{ji} - u_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N \quad (5.40)$$

Defining the group estimated composite residual as  $\varepsilon_{ji} = v_{ji} - u_{ji}$ , the group-specific frontier (Equation 5.40) and its maximum likelihood estimated value can be rewritten as:

$$\ln y_{ji} = \ln f^j(x_{ji}, \beta_j) + \varepsilon_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N \quad (5.41)$$

$$\ln y_{ji} = \ln \hat{f}^j(x_{ji}, \beta_j) + \hat{\varepsilon}_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N \quad (5.42)$$

Then technical efficiency relative to the group-specific frontier can be estimated as:

$$TE_i^j = \hat{E}(e^{-u_{ji}} | \hat{\varepsilon}_{ji}) \leq 1 \quad (5.43)$$

Based on Equation (5.41) and Equation (5.42) the metafrontier estimation error can be defined as  $v_{ji}^M = \varepsilon_{ji} - \hat{\varepsilon}_{ji} = \ln \hat{f}^j(x_{ji}, \beta_j) - \ln f^j(x_{ji}, \beta_j)$ , thus,  $\ln \hat{f}^j(x_{ji}, \beta_j) = \ln f^j(x_{ji}, \beta_j) + v_{ji}^M$ . The logarithmic form of the metafrontier production function (Equation (5.35)) is:

$$\ln f^j(x_{ji}, \beta_j) = \ln f^M(x_{ji}, \beta^M) - u_{ji}^M, \quad \forall j, i, \quad (5.44)$$

can be rewritten as:

$$\ln \hat{f}^j(x_{ji}, \beta_j) = \ln f^M(x_{ji}, \beta^M) + v_{ji}^M - u_{ji}^M, \quad \forall j, i. \quad (5.45)$$

The estimated value of the technology gap ratio can be estimated by:

$$TGR_i^j = \hat{E}(e^{-u_{ji}^M} | \hat{\varepsilon}_{ji}^M) \leq 1 \quad (5.46)$$

In summary, the two-step fully parametric SMF model consists of two parts, both using the SFA technique:

$$\ln y_{ji} = \ln f^j(x_{ji}, \beta_j) + v_{ji} - u_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N \quad (5.40)$$

$$\ln \hat{f}^j(x_{ji}, \beta_j) = \ln f^M(x_{ji}, \beta^M) + v_{ji}^M - u_{ji}^M, \quad \forall j, i. \quad (5.45)$$

Utilising *FRONTIER 4.1* the group-specific frontier (Equation (5.40)) from the first step is estimated respectively for each group ( $j = 1, 2, \dots, J$ ). Then the estimated value of technical efficiency relative to group-specific frontiers ( $TE_i^j$ ) can be obtained. In the second step, the estimated values from the first step for all  $J$  groups are used as the

output in the metafrontier production function (Equation (5.45)), and the samples in all groups are pooled to estimate the meta-production function using *FRONTIER 4.1* again. In this step the estimated value of the technology gap ratio ( $T\hat{G}R_i^j$ ) can be computed. Then the technical efficiency relative to the metafrontier is the product of  $T\hat{E}_i^j$  and  $T\hat{G}R_i^j$ :

$$M\hat{T}E_{ji} = T\hat{G}R_i^j \times T\hat{E}_i^j \quad (5.47)$$

Applying the fully parametric SMF model, the technical efficiency under regional technology, technology gap ratio and the technical efficiency level under national technology for SMEs in eastern and non-eastern regions can be estimated.

Beyond the technical efficiency estimation, the most significant aim of this research is to investigate the relationships of entrepreneurial, firm-specific and external factors with technical efficiency scores. The parametric approach for estimating determinants of technical efficiency used in this research is introduced in the next section.

## **5.6 Models for identifying determinants of technical inefficiency**

### **5.6.1 Traditional technical inefficiency effects model**

As discussed above, technical efficiency scores can be estimated by the parametric SFA technique. However, empirical researchers usually do not rest content with efficiency estimation. They try to explain why some firms are producing more efficiently than others. This is also the case for this research where the relationships of entrepreneurial, firm-specific and external factors with estimated technical efficiency levels are to be identified. For estimating the determinants of technical inefficiency the one-stage approach proposed by Battese and Coelli (1995) is most commonly utilised.

Before the introduction of this model, most studies researching the determinants of technical efficiency used a two-stage approach (e. g. Kalirajan, 1981; Pitt & Lee, 1981). The first stage involves estimation of the stochastic frontier production function and technical inefficiency term under the assumption that the inefficiency term is independent and identically (iid) distributed, while the second stage utilises an independent regression model to identify the determinants of estimated technical inefficiency assuming

inefficiency effects to be a function of exogenous explanatory variables which contradicts the assumption in the first stage (Battese & Coelli, 1995; Diaz & Sanchez, 2008; Iyer *et al.*, 2008; Liu & Nishijima, 2013). Moreover, Kumbhakar and Lovell (2003) pointed out that the second assumption also leads to biased estimation of the stochastic frontier production function and technical inefficiency effects because of the omission of these exogenous determinants in the first stage.

To resolve these problems Battese and Coelli (1995) proposed a single-stage approach considering the relationship of environmental variables with inefficiency, such that the stochastic frontier production function model and inefficiency effect model can be estimated simultaneously. This model provides a higher level of consistency and unbiased results for the scores and determinants of technical efficiency (Wang & Schmidt, 2002; Simar & Wilson, 2007; Yang & Chen, 2009; Liu & Nishijima, 2013). In this single-stage approach the stochastic production function using cross-sectional data is as shown as:

$$y_i = f(x_i, \beta) \exp(v_i - u_i) \quad (5.24)$$

where  $u_i$  is assumed to be independently distributed, which can be obtained by truncation of the normal distribution at zero with  $z_i\delta$  mean and  $\sigma^2$  variance. Thus,  $u_i$  can be assumed as a function of the explanatory variables and the technical inefficiency effect model can be expressed as:

$$u_i = z_i\delta + w_i \quad (5.48)$$

where  $z_i$  is a vector of explanatory variables,  $\delta$  is a vector of unknown coefficients to be estimated in the regression and  $w_i$  is a random error in the technical inefficiency effects model which is normally distributed and truncated at zero with zero mean and  $\sigma^2$  variance, such that the truncation point is  $-z_i\delta$  and  $u_i$  is non-negative (i.e.,  $w_i \geq -z_i\delta$ ).

The stochastic frontier production function model (Equation (5.24)) and technical inefficiency effect model (Equation (5.48)) can be estimated simultaneously using MLE. The likelihood function is expressed in terms of variance parameters as:

$$\sigma_s^2 \equiv \sigma_v^2 + \sigma_u^2 \text{ and } \gamma = \sigma_u^2 / \sigma_v^2. \quad (5.49)$$

where  $\sigma_v^2$  is the variance of statistical noise,  $\sigma_u^2$  is the variance of technical inefficiency effects and  $\gamma$  represents the share of inefficiency in the total residual variance. Then the technical efficiency of the  $i^{th}$  firm can be defined as:

$$TE_i = \exp(-u_i) = \exp(-z_i\delta - w_i). \quad (5.50)$$

### 5.6.2 Determinants of group-frontier technical efficiency: Technical inefficiency effect model

As discussed by Huang *et al.* (2014), the technical inefficiency effect model is applicable in the fully parametric SMF model. For group-specific frontiers as shown by Equation (5.40):

$$\ln y_{ji} = \ln f^j(x_{ji}, \beta_j) + v_{ji} - u_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N, \quad (5.40)$$

the non-negative  $u_{ji}$  is the group technical inefficiency term which is assumed to be truncated and normal distributed (at zero):  $u_{ji} \sim N^+(\mu^j(z_{ij}), \sigma_u^{j^2}(z_{ij}))$ , where  $z_{ij}$  is a vector of explanatory variables for technical inefficiency relative to group-specific frontiers. Thus, the group-specific technical inefficiency (relative to the group frontier) effect model for the  $i^{th}$  firm in the  $j^{th}$  group is:

$$u_{ji} = z_{ji}\delta_j + w_{ji}, \quad i = 1, 2, \dots, N_j, \quad j = 1, 2, \dots, J, \quad \sum_{j=1}^J N_j = N, \quad (5.51)$$

where  $\delta_j$  is a vector of unknown coefficients to be estimated in the regression and  $w_{ij}$  is a random error in the group-specific technical inefficiency effects model.

In the first step of the fully parametric SMF model by Huang *et al.* (2014), the group-specific stochastic frontier production function model as given by Equation (5.40) and group-specific technical inefficiency effect model as given by Equation (5.51) are estimated simultaneously for each group using MLE by *FRONTIER 4.1*. The group-specific likelihood function is:

$$\sigma_s^j \equiv \sigma_v^{j^2} + \sigma_u^{j^2} \quad \text{and} \quad \gamma^j = \sigma_u^{j^2} / \sigma_v^{j^2}, \quad j = 1, 2, \dots, J \quad (5.52)$$

where  $\sigma_v^{j^2}$ ,  $\sigma_u^{j^2}$  and  $\gamma^j$  denote the variance of statistical noise, variance of group-specific technical inefficiency effects and the share of inefficiency relative to group frontiers in

the total residual variance in the production function of group  $j$ . The technical efficiency of the  $i^{th}$  firm in group  $j$  can be estimated as:

$$TE_i^j = \exp(-u_{ji}) = \exp(-z_{ji}\delta_j - w_{ji}). \quad (5.53)$$

Thus, the unbiased scores and determinants of technical efficiency relative to group-specific frontiers can be obtained in one step.

### 5.6.3 Determinant of the technology gap ratio: Technology gap effect model

In the second step of the fully parametric SMF model, the model of Battese and Coelli (1995) is also utilised to identify the determinants of the technology gap ratio (Huang *et al.*, 2014; Chang *et al.*, 2015). In the metafrontier function shown as:

$$\ln \hat{f}^j(x_{ji}, \beta_j) = \ln f^M(x_{ji}, \beta^M) + v_{ji}^M - u_{ji}^M, \quad \forall j, i, \quad (5.45)$$

the non-negative technology gap term  $u_{ji}^M$  is also assumed to be truncated-normal distributed:  $u_{ji}^M \sim N^+(\mu^M(z_{ji}^M), \sigma_u^{M^2}(z_{ji}^M))$ , where  $z_{ji}^M$  is a vector of explanatory variables for the technology gap (distance from the maximum output on the group-specific frontier to maximum output on the metafrontier for a given input).

Thus, based on the model of Battese and Coelli (1995) the determinant of the technology gap for the  $i^{th}$  firm in the  $j^{th}$  group can be identified by the regression:

$$u_{ji}^M = z_{ji}^M \delta^M + w_{ji}^M \quad \forall j, i \quad (5.54)$$

referring to a technology gap effects model, where  $\delta^M$  is a vector of unknown coefficients that need to be estimated and  $w_{ji}^M$  is a random error in the model.

Therefore, in the second step of the fully parametric SMF model, the metafrontier function model (Equation (5.45)) and technology gap effects model (Equation (5.54)) can also be estimated simultaneously by pooling samples in all groups together, using MLE by *FRONTIER 4.1*. The variance parameters for the metafrontier likelihood function are:

$$\sigma_s^M \equiv \sigma_v^{M^2} + \sigma_u^{M^2} \quad \text{and} \quad \gamma^M = \sigma_u^{M^2} / \sigma_v^{M^2}, \quad (5.55)$$

where  $\sigma_v^{M^2}$ ,  $\sigma_u^{M^2}$  and  $\gamma^M$  denote the variance of the random error, variance of technology gap effects and the share of the technology gap in the total residual variance in the metafrontier function.

Combining the technology gap effects model, the technology gap ratio of the  $i^{th}$  firm in group  $j$  can be rewritten as:

$$TGR_i^j = \exp(-u_{ji}^M) = \exp(-z_{ji}^M \delta^M - w_{ji}^M). \quad (5.56)$$

Therefore, using the fully parametric SMF-technology gap effects model, the scores and determinants of the technology gap ratio can also be obtained by one step.

The fully parametric SMF, technology inefficiency effects model and technology gap effects model have been combined to be used empirically by only a few studies, including by Huang *et al.* (2014) for chain-operated and independently-operated hotels in Taiwan, by Chang *et al.* (2015) for accounting firms in the US, China, and Taiwan and by Melo-Becerra and Orozco-Gallo (2017) for small crop and livestock farmers under different production systems in Colombia. But this technique has not been applied to estimate the scores and determinants of group-specific technical efficiency and technology gap ratio for SMEs, especially in the special context of China where significant regional disparities persist. This research fills this gap.

#### **5.6.4 Determinants of metafrontier technical efficiency: The Tobit model**

In identifying the determinants of metafrontier technical efficiency, which is estimated by the product of group-specific technical efficiency and the technology gap ratio, a maximum likelihood Tobit regression is utilised. In regressing the technical efficiency scores on explanatory variables, it is commonly accepted that the Tobit regression model is preferred to the Ordinary Least Squares (OLS) model (Kumbhakar & Lovell, 2003; Coelli *et al.*, 2005; McDonald, 2009; Otieno *et al.*, 2014). This is because the estimated technical efficiency scores are bounded between 0 and 1. For a regression in which the dependent variable has a bounded value, utilising traditional OLS in estimation can lead to biased results because OLS is likely to provide predicted values which are larger than one (Bravo-Ureta & Pinheiro, 1997; Kumbhakar & Lovell, 2003; Coelli *et al.*, 2005; Wooldridge, 2010). This requires the use of a technique that can be utilised under this

limitation on the value of the dependent variable. The Tobit regression model proposed by Tobin (1958) can accommodate the upper censoring and is applicable for truncated data (McDonald & Moffitt, 1980; Breen, 1996; Chen & Song, 2008); therefore, it is suitable for regression with technical efficiency as a dependent variable (Kumbhakar & Lovell, 2003; Coelli *et al.*, 2005). Although there are some other techniques that can be utilised for truncated data<sup>22</sup>, Tobit regression is easy to compute and transparent to use (Hoff, 2007; McDonald, 2009). Therefore, Tobit regression has been utilised for estimating traditional efficiency determinants, especially in a DEA model, by many empirical studies (e.g. Chilingirian, 1995; Fethi *et al.*, 2002; McDonald, 2009). In the stochastic metafrontier approach, the Tobit regression is also applicable to estimate determinants of metafrontier technical efficiency. This is referred to as the SM-Tobit model by Otieno *et al.* (2014). The maximum likelihood estimation for a two-limit Tobit model in the metafrontier approach is shown as follows:

$$MTE_{ji}^* = z_{ji}^{MTE} \delta^{MTE} + w_{ji}^{MTE} \quad \forall j, i$$

$$MTE_{ji} = \begin{cases} MTE_{ji}^* & \text{if } 0 < MTE_{ji}^* < 1 \\ 0 & \text{if } MTE_{ji}^* \leq 0 \\ 1 & \text{if } MTE_{ji}^* \geq 1 \end{cases} \quad (5.57)$$

where  $MTE_{ji}^*$  and  $MTE_{ji}$  denote the latent and observed metafrontier technical efficiency scores of the  $i^{th}$  firm in group  $j$  respectively;  $z_{ji}^{MTE}$  represents the explanatory variables for metafrontier technical efficiency;  $\delta^{MTE}$  is a vector of unknown parameters to be estimated and  $w_{ji}^{MTE}$  is the random error item.

The hypothesis tests of the Tobit regression can be conducted to test the significance of each explanatory factor on the technical efficiency level relative to the metafrontier. However, as pointed out by Otieno *et al.* (2014), there is a dearth of empirical studies applying the SM-Tobit model with only Chen and Song (2008) as an exception. This research applies this method to fill this gap.

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<sup>22</sup> Hoff (2007) discussed some alternatives to Tobit regression in explaining technical efficiency differences, such as a non-linear quasi-likelihood model proposed by Papke and Wooldridge (1996).

In summary, for estimating the scores and determinants of technical efficiency relative to a regional frontier, the technology gap ratio between the eastern region and the non-eastern region and technical efficiency relative to a national metafrontier for private manufacturing SMEs in China, this research utilises a fully parametric SMF model by Huang *et al.* (2014), a one-stage approach SFA (technical inefficiency or technology gap effects model) by Battese and Coelli (1995) and a Tobit regression model. We use the SMF-one-stage SFA-Tobit to represent this combined model, which follows six steps as summarised in Table 5.2. The data and variables used are discussed in Chapter 6.

**Table 5.2 Analytical process in this research: SMF-one-stage SFA -Tobit model**

Step	Process
<b>Step 1</b>	Identifying inputs and outputs used by firms and the entrepreneurial, internal and external firm factors that can have relationship with the technical efficiency and technology gap ratio.
<b>Step 2</b>	Private SMEs in the sample are classified into two groups: firms in developed eastern regions; and firms in less-developed non-eastern provinces.
<b>Step 3</b>	Two regional frontiers are constructed using group samples by the first step of the fully parametric stochastic meta-production function (SMF) model (Huang <i>et al.</i> , 2014) and technical inefficiency effects model based on the one-stage approach SFA (Battese & Coelli, 1995) to obtain: <ul style="list-style-type: none"> <li>(1) SFA efficiency scores of each firm with respect to their own regional frontier (<math>\hat{T}E_i^j</math>) and</li> <li>(2) the relationships of entrepreneurial, internal and external firm factors with technical inefficiency relative to the regional frontier of each group.</li> </ul>
<b>Step 4</b>	Using the fitted value in the estimated regional production function from step 3 as output and pooled samples, the metafrontier is constructed by the second step of SMF (Huang <i>et al.</i> , 2014) and technology gap effects model based on the one-stage approach SFA (Battese & Coelli, 1995) to obtain: <ul style="list-style-type: none"> <li>(1) the technology gap ratio score of each firm (<math>\hat{T}GR_i^j</math>) and</li> <li>(2) the relationships of entrepreneurial, internal and external firm factors with the technology gap ratio between eastern and non-eastern private manufacturing SMEs.</li> </ul>
<b>Step 5</b>	The technical efficiency of each firm relative to the metafrontier ( $M\hat{T}E_{ji}$ ) is estimated by: $M\hat{T}E_{ji} = \hat{T}E_i^j \times \hat{T}GR_i^j$
<b>Step 6</b>	Finally, the relationships of entrepreneurial, internal and external firm factors with the technical efficiency relative to the metafrontier are estimated by the Tobit regression model.

Source: Author's summary.



## 5.7 Summary

This chapter discussed utilisation of the metafrontier rather than the traditional production frontier to estimate technical efficiency and the technology gap ratio by using the fully parametric SMF approach. Based on the definition of technical efficiency proposed by Koopmans (1951), Farrell (1957) developed the traditional type efficiency measure using Shephard's input and output distance functions (Färe & Lovell, 1978; Färe *et al.*, 1994; Balk, 2001; Coelli *et al.*, 2005). While Farrell's traditional efficiency measure assumed that all firms in the estimated sample utilise the same technology in production, the metafrontier approach argues that firms in the sample may use different technology due to constraints that they may face relating to physical, human and financial capital and business environments (Sharma & Leung, 2000; Battese *et al.*, 2004; O'Donnell *et al.*, 2008). Given that it is meaningless to compare efficiency levels measured relative to different frontiers, the metafrontier technical efficiency should be estimated to compare efficiency levels between groups (O'Donnell *et al.*, 2008). This is especially the case for China's SMEs due to the different development stages of eastern and non-eastern regions (see details in Chapter 2 and 3). The metafrontier can be constructed by enveloping all group-specific frontiers, assuming that all firms can potentially use the common meta-technology (see Figure 5.5) (Van der Sluis *et al.*, 2005; O'Donnell *et al.*, 2008; Wang *et al.*, 2013). Three estimators can be obtained from the metafrontier technique, including: technical efficiency relative to the group frontier ( $TE_i^j$ ), technical efficiency relative to the metafrontier ( $MTE_{ji}$ ), and the technology gap ratio ( $TGR_i^j$ ). The metafrontier technique has been utilised in many research areas, such as agriculture and energy efficiency in China (e.g. Chen & Song, 2008; Chang *et al.*, 2015; Yao *et al.*, 2015), but there is still no empirical study applying the metafrontier technique to SMEs. This research fills this gap by estimating the technical efficiency relative to regional frontiers, the technology gap ratio between the regional frontier and metafrontier and technical efficiency relative to the metafrontier for private manufacturing SMEs in the eastern and non-eastern provinces of China.

For empirical estimation of technical efficiency there exist two competing approaches: the parametric stochastic frontier analysis (SFA) and non-parametric data envelopment analysis (DEA). The DEA technique constructs a production frontier by enveloping all the best-practice production units and regarding all deviations from the production

frontier as being due to technical inefficiency (Mortimer & Peacock, 2002; Coelli *et al.*, 2005; Fried *et al.*, 2008; Cooper *et al.*, 2011). However, SFA is a parametric regression-based technique. It pre-assumes the form of the production function with an inefficiency effect term and random error, and utilises the maximum likelihood method to estimate the production function (Mortimer & Peacock, 2002; Coelli *et al.*, 2005). Both the parametric SFA and non-parametric DEA have their own advantages and disadvantages (Hjalmarsson *et al.*, 1996; Mortimer & Peacock, 2002). Considering the random error in the production function, SFA can provide statistical properties and confidence intervals on estimates, and the estimates from SFA are less sensitive to statistical noise, especially outliers, compared with those obtained from DEA (Coelli *et al.*, 2005; Fried *et al.*, 2008; Andor & Hesse, 2014). Also, with a pre-assumed production function form, SFA can provide the marginal product of each input while DEA cannot (Charoenrat & Harvie, 2013; 2014). However, compared with DEA, SFA requires a large sample size to get unbiased results (Murillo-Zamorano, 2004; Coelli *et al.*, 2005). Also, the pre-assumption of the functional form can only provide output-oriented efficiency estimates, while DEA can allow for both input- and output-orientation. The estimates from SFA are also sensitive to the choice of functional form (Coelli, 1996; Fried *et al.*, 2008). Given the potential existence of outliers in firm-level data, the appropriateness of using output-orientation for SMEs due to the resource constraints they face, the large sample size for this study and the well-developed metafrontier technique in the parametric approach, we argue that the advantage of SFA can outweigh its weaknesses in the context of this research. Therefore, the parametric approach is chosen for this study.

The parametric SMF model was first proposed by Battese and Rao (2002) and further developed by Battese *et al.* (2004). This model constructs group-specific frontiers by using the traditional parametric SFA technique, then the metafrontier is constructed by 'best' enveloping all group-specific frontiers using mathematic programming. Without considering random error in the metafrontier function this model is only a half-parametric method and can still give biased results for metafrontier technical efficiency (Chen *et al.*, 2014; Huang *et al.*, 2014; Chang *et al.*, 2015; Huang *et al.*, 2015). The fully parametric SMF model has been developed by Huang *et al.* (2014) and constructs group-specific frontiers and a metafrontier using a parametric production function considering statistical

noise and thus provides unbiased estimates. This model is utilised for metafrontier technical efficiency estimation in this research.

Finally, the main aim of this research is to investigate the relationships of entrepreneurial, external and firm-specific factors with the technical efficiency of private manufacturing SMEs in China. This requires the estimation of determinants of technical efficiency. For group-specific technical efficiency the scores and determinants are estimated simultaneously by the group-specific production function model in the first step of the SMF model (Equation (5.40)) and the technical inefficiency effects model based on the one-stage SFA approach by Battese and Coelli (1995) (Equation (5.51)). The scores and determinants of the technology gap ratio are also estimated simultaneously, utilising the metafrontier function model in the second step of the SMF model (Equation (5.45)) and the technology gap effects model based on the one-stage SFA approach (Equation (5.54)). The one-stage SFA approach is utilised because it can provide higher consistency in estimating the scores and determinants of technical efficiency (technology gap ratio) (Wang & Schmidt, 2002; Simar & Wilson, 2007; Diaz & Sanchez, 2008). Then the determinants of metafrontier technical efficiency, which is the product of the estimated group-specific technical efficiency and technology gap ratio, are estimated using a Tobit regression model developed by Tobin (1958). The Tobit regression is used instead of normal OLS because it is more appropriate when the value of dependent variable technical efficiency scores is bounded between 0 and 1 (Kumbhakar & Lovell, 2003; Coelli *et al.*, 2005; Otieno *et al.*, 2014). The combined model utilised in this research is represented by the SMF-one-stage SFA-Tobit for short. The detailed analytical process involved in this research is summarised in Table 5.2. Utilising this model for empirical analysis in this research, the inputs and outputs used by firms in production and relevant entrepreneurial, internal and external firm factors need to be identified in terms of variables and data. This is conducted in Chapter 6.

## **Chapter 6 Data sources, sample selection and variables**

### **6.1 Introduction**

This chapter introduces the data sources and sample selection used in this study. The location and size distribution of firms in the sample, the efforts made to reduce survey errors and variables to be used in the empirical analysis are also shown. The data used in this research is from the 2012 Chinese private enterprises survey conducted jointly by The United Front Work Department of the CPC Central Committee (UFWD), All-China Federation of Industry and Commerce (AFIC), State Administration of Industry and Commerce (SAIC) and the China Society of Private Economy at the Chinese Academy of Social Sciences (CASS). As the only officially authorised survey on the private sector in China, the data set obtained from this series of surveys is of high quality and is the most commonly used for the study of China's entrepreneurs and private firm performance. Of the total of 5,073 observations obtained from the 2012 survey, 664 are private manufacturing SMEs with adequate data for technical efficiency estimation and the identification of key determinants (see literature review in Chapter 4). These 664 private manufacturing SMEs constitute the final sample to be used in this study. The survey group used various methods to reduce the sampling, measurement, coverage and non-response errors to ensure the information obtained reliable. The variables used in the SMF-one-stage SFA-Tobit model introduced in Chapter 5 include output and three inputs for estimating technical efficiency scores. Nine entrepreneurial factors and six control variables on firm-specific factors are used in identifying the determinants of technical efficiency. The measures for these variables are introduced in detail in this chapter.

The chapter is organised as follows. Section 6.2 introduces the Chinese private enterprises survey of 2012, the extracting steps used to draw usable sample data from the original sample, and the location and size distribution of the private manufacturing SMEs used in the final sample. The ways to reduce survey errors are discussed in Section 6.3. The inputs and outputs used for estimating technical efficiency and variables on entrepreneurial factors and firm-specific factors used for identifying determinants of the estimated scores are described in Section 6.4. A summary of this chapter is provided in Section 6.5.

## 6.2 Data source

The raw data source of this study is from the Chinese private enterprises survey conducted in 2012. Due to the increasing importance of the private sector, the Chinese government decided to carry out sample surveys on entrepreneurs and their private enterprises from 1992. These surveys are designed by *China's Private Enterprise Research Group* and are jointly compiled by The United Front Work Department of the Communist Party of China (UFWD), Central Committee (CC), All-China Federation of Industry and Commerce (AFIC), State Administration of Industry and Commerce (SAIC) and the China Society of Private Economy at the Chinese Academy of Social Sciences (CASS). The surveys are then jointly carried out by province, city and district-level branches of the Federation of Industry and Commerce (FIC) and Administration of Industry and Commerce (AIC). According to China's Private Enterprise Research Group (2012), the main aim of the Chinese private enterprises survey is to: (1) obtain information on the business conditions, and development tendency of China's private enterprises, and (2) provide data resources for quantitative analyses of the performance, obstacles and development of the Chinese private sector. These surveys provide evidence to policy makers concerning the effective promotion of the private sector, provide information about the private sector for the public and provide primary data for the study of the Chinese private sector. Until 2014, this series of surveys had been conducted eleven times, every two years, from 1992. It has tracked the development of private enterprises from a negligible sector to a significant sector of China's economy. It covers comprehensive information on the background of entrepreneurs and the performance, challenges and obstacles faced by their firms.

The nationwide coverage and reliability of this survey make it a significant source for the study of entrepreneurs and private enterprises in China. In fact, it is the only reliable dataset that contains detailed information on Chinese entrepreneurs and their private enterprises simultaneously. Therefore, this survey data has been utilised in a number of academic studies (Chow *et al.*, 2012). For example, Li *et al.* (2006) examined the determinants of an entrepreneur's political participation using data from the 5<sup>th</sup> private enterprises survey conducted in 2002. Utilising the same dataset, Li *et al.* (2008) identified the relationship of an entrepreneur's political connections with a firm's access to bank loans and confidence in the Chinese legal system, while Chow *et al.* (2012) investigated the relationship of an investment opportunity set and an entrepreneur's

political connections with firm performance. Lu *et al.* (2010) used data from the 7<sup>th</sup> private enterprises survey in 2006 to examine the relationships of union membership with the profitability of private enterprises in China. The same data was also utilised by Su and He (2010) to identify the relationship between a firm's philanthropic donations and profitability, while Chong *et al.* (2013) researched private firm credit constraints in China. Pooling data from the surveys in 2004 and 2006, Talavera *et al.* (2012) examined the relationship of an entrepreneur's social capital with a firm's access to finance. The wide usage of data from this survey series is testimony to its quality and reliability.

Nevertheless, there has been no study identifying the relationships of entrepreneur's start-up motivation, personal characteristics and networks with private firm efficiency in China using this dataset. Also, the studies introduced above used survey data from 2002, 2004 or 2006, which are now out of date. This research will use the latest available cross-sectional data for 2012 to show the recent development of private manufacturing SMEs in China. However, this data series cannot be used to estimate the productivity of firms. This is because the firms surveyed can be different in each year, thus cannot form the panel data required for productivity estimation. This is the main drawback of this data series, and also the reason that only technical efficiency can be estimated as a performance indicator and only one year of data (for 2012) has been utilised in this research.

### ***2012 China private enterprises survey***

The raw data to be used in this study was captured from the 2012 private enterprises survey. Unlike surveys in earlier years, which covered mainly large and medium-sized enterprises, this 10<sup>th</sup> survey included more small and micro-sized enterprises due to the increasing importance of the small and micro sector to the economy. The sample was drawn from 31 province-level regions, covering all of the political subdivisions in mainland China. In 2012 the number of private enterprises in China was 9,676,776. The survey comprises 4,800 newly surveyed enterprises (2,400 by FIC and 2,400 by AIC), which represents 0.05 per cent of the total number, and 653 enterprises tracked from the previous survey sample. The number of private enterprises to be surveyed in each province-level region was the product of the share of this region in the national total number of private enterprises and the total survey sample size (4,800). Then the number of firms in every sub-sample (in each city/county, urban/rural area and industry) was

decided upon using the same process as that used by China's Private Enterprise Research Group. In drawing up the final list of private enterprises in the sample, FIC used an isometric sampling method, while a simple random sampling method was used by AIC. The questionnaire for the survey in 2012 consisted of 31 main questions grouped into three sections: (1) the characteristics of entrepreneurs, including their gender, year of birth, education level, occupation history, political and social affairs participation and household income; (2) the information on the firm, including the firm's main industry, registration year, capital structure, operating cost, employee usage, cost and benefits, finance sources, total revenue, tax, profit, new investments, exports, decision-making process, pollution control and donations; (3) the opinion of entrepreneurs on the current business environment and policies promoting the development of the private sector.

In the 2012 survey a total of 5,940 questionnaires were distributed, consisting of 2,640 by FIC and 3,300 by AIC. The response rate was 85.40 per cent, with 5,073 questionnaires returned. The final sample used in this research were extracted from these 5,073 observations in three steps. First, these 5,073 private enterprises cover all industries in China. The share of each industry in the sample is shown in Table 6.1. Of the 5,073 observations there were 1,866 private enterprises operating in the manufacturing sector. Because this study focuses on the manufacturing sector, only these 1,866 firms involved in manufacturing are extracted from the sample. Hence, the sample size used in this study was reduced to 1,866 in the first step.

Second, this study focuses on SMEs. In the second step, manufacturing SMEs from the total of 1,866 manufacturing private enterprises were extracted from the sample. As discussed in Chapter 2, SMEs are defined according to a firm's total revenue and employee numbers. 100 observations with missing values for revenue and employee numbers were dropped, reducing the sample size to 1,766. These 1,766 private manufacturing firms were classified into large, medium, small and micro enterprises. As shown in Table 6.2, among the manufacturing sub-sample, 1,712 (96.94 per cent) are SMEs. Thus, the sample size used in this study was further reduced to 1,712. Of these 1,712 SMEs the biggest group size is small firms, while medium and micro sized firms accounted for 18.86 per cent and 20.10 per cent of the sample, respectively.

**Table 6.1 Industry share of private enterprises in the 2012 survey sample**

<b>Industry</b>	<b>Number</b>	<b>Percentage (%)</b>
Agriculture, Forestry, Animal Husbandry and Fishery	341	6.86
Mining	109	2.19
Manufacturing	1,866	37.55
Production and Supply of Electricity, Gas and Water	58	1.17
Construction	441	8.88
Transport, Storage and Post	187	3.76
Information Transmission, Computer Services and Software	241	4.85
Wholesale and Retail Trades	1,225	24.65
Hotels and Catering Services	324	6.52
Financial Intermediation	82	1.65
Real Estate	399	8.03
Leasing and Business Services	352	7.08
Scientific Research, Technical Services and Geologic Prospecting	198	3.98
Management of Water Conservancy, Environment and Public Facilities	37	0.74
Services to Households and Other Services	133	2.68
Education	56	1.13
Health, Social Security and Social Welfare	47	0.95
Culture, Sports and Entertainment	104	2.09
Public Management and Social Organizations	620	12.48
<b>Total</b>	<b>6820</b>	<b>137.25</b>

Source: Author's summary.

Note: The sum of enterprise number is larger than 5,073 and the sum of each share is larger than 100 per cent because many private enterprises were involved in several industries and the survey allowed firms to report up to three main industries.

**Table 6.2 Private manufacturing enterprises by size group in the 2012 survey sample**

	<b>Large</b>	<b>SMEs</b>	<b>Medium</b>	<b>Small</b>	<b>Micro</b>	<b>Total</b>
<b>Number</b>	54	1,712	333	1,024	355	1766
<b>Percentage (%)</b>	3.06	96.94	18.86	57.98	20.10	100.00

Source: Author's summary.

In the third step, of the remaining 1,712 private manufacturing SMEs, some observations needed to be further deleted because of a missing value problem. In estimating a firm's technical efficiency data on a firm's output revenue, employee numbers, capital, cost of intermediate inputs, net profit, tax and expenditure on employees as inputs are all required. Moreover, as the logarithm of output and inputs is used in the estimation model, observations with negative or zero values need to be excluded. Also, in order to identify the relationship of entrepreneurial and firm-specific factors with a firm's technical efficiency, data on the entrepreneur's age, gender, education level, occupation history, political and social affairs participation, firm's registration year, export participation,



credit access, research and development (R&D) activities and location are needed. Of the 1,712 sub-sample obtained in the second step, only 664 with adequate data for estimating scores and determinants of a firm's technical efficiency were extracted.

Hence, after applying the above three steps to the original cohort of firms, the final sample used for this study was 664 private manufacturing SMEs with sufficient information. These 664 private manufacturing SMEs include medium, small and micro-sized enterprises in each province of China. Table 6.3 shows the size and location distribution of these 664 private manufacturing SMEs in our sample. As discussed in Chapter 2, China has a significant regional disparity between eastern and non-eastern regions in terms of economic, market and private sector development. Therefore, SMEs in the sample are classified into two groups in this study to obtain robust estimation based on their location: SMEs located in eastern regions of China contain ten provinces and non-eastern regions of China include the remaining 21 provinces.

As shown in Table 6.3, although it includes only ten provinces, the number of private manufacturing SMEs in the eastern region is significantly higher than in the non-eastern region, which includes 21 central, western and northeastern provinces. Of the 664 manufacturing SMEs in the sample, 439 are in eastern provinces, accounting for 66.1 per cent of the total sample size. The eastern Jiangsu and Zhejiang provinces, in which entrepreneurship is developing most vigorously, contributed 25.9 per cent and 16.0 per cent of the total sample respectively. The other 225 SMEs in the sample are in the non-eastern regions, consisting of 78 (11.747 per cent) SMEs in central provinces, 77 (11.596 per cent) SMEs in northeastern provinces and 70 (10.542 per cent) SMEs in the western regions. The regional distribution of private manufacturing SMEs in the sample is consistent with the distribution of SMEs in the whole of China, in that the eastern provinces contained the majority of SMEs in 2012 (see Table 3.14). For both eastern and non-eastern sub-groups, most of the private manufacturing SMEs are small-sized, accounting for 67.426 per cent and 63.556 per cent of the total respectively. However, the share of medium-sized firms in eastern regions was 23.690 per cent, significantly higher than that in non-eastern provinces (10.667 per cent), showing that the firm size of SMEs in the more developed eastern regions is bigger than that in non-eastern provinces.

**Table 6.3 Number and regional distribution of private manufacturing SMEs and by size in the study sample**

Province-level regions	Medium	Small	Micro	Total	Percentage (%)
<b>Eastern provinces</b>					
Beijing	1	5	0	6	0.904
Tianjin	3	12	8	23	3.464
Hebei	3	5	2	10	1.506
Shanghai	2	9	0	11	1.657
Jiangsu	40	121	11	172	25.904
Zhejiang	30	71	5	106	15.964
Fujian	3	15	3	21	3.163
Shandong	17	28	6	51	7.681
Guangdong	5	30	3	38	5.723
Hainan	0	0	1	1	0.151
<b>Total</b>	<b>104</b>	<b>296</b>	<b>39</b>	<b>439</b>	<b>66.114</b>
<b>Percentage (%)</b>	<b>23.690</b>	<b>67.426</b>	<b>8.884</b>	<b>100</b>	
<b>Non-eastern provinces</b>					
<b>Central provinces</b>					
Shanxi	1	2	0	3	0.452
Anhui	6	20	3	29	4.367
Jiangxi	0	6	5	11	1.657
Henan	1	2	2	5	0.753
Hubei	3	19	6	28	4.217
Hunan	0	2	0	2	0.301
<b>Total</b>	<b>11</b>	<b>51</b>	<b>16</b>	<b>78</b>	<b>11.747</b>
<b>Western provinces</b>					
Inner Mongolia	0	1	1	2	0.301
Guangxi	1	4	0	5	0.753
Chongqing	2	10	6	18	2.711
Sichuan	3	8	0	11	1.657
Guizhou	1	1	0	2	0.301
Yunnan	0	1	1	2	0.301
Tibet	0	1	0	1	0.002
Shaanxi	1	7	2	10	1.506
Gansu	0	6	0	6	0.904
Qinghai	1	2	1	4	0.602
Ningxia	1	2	0	3	0.452
Xinjiang	1	3	2	6	0.904
<b>Total</b>	<b>11</b>	<b>46</b>	<b>13</b>	<b>70</b>	<b>10.542</b>
<b>Northeastern provinces</b>					
Liaoning	2	23	11	36	5.422
Jilin	0	8	6	14	2.108
Heilongjiang	0	15	12	27	4.066
<b>Total</b>	<b>2</b>	<b>46</b>	<b>29</b>	<b>77</b>	<b>11.596</b>
<b>Total</b>	<b>24</b>	<b>143</b>	<b>58</b>	<b>225</b>	<b>33.886</b>
<b>Percentage (%)</b>	<b>10.667</b>	<b>63.556</b>	<b>25.778</b>	<b>100</b>	
<b>Sum</b>	<b>128</b>	<b>439</b>	<b>97</b>	<b>664</b>	<b>100</b>
<b>Percentage (%)</b>	<b>19.277</b>	<b>66.114</b>	<b>14.608</b>	<b>100</b>	

Source: Author's summary.

Thus, the pooled sample in this study consists of 664 private manufacturing SMEs with 128 medium firms, 439 small firms and 97 micro enterprises. Considering that firms located in the central, western and northeastern provinces experience different economic and technical environments from those in the more well-developed eastern provinces, in this study we group all non-eastern regions together and use the metafrontier technique to estimate group-specific frontiers for private manufacturing SMEs in the non-eastern provinces and eastern provinces respectively, and then estimate a common metafrontier. Therefore, the total sample in this study is categorised into two sub-samples. The non-eastern sub-sample is comprised of 225 private manufacturing SMEs including 24 medium-sized, 143 small-sized and 58 micro-sized firms, while the eastern sub-sample has 439 private manufacturing SMEs, consisting of 104 medium-sized, 296 small-sized and 39 micro-sized enterprises. Separating the cohort of total firms into these two regions can also generate robust empirical results, and thus leads to reliable conclusions and policy recommendations for this research.

### **6.3 Survey errors**

As the only officially authorised survey on the private sector in China, the quality of this survey has been strictly controlled to minimise the survey errors. Statistical surveys usually contain four types of errors, including: sampling, measurement, coverage and non-response errors. The survey group has made many efforts to minimise these errors.

#### **6.3.1 Sampling error**

When observing a sample to represent the population instead of investigating the whole population, sampling error often occurs in the random sample selection process, due to which a survey statistic can differ from its ‘true’ value. When the population number is big and using a sample is the only way to estimate values, a sampling error becomes unavoidable. But there are two common methods that can minimise it, which is utilised by the *Private Enterprises Surveying Group*:

- First, the sampling error can be effectively reduced by increasing the sample size. The sample size is chosen to be 3,000 in the 2010 survey, which accounts for 0.035% of the total private enterprises. In the 2012 survey, this ratio increased to 0.05%, making

the sample size increase to 5,453 with the objective of reducing the sampling error.

- Second, a significant method to reduce sampling error is to use stratified-random sampling, which is preferred to random sampling because it can ensure the sample covers every subpopulation to avoid bias. The survey group applied a multi-stage stratified-random sampling method for sample selection. As described in Section 6.2, the number of enterprises to be interviewed in each province/city/county, urban/rural area and industry is determined based on its share of total private firms in China. Then the private enterprises interviewed are chosen randomly by the government. In this way, the sample can comprehensively cover all regions with different development levels and all industry sectors of China to minimise sampling error.

### **6.3.2 Measurement error**

The measurement error is about the accuracy of the answers to survey questions. It is the difference between the answer recorded in the survey and the true answer of the question. The measurement error relates to the understanding and knowledge of the survey questions and items by respondents and interviewers. It also involves the incentives for respondents to provide and interviewers to record current answers. The *Private Enterprises Surveying Group* tried to reduce measurement error by various methods:

- First, in the questionnaire development, cognitive research has been conducted to evaluate the understanding of the key questions and concepts. Questions were designed to be well-presented and easy to understand based on the research result.
- Second, the interviewers are required to be professional and receive training for three months to better understand the research items, questions and concepts. At the end of the training there was an assessment examining the understanding of interviewers and only those who passed the assessment conducted interviews in the survey.
- Third, the pre-testing covering 100 random private enterprises was conducted a half year before the survey to rehearse for the whole survey process and identify problems relating to the wording of questions. Questions that cannot be easily understood and answered were modified or replaced.
- Fifth, the objective of the private enterprises survey is to obtain information about the entrepreneurs and the firm. The best respondents that can access this information are the entrepreneurs themselves. Thus, the survey required that the respondents must be the entrepreneurs in person, which is supported by Chinese legal regulations.

- Last, the truthful reporting of surveyed firms and recording of interviewers are also required by Chinese legal regulations with strict penalties for those providing inaccurate information on purpose.

### 6.3.3 Coverage error

Besides sampling and measurement errors, another significant error relating to surveys is the coverage error, which usually occurs if some members of the population are excluded from the possibility of sample selection. To reduce the coverage error, it requires a comprehensive sample frame that can best represent the target population. In order to deal with coverage error, the *Private Enterprises Surveying Group* used:

- On-site face-to-face interviews: Face-to face interview is a data collection mode with lower coverage error than telephone interviews, which excludes those without officially registered business telephone numbers, and internet surveys, which excludes enterprises without an official email address and websites.
- Use of a sample list based on private business registrations in the Administration of Industry and Commerce (AIC) database: According to the *Chinese Enterprises Law*, every business should be registered in the local AIC and update their demographic information (e.g. address, legal entities) yearly. Using the official register as a sample list can ensure the inclusion of all active private enterprises in a region to reduce coverage error.

### 6.3.4 Non-response error

The last type of survey error is non-response error, which occurs when respondents in the sample do not respond to the interview or some of the survey questions. To reduce this error, the following methods are utilised by the *Private Enterprises Surveying Group*:

- First, the importance of the private enterprises survey was well propagandized via traditional media, social media, business associations and AIC before the survey. AIC also sent entrepreneurs in advance letters to show the importance of their participation in the survey. This made entrepreneurs notice that their responses are significant for China's economic development and can contribute to policy-making that ultimately promotes their enterprises, thus, increase their incentive to respond to the survey.
- The duration of the interview is designed to be within a half hour to reduce the cost involved for respondents in completing the survey.

**Table 6.4 Summary of variables to be used in the models and their description**

<b>Variables</b>	<b>Description</b>
<b>Technical efficiency estimation</b>	
<b>Output variables</b>	
Output ( $\ln Y$ )	The logarithm of a firm's total revenue in 2012 (in thousand RMB)
<b>Input variables</b>	
Labour input ( $\ln L$ )	The logarithm of a firm's total employee numbers in 2012 (in persons)
Capital input ( $\ln K$ )	The logarithm of a firm's capital at the end of 2012 (in thousand RMB)
Intermediate input ( $\ln M$ )	The logarithm of a firm's material, energy, fuel, purchased service and outsourcing cost, proxied by the total cost of the firm excluding employee expenditures (in thousand RMB)
<b>Determinants of technical efficiency scores and technology gap ratio identification</b>	
<b>Entrepreneurial factor variables</b>	
Entrepreneur's start-up motivation	
Motivation ( <i>Opportunity</i> )	Dummy variable: if the entrepreneur is opportunity-driven, represented by no unemployment experience prior to start-up
Entrepreneur's personal characteristics	
Age ( <i>Age</i> )	Entrepreneur's age at start-up, calculated by firm's registration year minus entrepreneur's birth year
Gender ( <i>Male</i> )	Dummy variable: if the entrepreneur is male (1 = male, 0 = female)
Education ( <i>Edu</i> )	Dummy variable: if the entrepreneur has at least a bachelor's degree (bachelor's degree or above = 1, less than bachelor's degree = 0)
Experiences	
Management ( <i>Exp<sub>manage</sub></i> )	Dummy variable: if the entrepreneur has management experience (management experience = 1, no management experience = 0)
Start-up ( <i>Exp<sub>startup</sub></i> )	Dummy variable: if the entrepreneur has start-up experience (start-up experience = 1, no start-up experience = 0)
Technical ( <i>Exp<sub>technical</sub></i> )	Dummy variable: if the entrepreneur has technical staff experience (technical staff experience = 1, no technical staff experience = 0)
Entrepreneur's networks ( <i>Guanxi</i> )	
Political ( <i>Guanxi<sub>political</sub></i> )	Dummy variable: if the entrepreneur is a prior/current government officer, a member of the Communist Party of China (CPC), People's Congress (PC) or Chinese People's Political Consultative Conference (CPPCC) (member = 1, not a member = 0)
Business ( <i>Guanxi<sub>business</sub></i> )	Dummy variable: if the entrepreneur is a member of All-China Federation of Industry and Commerce (ACFIC) (member = 1, not a member = 0)
<b>Firm-specific factor variables</b>	
Medium-sized ( <i>Size<sub>medium</sub></i> )	Dummy variable: if the firm is medium-sized (medium size = 1, small and micro firms = 0)
Firm's age ( <i>Firmage</i> )	Firm's operating years until 2012 calculated by 2012 minus firm's registration year
Export intensity ( <i>Export</i> )	The ratio of total export value to total sales in 2012
Credit in 2012 ( <i>Credit</i> )	The ratio of total bank loans obtained in 2012 to total capital
R&D intensity ( <i>R&amp;D</i> )	The ratio of total R&D expenditure to total sales in 2012
Location ( <i>Noneast</i> )	Dummy variable: if the firm is located in non-eastern provinces (non-eastern province = 1, eastern province = 0)
Location ( <i>GDP</i> )	GDP per capita of the province that the SME is located in in 2012.

Source: Author's summary.

## 6.4 Description of variables

This section introduces the variables to be used in the SMF-one-stage SFA-Tobit regression model discussed in Chapter 5. The variables used for the estimation of technical efficiency include variables for output and labour, capital and intermediate inputs. Nine entrepreneurial characteristic variables and six firm-specific variables are used to identify the determinants of estimated scores. The descriptions of these variables are summarised in Table 6.4.

### 6.4.1 Variables used in the estimation of technical efficiency and technology gap ratio: Inputs and output

As discussed in Chapter 5 the estimation of technical efficiency scores requires the building of production frontiers. To build production frontiers, data on firm inputs and outputs are required (Färe *et al.*, 1985). According to Coelli *et al.* (2005), the quantity, price and quality of a firm's inputs and outputs are important in the context of productivity and efficiency measurement.

#### 6.4.1.1 Output ( $\ln Y$ )

In the context of estimating productivity and efficiency, the two most common measures of output for manufacturing enterprises or industries are: (1) gross output and (2) value-added (OECD, 2001; Cobbold, 2003; Söderbom & Teal, 2004). While the gross output approach measures output using capital (K), labour (L) and intermediate inputs (M), the value-added approach measures output produced with capital (K) and labour (L), excluding intermediate inputs (M) (*Value-added = Gross output – Intermediate inputs*).

Both the gross output approach and the value-added approach have their own advantages and drawbacks. Since firms may use goods and services from other industries as intermediate inputs, many empirical researchers argue that the value-added approach is more applicable because it waives the difficulties of dealing with inter-industry flows of goods and services and making estimated efficiency levels comparable across sectors or industries (Cobbold, 2003; Hossain & Karunaratne, 2004). Moreover, the value-added approach also accounts for the quality of intermediate inputs and minimises double counting for aggregated output (Salim & Kalirajan, 1999). Therefore, value-added has

been used as the proxy for output in many studies estimating technical efficiency (Brada *et al.*, 1997; Chapelle & Plane, 2005; Charoenrat & Harvie, 2014).

However, other researchers have pointed out that, in micro level studies, the value-added approach is conceptually flawed, and thus the estimated results can be hard to interpret (OECD, 2001; Balk, 2009). First, in the real world, firms or industries produce in units of gross output, other than value-added, using capital, labour, energy and raw materials (Oulton & O'Mahony, 1994; Cobbold, 2003). As stated by Basu and Fernald (1995), it is more reasonable to suggest how much the total output level a firm can increase under the same level of all inputs using the estimated efficiency score, rather than how much they can increase value-added output, which they are actually not producing. Second, the gross output approach can give more accurate results. This is because the value-added approach assumes that the marginal product of intermediate inputs is equal to their price, which only holds in a perfectly competitive market (Basu & Fernald, 1995). Also, in production, the roles of all three inputs are symmetric and substitution can proceed between them (Basu & Fernald, 1995). Nevertheless, the value-added approach does not estimate the productive contribution of intermediate input. Thus, the elasticity of substitution between intermediate input and the other two inputs cannot be estimated (Jorgenson *et al.*, 1987; Cobbold, 2003). As the gross output approach is a preferable measure in technical efficiency estimation, many empirical studies have used gross output as a measure of manufacturing output (e.g. Nishimizu & Page, 1982; Page, 1984; Hill & Kalirajan, 1993; Sun *et al.*, 1999; Lundvall & Battese, 2000; Alvarez & Crespi, 2003; Zheng *et al.*, 2003; Oczkowski & Sharma, 2005; Amornkitvikai & Harvie, 2011).

Due to the fact that this research focuses on the manufacturing industry without considering subsectors because of data limitations, the technical efficiency across industries and sectors will not be compared. Additionally, this research estimates the firm-level technical efficiency of private manufacturing SMEs in China, in which the double counting problem of aggregate output becomes insignificant. Moreover, although the absolute monopoly of China's electricity industry by central state-owned companies has been broken since 1985, the current electricity industry in China is still relatively monopolistic (Wang & Chen, 2012). This situation is similar in the gas, water supply and energy industries (Guo & Hu, 2004; Wang *et al.*, 2011). Therefore, the aim of this



research, and the imperfect intermediate inputs markets in China, make the advantages of the gross output approach outweigh the value-added approach. This research uses the logarithm of a firm's gross output ( $\ln Y$ ) as the output measure in the production functions, using a firm's total revenue in 2012 as a proxy.

#### 6.4.1.2 Labour input ( $\ln L$ )

As one of the three inputs in the gross output approach, labour input can be measured by (1) the number of persons employed, (2) the number of hours of labour input, (3) the number of full-time equivalent employees or (4) the total wages and salaries bill (Coelli *et al.*, 2005). According to OECD (2001) and Coelli *et al.* (2005), the number of working hours is the most appropriate measure for labour input in productivity and efficiency estimation because it accounts for the hours worked by full-time employees and also the share of part-time employees. However, data on employees' work hours is usually not available. This is also the situation for this research. Alternatively, researchers can use the total annual wage bill and the total number of employees to measure labour input. The wage bill paid by a firm annually is argued to be a good measure by some researchers because the wage can capture the marginal product of labour (Syverson, 2011). Nevertheless, as emphasised by Coelli *et al.* (2005), measuring labour input by the total wage bill has a significant drawback because it ignores wage differences across sectors and regions, and the consequent fact that wages fail to reflect labour quality and working hours when there is a large sectoral or regional disparity.

The significant regional disparity in China (see Chapter 2) is also evident in wages. According to NBS (2017b), the average annual wage in the manufacturing sector in 2016 was RMB 61,667 in Tianjin, but only RMB 30,085 in Jilin province. Although the data for total employee numbers and the wage bill are both available in the 2012 private enterprises survey, the big regional wage disparity in China makes the drawback of using the wage bill measure significant. This research uses a more straightforward and appropriate measure for labour input, which is total employee numbers. There are many studies using employee numbers as the labour input measure to estimate technical efficiency in the manufacturing sector (e.g. Hill & Kalirajan, 1993; Kaynak & Pagán, 2003; Hossain & Karunaratne, 2004; Wu *et al.*, 2007). Therefore, this study will use the

logarithm of total labour employee numbers in 2012 ( $\ln L$ ) in estimating the production functions and technical efficiency scores.

#### 6.4.1.3 Capital input ( $\ln K$ )

The benefits of capital input can be derived from the services that flow from the various physical assets of firms used in production, which can be measured by total machine hours. But total machine hours are usually unobservable. Assuming the capital service flow is proportional to the capital stock for each productive asset, the total capital stock can be used as a practical tool for estimating capital service flows (OECD, 2001; Coelli *et al.*, 2005). The most appropriate method to measure capital stock is the Perpetual Inventory Method, requiring data on various factors including: (1) a time series of investments on this asset, (2) a price index series, (3) retirement patterns for this asset, and (4) the age-efficiency pattern of this asset (Coelli *et al.*, 2005). Such required data are not available in the 2012 private enterprises survey, making it impossible to be applied in this study.

Usually, the alternative measures for capital input are (1) the replacement value of productive capital (e.g. Nishimizu & Page, 1982; Lundvall & Battese, 2000; Aggrey *et al.*, 2010), (2) gross fixed assets (e.g. Kalirajan & Tse, 1989; Jones *et al.*, 1998; Sun *et al.*, 1999; Hossain & Karunaratne, 2004) and (3) net fixed assets (e.g. Wu, 1995; Zheng *et al.*, 2003; Destefanis & Sena, 2007; Wu *et al.*, 2007; Charoenrat & Harvie, 2014). But when information on fixed assets and replacement value is not available, the current capital value can also be used as an alternative measure for capital input (e.g. Harada, 2004; Oczkowski & Sharma, 2005; Minh *et al.*, 2007). Moreover, as discussed by Salim and Kalirajan (1999), firms may use machines more often at a constant level of output for a much longer period than the accounting depreciatory life of the machine until it is totally discarded or sold for scrap, especially in less developed countries. Therefore, the use of gross capital stock, rather than net capital, is more appropriate for developing countries (Hossain & Karunaratne, 2004) like China. The 2012 private enterprises survey only provides information about the total capital owned by the firm at the end of 2012 but does not provide data for fixed assets. Due to this data limitation, this research utilises the logarithm of the capital input ( $\ln K$ ), using a firm's total capital at the end of 2012 as a proxy in estimating technical efficiency.

#### 6.4.1.4 Intermediate input ( $\ln M$ )

In the gross output approach, a significant input in the production process is intermediate inputs, mainly including (1) energy input, (2) materials, and (3) purchased services and outsourcing (Coelli *et al.*, 2005). Some empirical studies only use material input in estimating a manufacturing firm's technical efficiency (e.g. Nishimizu & Page, 1982; Chirwa, 2001), omitting the role of energy and purchased services in production. On most occasions it is hard to obtain expenditure on energy, materials, purchased services and outsourcing separately in detail. These inputs are usually aggregated into one category in most empirical estimations. For example, Hill and Kalirajan (1993) aggregated total consumption of material inputs and energy inputs for Indonesian small enterprises in the garment sector. There are also many studies using aggregated costs, including raw materials, solid and liquid fuel, electricity and water, as proxies for intermediate inputs following the study done by Lundvall and Battese (2000). But the 2012 private enterprise survey does not provide direct information on cost of materials, fuel, electricity, water and purchased services. Instead, data on net profit, tax and turnover, which can be used to compute costs of the firm, and total employee expenditures, are available. This study follows Amornkitvikai and Harvie (2011) to derive intermediate inputs by subtracting total employee expenditures from the sum of production and non-production costs.

In China, the production cost of a firm comprises (1) material cost, (2) fuel and energy cost, (3) labour cost, and (4) manufacturing overheads, while non-production cost includes (1) selling expenses, (2) general and administrative expenses, and (3) financial expenses. According to Chinese accounting principles, net profit can be derived by subtracting production and non-production cost described above, operating taxes and surcharges, income taxes and non-operating expenditure from operating and non-operating revenue. Therefore, the sum of production cost and non-production cost can be measured by subtracting net profit and taxes (sum of operating taxes and surcharges and income taxes) from total operating revenue. Non-operating revenue and expenditure is not considered in this research, assuming gross profit equals operating profit, because non-operating activities are negligible for private SMEs in China. Also, using production and non-production costs as a proxy for intermediate input, total employee expenditures including total wages, bonuses and employee benefits should be excluded. This is because employee expenditure is a cost relating to labour input other than an intermediate input.

As a result, intermediate input ( $M$ ) is represented by the sum of operating costs including (i) material cost (raw materials, auxiliary materials, spare parts, purchased components and other materials), (ii) cost of fuel, (iii) cost of energy, (iv) purchased services and outsourcing, and (v) other production and non-production costs. It is measured by subtracting net profit  $NP_i$ , taxes  $Tax_i$  and employee expenditures  $E_i$  from total operating revenue ( $Y_i$ ) in 2012, which is shown in the following:

$$\ln M_i = \ln(Y_i - NP_i - Tax_i - E_i).$$

#### **6.4.2 Variables used in identifying the determinants of technical efficiency and the technology gap ratio**

After estimating technical efficiency scores, it is then necessary to identify variables capturing the relationships of entrepreneurial factors with the technical efficiency of private SMEs in China. These variables include entrepreneurial factors and internal and external firm-specific control variables.

##### 6.4.2.1 Entrepreneurial variable factors

The entrepreneurial variables include an entrepreneur's start-up motivation, age, gender, education level, management, start-up and technical experiences and political and business connections. The details of these variables are described in the following.

##### ***Entrepreneur's start-up motivation (opportunity- or necessity-driven)***

As discussed in Chapter 4 this research applies the entrepreneur's start-up motivation classification identified by the Global Entrepreneurship Monitor (GEM). While opportunity-driven entrepreneurs are motivated by exploring and seizing opportunities in the market, necessity-driven entrepreneurs start a firm due to lack of opportunities in the waged sector (Reynolds *et al.*, 2002).

In empirical research the identification of whether an entrepreneur is opportunity-driven or necessity-driven is usually based on start-up reasons. Some researchers classify detailed reasons into opportunity-driven and necessity-driven categories (e.g. Williams, 2008; Williams & Round, 2009). Others use one simple question about whether the

entrepreneur started their business because of an opportunity or out of necessity (e.g. Robichaud *et al.*, 2010; Verheul *et al.*, 2010). Another way to identify opportunity/necessity-driven entrepreneurs is based on whether they left their previous job voluntarily (e.g. Block & Sandner, 2009; Block & Wagner, 2010). These studies all used self-conducted surveys with specially designed questions on the start-up motivation.

The 2012 private enterprises survey, however, does not contain detailed information about start-up reasons. Under this circumstance a proxy for start-up motivation needs to be found. According to the push and pull theory, the most significant factor pushing a necessity-driven entrepreneur to start up a business is unemployment (Granger *et al.*, 1995; Kautonen & Palmroos, 2010). Therefore, necessity-driven entrepreneurs are often narrowly defined as those who start up their businesses because of unemployment-related reasons although some other factors can also play a role. This has been confirmed by many empirical studies where most necessity-driven entrepreneurs were unemployed prior to start-up (Block & Wagner, 2010).

Following van Praag (2003), this research utilises unemployment as a proxy for the necessity-driven start-up motivation. A dummy variable *Opportunity* is created to identify whether the entrepreneur is opportunity-driven. It takes a value of 0 if the entrepreneur responded 'yes' to the question as to whether they were 'unemployed prior to start-up'; otherwise it is given a value of 1. However, it should be noted that not all necessity-driven entrepreneurs are pushed into entrepreneurship because of unemployment and not all employed individuals choose to become entrepreneurs because of business opportunities. Some entrepreneurs could also be driven by necessity and opportunity motivations simultaneously (Block & Sandner, 2009). Therefore, the results based upon this factor need to be interpreted with caution.

### ***Entrepreneur's age***

In research identifying the relationship between an entrepreneur's age and firm performance, the entrepreneur's age is usually measured in a straightforward way. Some empirical research has used dummy variables to indicate an entrepreneur's age group (e.g. Bates, 1990; Arribas & Vila, 2007). However, in order to identify a more detailed relationship, this research uses an entrepreneur's age at start-up in years (*Age*). The age

at start-up is chosen instead of current age to eliminate the multicollinearity between entrepreneur's age and firm's age. This measure has been used by many similar studies (e.g. Cressy, 1996; Storey & Wynarczyk, 1996; van Praag, 2003). The entrepreneur's age at start-up (*Age*) is calculated by subtracting the entrepreneur's birth year from the firm's registration year.

### ***Entrepreneur's gender***

Another potentially significant characteristic of the entrepreneur is their gender which is usually measured by a dummy variable in empirical studies. Some studies use a dummy variable for female entrepreneurs (e.g. Kalleberg & Leicht, 1991; Loscocco & Robinson, 1991; Parker & van Praag, 2006; Fairlie & Robb, 2009; Robb & Watson, 2012), while other studies used a dummy variable to represent male entrepreneurs (e.g. Cooper *et al.*, 1994; Du Rietz & Henrekson, 2000; Bosma *et al.*, 2004). This research follows the second approach and creates a dummy variable *Male* to measure the gender of the entrepreneur. It is equal to 1 for a male entrepreneur or 0 for a female entrepreneur.

### ***Entrepreneur's education level***

In empirical studies capturing the relationship between an entrepreneur's education level and firm performance, several indicators for the education level of the entrepreneur have been utilised. One of the most commonly used indicators is the years of schooling (e.g. Brüderl *et al.*, 1992; Brüderl & Preisendörfer, 1998; Parker & van Praag, 2006; Amaechi *et al.*, 2014). However, the data used in this research does not have this information. Instead, the 2012 private enterprises survey provides the highest educational level achieved by the entrepreneur including (1) primary or less, (2) junior high school, (3) senior high school, (4) diploma, (5) bachelor and (6) postgraduate degree. Bates (1990) and Honig (1998) both created a dummy variable for each education degree group indicating an entrepreneur's education level. But this method may introduce too many dummy variables into the model, resulting in a dummy variable trap problem. To minimise this problem this research follows the method used by Cooper *et al.* (1994) and Bosma *et al.* (2004) by creating one dummy variable *Edu* according to whether the entrepreneur is highly educated with at least a bachelor degree. *Edu* = 1 if the entrepreneur has a bachelor or higher degree.

### ***Entrepreneur's experiences***

An entrepreneur's experience is a multidimensional factor. In this research, the management experience, start-up experience and technical experience of an entrepreneur are studied. These different kinds of experience are usually measured in two ways. Some researchers utilised nominal variables such as years of experience (e.g. Robinson & Sexton, 1994; Parker & van Praag, 2006; Amaechi *et al.*, 2014). However, in many cases, such detailed data on an entrepreneur's different experiences in years is unavailable. Most empirical studies create a dummy variable for each experience (e.g. Brüderl *et al.*, 1992; Jo & Lee, 1996; Brüderl & Preisendörfer, 1998; Bosma *et al.*, 2004).

This study also utilises this method by creating dummy variables for the entrepreneur's management, startup and technical experiences. Information on the experiences of the entrepreneur is obtained from specific questions on the entrepreneur's occupation history in the survey. The dummy variable  $Exp_{manage}$  for management experience is given a value of 1 if the entrepreneur had been a manager in other enterprises. For start-up experience a dummy variable  $Exp_{startup}$  was used to indicate whether the entrepreneur has experience in building a private firm or individual business. The method used to measure an entrepreneur's technical experience is similar. A dummy variable  $Exp_{technical}$  is introduced to identify an entrepreneur's experience in technical work. If the entrepreneur has work experience as a technical staff member in a government organisation or other enterprises,  $Exp_{technical}$  will take a value of 1. The dummy trap problem has been avoided in the model because the question on the occupation history includes many other answers, such as general staff in enterprises, teachers and so on.

### ***Entrepreneur's political connections***

Political connection is a significant component of an entrepreneur's network (*guanxi*). In western studies, empirical research has often utilised direct questions or a 'name-generator'<sup>23</sup> approach by asking interviewees to name their contacts in order to measure their social network (Marsden, 1990; Campbell & Lee, 1991; Carrasco *et al.*, 2008).

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<sup>23</sup> A name generator is a commonly used technique to elicit network members. It consists of free recall questions asking the respondent to name a list of people that fit a given criterion relationship (Carrasco *et al.*, 2008; Pustejovsky & Spillane, 2009).

However, as pointed out in many studies (e.g. Burt, 1997; Peng & Luo, 2000; Li *et al.*, 2009), connection with the CPC and government is a sensitive topic in China, such that direct questions and a name-generator approach will result in little response. Alternative measures of the political connections of entrepreneurs or managers are required in the context of China. One of these measures is to use a seven or three-point Likert scale (from ‘very little’ to ‘very extensive’) questions on entrepreneur connections with (1) political leaders in government, (2) officials in industrial bureaus and (3) officials in regulatory and supporting organisations (Peng & Luo, 2000; Park & Luo, 2001; Li *et al.*, 2009). Besides this alternative, Chan *et al.* (2012) and Zhou (2013) utilised a dummy variable to define politically connected entrepreneurs as those who were current or former government officials. Previous government official experience can be used as a proxy since Chinese people usually retain relationships with former colleagues. Moreover, an entrepreneur who is a member of the Communist Party of China (CPC), People’s Congress (PC) or Chinese People’s Political Consultative Conference (CPPCC) is also likely to be politically connected, because the Communist Party is the only governing party and the PC and CPPCC are the most powerful political organisations in China (Li *et al.*, 2008; Cao *et al.*, 2011; Chow *et al.*, 2012). Combining these views in this study, the political connection of an entrepreneur can be captured by a dummy variable  $Guanxi_{political}$ . It takes a value of 1 if the entrepreneur (i) worked in the CPC and government organs and institutions, (ii) currently works in a government institution (county level or under)<sup>24</sup>, (iii) is a member of the Communist Party of China (CPC), (iv) is a member of the People’s Congress (PC) or (v) is a member of the Chinese People’s Political Consultative Conference (CPPCC). Otherwise,  $Guanxi_{political} = 0$ .

### ***Entrepreneur’s business connections***

As for political connections, direct questions and a name generator approach are also ineffective in measuring the business connections of entrepreneurs in China because the personal business contacts of an entrepreneur are usually regarded as a personal or business secret (Peng & Luo, 2000). Therefore, a proxy needs to be found to measure an entrepreneur’s business connections. Seven or three-scale point questions on an entrepreneur’s relationships with their (1) buyers, (2) suppliers and (3) competitors can

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<sup>24</sup> In China, only government officials at or under the county level are allowed to own a private enterprise.



be utilised to measure the business connections of an entrepreneur (e.g. Peng & Luo, 2000; Park & Luo, 2001; Li *et al.*, 2009). Instead, this study uses a dummy variable  $Guanxi_{business}$  to define an entrepreneur's business connections, in line with measuring an entrepreneur's political connections. According to Wank (1996), one of the most significant forms of business *guanxi* is participation in business associations. In China, the biggest government accredited business association is the All-China Federation of Industry and Commerce (ACFIC) which was founded in 1953. One of its core responsibilities is organising meetings, commodity fairs and trade fairs to promote connections, communications, cooperation and information exchanges with local, domestic and foreign commercial and industrial entities. Thus, in this study, entrepreneurs with business connections are defined as those who are members of the ACFIC. The dummy variable  $Guanxi_{business}$  equals 1 if the respondent is a member of the ACFIC.

#### 6.4.2.2 Variables for internal and external firm-specific factors (control variables)

The identification of relationships of entrepreneurial factors with a firm's technical efficiency needs to exclude the influence of firm-specific factors. Therefore, internal and external firm-specific factors are also included in the model as control variables, including variables on a firm's size, age, exports, credit access and research and development (R&D) activities. The details of these variables are introduced in the following sections.

##### ***Firm size***

A firm's size can be measured by many proxies including total assets, capital stock, sales, value added, fixed assets, intermediate inputs or employee number (Lundvall & Battese, 2000; Amornkitvikai & Harvie, 2011). Instead of a nominal variable, some studies also utilised dummy variables to identify whether the SME is a medium-sized, small or micro-sized enterprise (e.g. Alvarez & Crespi, 2003; Charoenrat & Harvie, 2014). In this research, a dummy variable  $Size_{medium}$  is used. If the firm is classified as a medium-sized enterprise,  $Size_{medium} = 1$ . If the firm is defined as a small or micro enterprise,  $Size_{medium} = 0$ .

##### ***Firm age***

Following existing empirical research on technical efficiency determinants, the age of the firm is defined as the operating year of the firm since registration until the time of the

survey, which is 2012 (e.g. Lundvall & Battese, 2000; Sheu & Yang, 2005; Charoenrat & Harvie, 2014). The variable *Firmage* is calculated by subtracting the firm registration year from 2012 ( $Firmage = 2012 - \text{registration year}$ ).

### ***Export intensity***

In order to identify the relationship of export activity with technical efficiency, some empirical studies use a dummy variable to capture export orientation. For example, Alvarez and Crespi (2003) and Charoenrat and Harvie (2014) introduced a dummy variable indicating whether the firm sells mainly to the international market (exports more than 50 per cent of its total sales). However, using this dummy variable cannot capture the performances of firms with different export intensity. Therefore, this research follows Mok *et al.* (2010), Fu (2005) and Amornkitvikai and Harvie (2011) to measure export intensity by the ratio of the export value to total sales of the firm for the variable *Export*.

### ***Access to credit***

As one of the biggest obstacles to the development of private SMEs, access to finance, or more specifically access to credit, is regarded as a potential major determinant of private SMEs' technical efficiency. There are many ways to measure a firm's access to finance. Asiedu *et al.* (2013) utilised a self-assessed credit constraint level evaluated by a five point-scale question from no credit constraint to very high credit constraint. Alvarez and Crespi (2003) used a dummy variable to identify whether the firm has a bank loan to measure its access to credit. Alternatively, total interest expense was used by Amornkitvikai and Harvie (2011) to evaluate a firm's external finance access. The 2012 private enterprises survey provided detailed information about the financial sources and values of loans obtained. A more appropriate measure for credit access can be utilised in this research, which is the ratio of loans obtained to total capital stock in 2012 (*Credit*). This ratio is used instead of values of loans to eliminate the influence of firm size.

### ***Research and Development (R&D) activities***

Due to the potentially significant relationship of R&D activities with technical efficiency improvement, R&D activities have been included as an explanatory variable of a firm's technical efficiency in many empirical studies. Some of these studies used a dummy

variable to indicate whether the firm has expenditure on R&D activity (e.g. Dilling-Hansen *et al.*, 2003). Using a nominal variable, the total expenditure on R&D activities is also commonly utilised in empirical research (e.g. Batra & Tan, 2003; Sheu & Yang, 2005; Li & Hu, 2013). This research follows Kim (2003) and utilises the ratio of R&D expenditure to total sales ( $R \& D$ ) as a proxy for a firm's R&D intensity. This can eliminate the multicollinearity between variables for R&D and firm size.

### ***Location***

In order to identify differences in the technical efficiency performance of SMEs located in eastern and non-eastern areas, this study utilises a dummy variable, *Noneast*, to represent the location of the firm. It takes a value of 1 if the SME is located in any one of the 21 non-eastern provinces in China, while a value of 0 will be given to a firm if it is located in an eastern province as defined in this study.

However, when identifying the determinants of the technology gap ratio and metafrontier technical efficiency, using *Noneast* may not be appropriate. This is because the technology gap ratio and metafrontier technical efficiency are estimated relative to the metafrontier, which is obtained by enveloping eastern and non-eastern regional frontiers. Therefore, the technology gap ratio and metafrontier technical efficiency scores are highly correlated with the eastern or non-eastern location. Using *Noneast* as an independent variable and technology gap ratio or metafrontier technical efficiency as a dependent variable will cause a serious endogeneity problem in the regression, which gives biased results. To avoid this problem, an instrument variable (IV) for *Noneast* should be utilised. In this research the GDP per capita of the province that the SME is located in is used as an instrument variable (IV) for firm location ( $GDP$ ) in identifying the determinants of the technology gap ratio and metafrontier technical efficiency.  $GDP$  could be a good instrument for *Noneast* because less developed non-eastern regions had much lower GDP per capita than developed eastern regions. According to NBS (2016c), in 2012 (the research year used by this study), the average GDP per capita for eastern provinces was RMB 64,539, which was nearly double the average GDP per capita for non-eastern provinces (RMB 33,314).

## 6.5 Summary

This chapter has introduced the sources of data and variables to be used for an empirical analysis of the SMF-one-stage SFA-Tobit model discussed in Chapter 5. The data used in this study is from one of the series of Chinese private enterprises surveys conducted jointly by the UFWD, AFIC, SAIC and China Society of Private Economy at CASS every two years from 1992. This survey aims to track the development and performance of the Chinese private sector utilising a multi-stage stratified sampling method to cover all of the 31 province-level regions and industries in China. As the only officially authorised survey on private enterprises in China, the dataset from these surveys has high quality and has been used in many high-quality academic journal articles. This study used the 2012 survey data, which is the latest that can be obtained by the public. It utilises cross-sectional data only from 2012 to estimate technical efficiency instead of productivity as the economic performance measure of private enterprises. The reason for this is that firms surveyed can be different in each year. Therefore, this series of survey data cannot include consistent firms and provide a panel data as required in productivity estimation.

The data for 2012 is comprised of that from 5,073 firm observations covering all industries. Since this study only focuses on private manufacturing SMEs, only SMEs in the manufacturing sector are extracted from the sample. Observations without adequate information on output and inputs for estimating technical efficiency scores, and entrepreneurial factors and firm-specific factors required to explain firm technical efficiency performance are also excluded. The final sample used in this research comprises 664 private manufacturing firms, including 439 located in eastern provinces and 225 located in non-eastern provinces. Most of these firms are small-sized.

To ensure the reliability of the information obtained by this survey, the *Private Enterprises Surveying Group* has made many efforts to reduce survey errors. It used larger sample size and stratified-random sampling to reduce sampling error. Questionnaires were developed to be well-presented and easy to understand, trainings were provided to interviewers, pre-testing were conducted, truthful reporting were required by law and the respondents were required to be entrepreneurs themselves to minimize measurement error. The coverage error was reduced by using on-site face-to-face interview and official business registration record in AIC as sample list, while the

response rate was improved by propagandizing the importance of this survey and reducing the time cost to complete the survey.

The key variables used in the empirical model to estimate technical efficiency in the model include one output and three inputs: labour, capital and intermediate inputs. Compared with the value-added approach, the gross output approach is more appropriate for measuring output in the context of China. The total output is proxied by a firm's total revenue in 2012. Labour input is measured by a firm's total employee numbers in 2012, while total capital at the end of 2012 is used as a proxy for capital input. Intermediate inputs are measured by total production and non-production cost excluding expenditures on employees in 2012. Moreover, nine variables on entrepreneurial factors are used to examine their relationships with a firm's regional frontier technical efficiency, technology gap ratio and metafrontier technical efficiency. These variables include an entrepreneur's start-up motivation, age, gender, education level, management, start-up and technical experiences and political and business connections. To exclude the influence of other internal and external firm-specific factors a firm's size, age, exports intensity, credit access, research and development (R&D) activities and location have been considered as control variables. A detailed description of each variable is shown in Table 6.4. The data, extracted sample, and variables described in this chapter are used in the empirical analysis to be conducted in the next chapter.

## Chapter 7 Empirical Results

### 7.1 Introduction

This chapter aims to estimate the comparable technical efficiency levels relative to the metafrontier of private manufacturing SMEs in China's eastern and non-eastern regions respectively and conduct an empirical analysis of the relationships of entrepreneurial factors with their metafrontier technical efficiency levels. As discussed in Chapter 5 the estimation of metafrontier technical efficiency scores of Chinese private manufacturing SMEs requires the computation of their regional frontier technical efficiency scores and their technology gap ratios. The scores and determinants of the regional technical efficiency, the technology gap ratio and the metafrontier technical efficiency of eastern and non-eastern SMEs are obtained in three steps.

In the first step the traditional one-stage SFA model proposed by Battese and Coelli (1995) is utilised to obtain regional technical efficiency measures for eastern and non-eastern SMEs respectively using *FRONTIER 4.1*. This model includes two components: (1) a region-specific stochastic production function model for regional efficiency scores ( $TE_i^j$ ) and (2) a region-specific technical inefficiency effects model for regional efficiency determinants of private manufacturing SMEs in eastern and non-eastern regions respectively. The second step is to then utilise a stochastic meta-production function (SMF)-one-stage SFA model as proposed by Huang *et al.* (2014) also using *FRONTIER 4.1*. This model is also composed of two parts: (1) an SMF model to calculate technology gap ratio scores ( $TGR_i^j$ ) and (2) a technology gap effects model to identify technology gap ratio determinants for private manufacturing SMEs in China. Then the metafrontier technical efficiency scores ( $MTE_{ji}$ ) of SMEs in the private manufacturing sector of China are estimated by the product of regional technical efficiency scores ( $TE_i^j$ ) and technology gap ratios ( $TGR_i^j$ ). Finally, the determinants of the obtained metafrontier technical efficiency of these SMEs are identified by a Tobit regression model utilising *STATA 14.0*, which provide evidences that the hypotheses proposed in Chapter 4 should be supported or not. These results can help to understand the efficiency and technology levels of private manufacturing SMEs in different regions of China.

This chapter is organised as follows. Section 7.2 introduces the empirical model for estimating technical efficiency scores and determinants of aggregate SMEs in the sample regardless of regional technology disparity, provides a statistical summary of the data for all private manufacturing SMEs in China and discusses the empirical results derived from this aggregate model. Section 7.3 shows the empirical models for regional one-stage SFA of eastern and non-eastern SMEs and differences in the entrepreneurial and firm characteristics for SMEs in these two regions, and discusses the regional technical efficiency scores and determinants for both eastern and non-eastern SMEs. Section 7.4 presents the empirical SMF-one-stage SFA model for pooled SMEs in both regions and explains the results obtained for the technology gap ratio scores and determinants for these SMEs in both regions. The empirical models and results of the metafrontier technical efficiency scores and determinants for these SMEs are shown in Section 7.5. The results on proposed hypotheses (in Chapter 4) testing are summarized in Section 7.6. Section 7.7 presents the major conclusions from this chapter.

## **7.2 Technical efficiency of Chinese private manufacturing SMEs in general regardless of regional differences**

Regarding all of the 664 observations in the sample as an aggregate group, traditional one-stage SFA can be used to estimate the technical efficiency level of Chinese private manufacturing SMEs in general. It is assumed that they are producing under the same production frontier regardless of regional differences.

As discussed in Chapter 5, utilising a parametric SFA model requires assuming a specific production functional form, in which Cobb-Douglas and Translog production functions are the most common forms from which to choose. Following most of the empirical studies using SFA to estimate technical efficiency (e.g. Estache *et al.*, 2002; Giannakas *et al.*, 2003; Amornkitvikai & Harvie, 2011; Castiglione, 2012; Charoenrat & Harvie, 2013), both Cobb-Douglas and Translog regional production functions are estimated. Then a log-likelihood ratio (LR) test is conducted to test which of these is appropriate for this research. The empirical model, data summary statistics and empirical results are as follows.

### 7.2.1 Empirical model

As introduced in Chapter 5, the empirical model of one-stage SFA as proposed by Battese and Coelli (1995) includes (1) a stochastic frontier production function model and (2) an inefficiency effects model. Applying the gross output approach with three inputs (labour, capital and intermediate inputs) (see Chapter 6), the stochastic production function model using the Cobb-Douglas functional form for the aggregate group in this research can be written as (Battese & Coelli, 1995; Coelli *et al.*, 2005):

$$\ln f(x_i; \beta) = \ln Y_i = \beta_0 + \beta_1 \ln(L_i) + \beta_2 \ln(K_i) + \beta_3 \ln(IM_i) + V_i - U_i \quad (7.1)$$

The Translog production function for the aggregate group can be written as:

$$\begin{aligned} \ln f(x_i; \beta) = \ln Y_i = & \beta_0 + \beta_1 \ln(L_i) + \beta_2 \ln(K_i) + \beta_3 \ln(IM_i) + 1/2\beta_4 \ln(L_i)^2 \\ & + \beta_5 \ln(L_i) * \ln(K_i) + \beta_6 \ln(L_i) * \ln(IM_i) + 1/2\beta_7 \ln(K_i)^2 \\ & + \beta_8 \ln(K_i) * \ln(IM_i) + 1/2\beta_9 \ln(IM_i)^2 + V_i - U_i \end{aligned} \quad (7.2)$$

where:

$f(x_i; \beta)$  = Production frontier of the aggregate group;

$x_i$  = Input vector of firm  $i$  in the aggregate group;

$\beta$  = Parameters to be estimated for the production frontier of the aggregate group;

$Y_i$  = Total turnover in 2012 of firm  $i$  in the aggregate group;

$L_i$  = Total employee number in 2012 of firm  $i$  in the aggregate group;

$K_i$  = Total capital at the end of 2012 of firm  $i$  in the aggregate group;

$IM_i$  = Total intermediate inputs value in 2012 of firm  $i$  in the aggregate group;

$V_i$  = Random error ( $V_i \sim iidN^+(0, \sigma_v^2)$ );

$U_i$  = Non-negative technical inefficiency effect ( $U_i \sim iidN^+(0, \sigma_u^2)$ );

$i = 1, \dots, N$ ,  $N = 664$ .

The second component is the technical inefficiency effects model of SMEs in all regions of China, in which  $U_i$  is explained by entrepreneurial and internal and external firm-specific factors as discussed in Section 6.4, and is:

$$\begin{aligned} U_i = & \delta_0 + \delta_1 Opportunity_i + \delta_2 Age_i + \delta_3 Male_i + \delta_4 Edu_i + \delta_5 Exp_{manage_i} + \delta_6 Exp_{startupi} \\ & + \delta_7 Exp_{technical_i} + \delta_8 Guanxi_{political_i} + \delta_9 Guanxi_{business_i} + \delta_{10} Firmage_i \\ & + \delta_{11} Size_{medium_i} + \delta_{12} Export_i + \delta_{13} Credit_i + \delta_{14} R \& D_i + \delta_{15} Noneast_i + W_i \end{aligned} \quad (7.3)$$



where:

$Opportunity_i = 1$  if the entrepreneur of firm  $i$  in the aggregate group was opportunity-driven; = 0 otherwise;

$Age_i$  = entrepreneur's age at start-up of firm  $i$  in the aggregate group in years;

$Male_i = 1$  if the entrepreneur of firm  $i$  in the aggregate group is male; = 0 otherwise;

$Edu_i = 1$  if the entrepreneur of firm  $i$  in the aggregate group has at least a bachelor's degree; = 0 otherwise;

$Exp_{manage_i} = 1$  if the entrepreneur of firm  $i$  in the aggregate group has management experience before this business; = 0 otherwise;

$Exp_{startup_i} = 1$  if the entrepreneur of firm  $i$  in the aggregate group has start-up experience before this business; = 0 otherwise;

$Exp_{technical_i} = 1$  if the entrepreneur of firm  $i$  in the aggregate group has technical experience before this business; = 0 otherwise;

$Guanxi_{political_i} = 1$  if the entrepreneur of firm  $i$  in the aggregate group has political connections; = 0 otherwise;

$Guanxi_{business_i} = 1$  if the entrepreneur of firm  $i$  in the aggregate group has business connections; = 0 otherwise;

$Firmage_i$  = operating years of the firm  $i$  in aggregate group at 2012;

$Size_{medium_i} = 1$  if firm  $i$  in the aggregate group is medium-sized; = 0, otherwise;

$Export_i$  = ratio of export value to total sales of firm  $i$  in the aggregate group in 2012;

$Credit_i$  = ratio of bank loans to total capital of firm  $i$  in the aggregate group in 2012;

$R \& D_i$  = ratio of total expenditure on R&D activities to total sales of firm  $i$  in the aggregate group in 2012;

$Noneast_i = 1$  if firm  $i$  in the aggregate group was located in the non-eastern regions of China; = 0 otherwise;

$W_i$  = Random error ( $W_i \sim N(0, \sigma_w^2)$ );

$i = 1, \dots, N$ ,  $N = 664$ .

## 7.2.2 Data statistics summary

The descriptive statistics for all the observations and variables used in this study are summarised in Table 7.1.

**Table 7.1 Statistics summary of Chinese private manufacturing SMEs for the entire sample**

Variable	Unit	Mean	Std. Dev.	Min	Max
<b>Observation Number: 664</b>					
<b>Output</b>					
Turnover (level in RMB)	RMB000,000	98.4452	255.1501	0.0300	5,000.0000
Turnover (level in US\$)	\$000,000	15.5953	40.4198	0.0048	792.0792
Turnover (logarithm)	Natural Logarithm	10.2436	1.7827	3.4012	15.4249
<b>Labour Input</b>					
Employee number (level)	No. of people	186.8690	437.6985	1.0000	10,000.0000
Employee number (logarithm)	Natural Logarithm	4.4711	1.3082	0.0000	9.2103
<b>Capital Input</b>					
Current capital (level in RMB)	RMB000,000	40.2354	179.5506	0.0300	4,200.0000
Current capital (level in US\$)	\$000,000	6.3739	28.4437	0.0048	665.3466
Current capital (logarithm)	Natural Logarithm	9.1417	1.7434	3.4012	15.2506
<b>Intermediate Input</b>					
Intermediate input (level in RMB)	RMB000,000	84.1030	244.3148	0.0090	4,900.0000
Intermediate input (level in US\$)	\$000,000	13.3233	38.7033	0.0014	776.2376
Intermediate input (logarithm)	Natural Logarithm	9.8917	1.9754	2.1972	15.4028
<b>Entrepreneur's motivation</b>					
Motivation (opportunity)	Dummy	0.9623	0.1905	0.0000	1.0000
<b>Entrepreneur's personal characteristics</b>					
Age	No. of years	47.9699	8.2533	25.0000	78.0000
Male	Dummy	0.8870	0.3168	0.0000	1.0000
Education (Bachelor)	Dummy	0.2711	0.4449	0.0000	1.0000
Experience (manager)	Dummy	0.4337	0.4960	0.0000	1.0000
Experience (start-up)	Dummy	0.4970	0.5004	0.0000	1.0000
Experience (technical)	Dummy	0.0889	0.2847	0.0000	1.0000
<b>Entrepreneur's Guanxi</b>					
Political connection	Dummy	0.7093	0.4544	0.0000	1.0000
Business connection	Dummy	0.7244	0.4472	0.0000	1.0000
<b>Firm characteristics</b>					
Size (medium)	Dummy	0.2380	0.4262	0.0000	1.0000
Firm age	No. of years	10.4051	4.9629	1.0000	23.0000
Export	% of total sales	0.0205	0.0716	0.0000	1.0000
Credit access	% of total capital	0.2135	0.2038	0.0000	1.0000
R&D	% of total sales	0.0251	0.0982	0.0000	1.7010
Non-eastern area	Dummy	0.3389	0.4737	0.0000	1.0000

Source: Author's summary of the data in the sample extracted from the 2012 Private Enterprises Survey.

In 2012, on average, private manufacturing SMEs in all regions of China had 187 employees, 40.2354 million RMB (US\$6.3739 million) capital and spent 84.1030 million RMB (US\$13.3233 million) on intermediate input. Utilising these inputs, they obtained 98.4452 million RMB (US\$15.5953 million<sup>25</sup>) in total turnover value on average in 2012. Until 2012 these SMEs had operated for 10.4 years on average. Around 24 per cent of them were of medium size while the others were of small or micro size. 33.89 per cent (225) of the 664 private manufacturing SMEs in the sample were based in non-eastern regions, while the other 439 SMEs were based in eastern regions.

Among the SMEs in the sample, exporting firms accounted for 26.80 per cent of the total and the contribution of exports to total sales was only 2.05 per cent on average in 2012. Among private manufacturing SMEs in the sample, 53.61 per cent of them engaged in R&D activities with a 2.51 per cent ratio of R&D expenditure to total sales. These results show that although a large portion of private manufacturing SMEs in China engaged in export and innovation activities, their performance could be further promoted due to their small export and innovation intensity (Zhang & Xia, 2014). Also, about 21.35 per cent of the total capital of these SMEs was from bank loans, confirming that credit access is a significant source of finance for Chinese private SMEs in the manufacturing sector.

The entrepreneurs of these SMEs in the sample had an average age of 48. Most (96.23 per cent of them) were opportunity-driven without unemployment experience before they started up their business. Around 88.70 per cent of them were male, confirming that males still dominate entrepreneurial activities in the manufacturing sector of China (Lu & Tao, 2010). The human capital level of the entrepreneurs in the sample is also shown in Table 7.1. Around 27.11 per cent of them had at least a bachelor's degree, while the rest had a lower educational attainment. Entrepreneurs with management, start-up and technical job experience prior to establishing their businesses accounted for 43.37 per cent, 49.70 per cent and 8.89 per cent of the sample, respectively. This is consistent with the viewpoint that private entrepreneurs have become a more highly educated and skilled social group in China in recent years (Li & Matlay, 2006). Moreover, the entrepreneurs of private manufacturing SMEs in the sample have well-developed business and political networks.

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<sup>25</sup> All the monetary data used in this research is in Renminbi (RMB). These are also converted into US dollars using the annual average RMB-US dollar exchange rate in 2012 (6.3125) to be comparable with studies of other countries.

Nearly 72.44 per cent of them built business connections by attending All-China Federation of Industry and Commerce (ACFIC) activities, while around 70.93 per cent had political connections by being members of the Chinese Communist Party, People’s Congress (PC) or Chinese People’s Political Consultative Conference (CPPCC) or from prior experiences of being government cadres. This implies that ‘*guanxi*’ is still a significant factor for China’s entrepreneurs (Chang, 2011).

### 7.2.3 Empirical results for aggregate SMEs using a one-stage SFA model

The maximum likelihood estimation (MLE) of the traditional one-stage SFA model for the aggregate of 664 SMEs in the sample is computed using *FRONTIER 4.1*. Four null hypotheses are initially tested to identify: (1) validation of the Cobb-Douglas production functional form ( $H_0: \beta_4 = \beta_5 = \dots = \beta_9$ ), (2) the absence of technical inefficiency effects ( $H_0: \gamma = \delta_0 = \delta_1 = \dots = \delta_{15} = 0$ ), (3) the absence of stochastic inefficiency effects ( $H_0: \gamma = \delta_0 = 0$ ), and (4) the insignificance of joint inefficiency variables in the production function for the aggregate model ( $H_0: \delta_1 = \dots = \delta_{15} = 0$ ). The generalised likelihood-ratio (LR) test is utilised:  $\lambda = -2\{\log L(H_0) - \log L(H_1)\}$ <sup>26</sup>. The test results are shown in Table 7.2.

**Table 7.2 Hypothesis tests for one-stage SFA for aggregate SMEs in the sample**

	(1)	(2)	(3)	(4)
<b>LLR</b>	$H_0: -224.0087;$ $H_1: -18.9284$	$H_0: -37.6452;$ $H_1: -18.9284$	$H_0: -25.5038;$ $H_1: -18.9284$	$H_0: -37.8654;$ $H_1: -18.9284$
<b>LR statistics</b>	410.1605	37.4337	13.1509	37.8640
<b>Critical Value (at <math>\alpha = 5\%</math>)</b>	12.592	28.268*	5.138*	24.996
<b>Decision</b>	Reject $H_0$	Reject $H_0$	Reject $H_0$	Reject $H_0$

Source: Author’s estimation.

Note: \* indicates a mixture of a chi-square distribution as shown in Kodde and Palm (1986).

<sup>26</sup>  $\log[L(H_0)]$  and  $\log[L(H_1)]$  are the estimated maximised values of the log-likelihood function for the SFA model under the null hypothesis ( $H_0$ ) and the alternative hypothesis ( $H_1$ ) (Battese & Coelli, 1995). The statistic of the LR test follows an asymptotic chi-square distribution with parameters equal to the number of restricted parameters imposed under the null hypothesis. Testing hypotheses (2) and (3) follows a mixture of a chi-square distribution as proposed by Kodde and Palm (1986). The null hypothesis test should be rejected if the LR statistic is greater than the critical value.

According to Table 7.2, the hypothesis test (1) on the validation of the Cobb-Douglas production function is rejected at the 1 per cent significance level. This supports the view that the Translog production function is more appropriate to use for the aggregate SME one-stage SFA model in this research. Hypothesis test (2) on the absence of the inefficiency effect is also rejected. This shows that inefficiency effects should be considered in the production process of Chinese private manufacturing SMEs. Therefore, the SFA model must be utilised instead of the traditional OLS model (Battese & Coelli, 1995). Rejection of null hypothesis (3) that inefficiency is not stochastic indicates that the inefficiency effects model is not reduced to the traditional mean response function. This confirms the necessity to use the one-stage SFA model (Battese & Coelli, 1995). The last hypothesis on the joint effect of explanatory variables in the inefficiency effects model is rejected, implying validation of the whole model as shown by Equation (7.3).

#### ***Aggregate Translog stochastic production function model***

The empirical results for the simultaneously estimated Translog stochastic production function model and technical inefficiency effects model for aggregate private manufacturing SMEs in the sample are shown in Table 7.3. Estimates of the labour input ( $\beta_1$ ), capital input ( $\beta_2$ ) and intermediate input ( $\beta_3$ ) are all found to be significant and positive as expected. Following equation  $E = \partial \ln Y_i / \partial \ln L_i + \partial \ln Y_i / \partial \ln K_i + \partial \ln Y_i / \partial \ln IM_i$ , the returns to scale for aggregate SMEs in the sample are estimated to be 0.9878, which is smaller than 1. This indicates decreasing returns to scale (DRS) in the production of aggregate Chinese private manufacturing SMEs. The production has been beyond the minimum efficiency scale, which is consistent with the excess capacity problem found in the manufacturing sector of China (Fan, 2015; Yuan, 2015; Zou, 2016).

#### ***Aggregate technical inefficiency effects model***

The second part of Table 7.3 shows empirical results for the aggregate technical inefficiency model. In interpreting the results, it is necessary to notice that the dependent variable used in the technical inefficiency model is the inefficiency level ( $U_i$ ). Positive signs imply that an increase in the explanatory variable would lead to an increase in inefficiency and thereby a decrease in the technical efficiency level. Therefore, to identify the determinants of technical efficiency the signs in the technical inefficiency model (second part of Table 7.3) must be interpreted conversely.

**Table 7.3 Maximum likelihood estimates for parameters of the one-stage SFA for aggregate private manufacturing SMEs in China**

Variables	Coeff.	Std.	t-ratio
<b>Translog Stochastic production function model</b>			
Constant	1.3808***	0.2857	4.8333
lnL	0.5961***	0.0741	8.0415
lnK	0.3693***	0.0621	5.9468
lnIM	0.2755***	0.0479	5.7470
1/2lnL*lnL	0.0327**	0.0159	2.0505
lnL*lnK	0.0417***	0.0096	4.3449
lnL*lnIM	-0.1003***	0.0086	-11.6629
1/2lnK*lnK	0.0295***	0.0089	3.3133
lnK*lnIM	-0.0764***	0.0072	-10.5794
1/2lnIM*lnIM	0.1675***	0.0078	21.5553
<b>Technical inefficiency effects model</b>			
Constant	0.3530***	0.1223	2.8873
<b>Entrepreneur's motivation</b>			
Motivation (opportunity)	-0.2039**	0.0822	-2.4817
<b>Entrepreneur's personal characteristics</b>			
Age	0.0009	0.0020	0.4683
Male	0.0254	0.0506	0.5007
Education (Bachelor)	-0.0796*	0.0427	-1.8633
Experience (manage)	-0.0311	0.0374	-0.8318
Experience (startup)	-0.1410***	0.0501	-2.8114
Experience (technical)	-0.2066***	0.0802	-2.5745
<b>Entrepreneur's <i>guanxi</i></b>			
Political connection	-0.0072	0.0455	-0.1592
Business connection	-0.0351	0.0419	-0.8377
<b>Firm characteristics</b>			
Firm size (medium)	-0.3131***	0.0932	-3.3602
Firm age	-0.0107**	0.0044	-2.4473
Exports	-0.8764***	0.1308	-6.6991
Credit access	-0.5302***	0.1612	-3.2891
R&D	-0.7824***	0.2889	-2.7078
Non-eastern area	0.1856***	0.0612	3.0313
<b>Variance parameters</b>			
Sigma-square	0.0820***	0.0083	9.8698
Gamma ( $\gamma^j$ )	0.3748***	0.0945	3.9661
Log-likelihood function			-18.9284
<b>Return to scale</b>			0.9878

Source: Author's estimation of Equations (7.2) and (7.3) simultaneously by *FRONTIER 4.1*.

Note: For the technical inefficiency effects model a positive coefficient indicates a lower technical efficiency level; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5% and 1% respectively.

As can be seen from Table 7.3 the internal and external firm-specific factors are all found to have significant relationships with the technical efficiency of aggregate private manufacturing SMEs in China. First, firm size is found to have a positive and significant relationship. Without considering regional differences, medium-sized private manufacturing firms are found to produce more technically efficiently than small and micro-sized enterprises in China's private manufacturing sector. Medium sized firms can enjoy an advantage in productive efficiency compared with small and micro-sized ones. This is consistent with results found for many other developing countries, such as Chile (Alvarez & Crespi, 2003) and Thailand (Charoenrat & Harvie, 2014).

Second, as with firm size, a positive and significant relationship with technical efficiency relative to the aggregate frontier of Chinese private manufacturing SMEs is also found for firm age. Although older firms have a higher cost of scrapping old production methods and technology (Admassie & Matambalya, 2002), a higher level of knowledge and ability to identify the optimal production scale of older firms (Admassie & Matambalya, 2002; Aggrey *et al.*, 2010) seems to be more significant for the production of Chinese private manufacturing SMEs. This result is consistent with that found in several other empirical studies (e.g. Tan & Batra, 1995; Charoenrat & Harvie, 2014).

Third, as an important means of international integration, private manufacturing SMEs with higher export intensity can produce more efficiently relative to the aggregate frontier. This confirms that, at the national level, private manufacturing SMEs in China can improve their efficiency levels through the exporting process and being exposed to higher competition in foreign markets (Clerides *et al.*, 1998; Blalock & Gertler, 2004). The importance of exporting to SME technical efficiency has also been found for other developing countries (e.g. Batra & Tan, 2003; Charoenrat & Harvie, 2014).

Fourth, access to credit is also found to be positively related to the technical efficiency level relative to the aggregate frontier. Considering SMEs in all regions of China in aggregate, firms that obtained more bank loans relative to their capital size enjoyed higher efficiency. This confirms that bank loans represent a significant source of finance for SMEs in China that can help not only their capital stock but their efficiency performance

(Wu *et al.*, 2008; Wang *et al.*, 2015). This is consistent with the findings of Kim (2003) for Korean manufacturing firms.

Fifth, and in terms of innovation, R&D intensity is found to be positively related to the technical efficiency level of aggregate private manufacturing SMEs in China. This result shows that in China R&D activities not only contribute to technological innovation, but can also improve the technical efficiency of SMEs, confirming the two faces of R&D activities<sup>27</sup> in the manufacturing private SME sector of China. The significance of R&D activities in improving the efficiency of SMEs has also been found by Dilling-Hansen *et al.* (2003) for Denmark and Li and Hu (2013) for Taiwan.

#### *Entrepreneurial factors*

The relationships of entrepreneurial factors with the technical efficiency level of aggregate private manufacturing SMEs in all regions of China are also shown in Table 7.3. Without considering regional disparity in China, only an entrepreneur's start-up motivation, education level, start-up and technical experiences are found to have a positive and significant relationship as expected. SMEs established by opportunity-driven entrepreneurs can produce more technically efficiently than those built by necessity entrepreneurs. This confirms that opportunity entrepreneurs in emerging economies like China can operate a firm with a better performance (Vivarelli, 2007), not only in profitability (Block & Wagner, 2010) and survival (Block & Sandner, 2009), but also in terms of their efficiency level.

A significant and positive relationship of an entrepreneur's bachelor's degree with technical efficiency relative to the aggregate frontier for SMEs in China is also found in this study. This is consistent with empirical studies for many other developing countries, such as Ghana (Gokcekus *et al.*, 2001) and Mexico (Amaechi *et al.*, 2014). With a university education, an entrepreneur can possess more knowledge about identifying efficient opportunities and resources, helping them to operate with a higher efficiency performance (Honig, 1998; Unger *et al.*, 2011). In China, universities have become the

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<sup>27</sup> Cohen and Levinthal (1989) and Griffith *et al.* (2004) summarised the two ways that R&D activities can benefit firm performance as the 'two faces of R&D': (1) generating technology progress via innovation, and (2) improving technical efficiency via the learning process during R&D activities (see Chapter 4.7.1).



incubator of high quality entrepreneurs by providing the basic knowledge and training required to be a successful entrepreneur (Li *et al.*, 2016). Results from this thesis provide strong empirical support for this role.

The prior start-up experiences of entrepreneurs can also have a significant and positive relationship with the efficiency level of SMEs relative to the aggregate frontier. With specific entrepreneurial knowledge and skills regarding the operation of a successful new business, entrepreneurs with start-up experience can have better decision-making capabilities and a better understanding of how to achieve technically efficient production (Delmar & Shane, 2006). This result provides empirical evidence that entrepreneurs with start-up experience can operate a firm not only with higher revenue (Haber & Reichel, 2007) and survival rate (van Praag, 2003), but also with a higher efficiency performance in the context of China's private manufacturing sector.

Moreover, an entrepreneur's working experience as a technical staff member before building a business is also found to have a significant and positive relationship. This shows that acquired technical knowledge and expertise from previous experiences is significant for attaining technically efficient production (Jones-Evans, 1996), especially for private SMEs in China with limited access to resources and advanced technologies (Chen, 2006). A positive and significant relationship of an entrepreneur's technical experiences has also been found with other firm performance indicators such as survival (Bayus & Agarwal, 2007).

The other entrepreneurial factors, however, including an entrepreneur's age, gender, management experiences, and networks are all found to be insignificant. But this does not necessarily illustrate that they are unimportant for the efficient production of private SMEs in China since private manufacturing SMEs in eastern and non-eastern regions of China are producing under different production frontiers due to their different technology levels (see Chapter 3 in detail). Therefore, the technical efficiency level of SMEs in these two regions should be estimated relative to separate regional frontiers, instead of using a single aggregate frontier. A significant difference in the technical efficiency level between eastern and non-eastern regions of China is confirmed by the results in Table 7.3. SMEs located in non-eastern regions are producing 18.56 per cent less efficiently.

Similarly, entrepreneurial factors may have different relationships with SMEs in different regions of China. Thus, the relationships of entrepreneurial factors with SMEs' technical efficiency should also be identified at the regional level.

### ***Aggregate technical efficiency scores***

From the Translog production function model, the technical efficiency scores for each firm can be estimated by  $TE_i = \exp(-U_i)$  from *FRONTIER 4.1*. A statistical summary of the estimated technical efficiency scores is shown in Table 7.4. The average technical efficiency relative to the aggregate frontier of SMEs in all regions of China was 0.8985 in 2012. In general, private manufacturing SMEs in China are producing inefficiently. They can increase their output by 10.15 per cent to achieve maximum output without any input increase. Their efficiency performance needs to be further improved. The scores and determinants of technical efficiency relative to the regional frontiers for eastern and non-eastern SMEs are estimated respectively in the next section.

**Table 7.4 Technical efficiency relative to aggregate production frontier of private manufacturing SMEs in China**

	Mean	Std.	Min	Max	Obs. number
scores	0.8985	0.0696	0.5208	0.9818	664

Source: Author's estimation from Equation  $TE_i = \exp(-U_i)$  by *FRONTIER 4.1*.

### **7.3 Technical efficiency of eastern and non-eastern Chinese private manufacturing SMEs relative to region-specific frontiers**

In order to estimate the technical efficiency level of eastern and non-eastern SMEs in China at the regional level, the 664 observations in the sample are categorised into two groups based on their locations, consisting of 225 SMEs in non-eastern regions and 439 SMEs in the more developed eastern regions. A traditional one-stage SFA model is used to estimate regional technical efficiency for those SMEs located in eastern regions and non-eastern regions respectively. As for the aggregate group, models using Cobb-Douglas and Translog production functional forms are both computed and a LR test is conducted to test which one is more appropriate for each region.

### 7.3.1 Empirical model

Similar to Equation (7.1) and Equation (7.2), the stochastic regional production function model using the Cobb-Douglas functional form for region  $j$  can be written as (Battese *et al.*, 2004; Huang *et al.*, 2014):

$$\ln f^j(x_i, \beta^j) = \ln Y_{ij} = \beta_0^j + \beta_1^j \ln(L_{ij}) + \beta_2^j \ln(K_{ij}) + \beta_3^j \ln(IM_{ij}) + V_{ij} - U_{ij}. \quad (7.4)$$

The Translog production function equivalent for region  $j$  can be written as:

$$\begin{aligned} \ln f^j(x_i, \beta^j) = \ln Y_{ij} = & \beta_0^j + \beta_1^j \ln(L_{ij}) + \beta_2^j \ln(K_{ij}) + \beta_3^j \ln(IM_{ij}) + 1/2\beta_4^j \ln(L_{ij})^2 \\ & + \beta_5^j \ln(L_{ij}) * \ln(K_{ij}) + \beta_6^j \ln(L_{ij}) * \ln(IM_{ij}) + 1/2\beta_7^j \ln(K_{ij})^2 \\ & + \beta_8^j \ln(K_{ij}) * \ln(IM_{ij}) + 1/2\beta_9^j \ln(IM_{ij})^2 + V_{ij} - U_{ij}. \end{aligned} \quad (7.5)$$

where:

$f^j(x_i, \beta^j)$  is the regional frontier of region  $j$ ;  $\beta^j$  is the vector of parameters of region  $j$  frontier to be estimated;  $x_{ij}$  is the input vector of firm  $i$  in region  $j$ ;  $Y_{ij}$ ,  $L_{ij}$ ,  $K_{ij}$  and  $IM_{ij}$  are the total turnover, employee number, capital and intermediate inputs value in 2012 of firm  $i$  in region  $j$ ;  $V_{ij}$  is the random error ( $V_{ij} \sim iidN^+(0, \sigma_{V_j}^2)$ ); and  $U_{ij}$  is the non-negative technical inefficiency effect ( $U_{ij} \sim iidN^+(0, \sigma_{U_j}^2)$ ) for region  $j$  frontier;  $i = 1, \dots, N^j$ ,  $j = 1, 2$ ,  $N^1 = 225$ ,  $N^2 = 439$ ,  $N^1 + N^2 = N = 664$ .

The second component of the technical inefficiency effects model of region  $j$ , in which  $U_{ij}$  is explained by entrepreneurial and firm-specific factors discussed in Chapter 6, is:

$$\begin{aligned} U_{ij} = & \delta_0^j + \delta_1^j Opportunity_{ij} + \delta_2^j Age_{ij} + \delta_3^j Male_{ij} + \delta_4^j Edu_{ij} + \delta_5^j Exp_{manage_{ij}} \\ & + \delta_6^j Exp_{startup_{ij}} + \delta_7^j Exp_{technical_{ij}} + \delta_8^j Guanxi_{political_{ij}} + \delta_9^j Guanxi_{business_{ij}} \\ & + \delta_{10}^j Firmage_{ij} + \delta_{11}^j Size_{medium_{ij}} + \delta_{12}^j Export_{ij} + \delta_{13}^j Credit_{ij} + \delta_{14}^j R \& D_{ij} + W_{ij} \end{aligned} \quad (7.6)$$

where:

all the variables used are the same as those explained for Equation (7.3) of firm  $i$  in region  $j$ ;  $W_{ij}$  is the random error ( $W_{ij} \sim N(0, \sigma_{W_j}^2)$ );  $i = 1, \dots, N^j$ ,  $j = 1, 2$ ,  $N^1 = 225$ ,  $N^2 = 439$ ,  $N^1 + N^2 = N = 664$ .

### 7.3.2 Data statistics summary

The data descriptive statistics for SMEs in the eastern and non-eastern regions of China are shown in Tables 7.5 and 7.6 respectively.

**Table 7.5 Summary statistics for eastern private manufacturing SMEs in China**

Variable	Unit	Mean	Std. Dev.	Min	Max
<b>Observation Number: 439</b>					
<b>Output</b>					
Turnover (level in RMB)	RMB000,000	107.7741	175.0090	0.2000	1,700.0000
Turnover (level in US\$)	\$000,000	17.0731	27.7242	0.0317	269.3069
Turnover (logarithm)	Natural Logarithm	10.6345	1.5337	5.2983	14.3722
<b>Labour Input</b>					
Employee number (level)	No. of people	201.4282	232.4574	3.0000	1736.0000
Employee number (logarithm)	Natural Logarithm	4.7368	1.1515	1.0986	7.4593
<b>Capital Input</b>					
Current capital (level in RMB)	RMB000,000	46.2909	208.6354	0.2000	4,200.0000
Current capital (level in US\$)	\$000,000	7.3332	33.0512	0.0317	665.3466
Current capital (logarithm)	Natural Logarithm	9.4497	1.6144	5.2983	15.2506
<b>Intermediate Input</b>					
Intermediate input (level in RMB)	RMB000,000	91.0599	163.0378	0.0630	1,700.0000
Intermediate input (level in US\$)	\$000,000	14.4253	25.8278	0.0100	269.3069
Intermediate input (logarithm)	Natural Logarithm	10.3060	1.7058	4.1431	14.3201
<b>Entrepreneur's motivation</b>					
Motivation (opportunity)	Dummy	0.9704	0.1697	0.0000	1.0000
<b>Entrepreneur's personal characteristics</b>					
Age	No. of years	48.0068	8.2693	26.0000	78.0000
Male	Dummy	0.9226	0.2676	0.0000	1.0000
Education (Bachelor)	Dummy	0.2437	0.4298	0.0000	1.0000
Experience (manager)	Dummy	0.4351	0.4963	0.0000	1.0000
Experience (start-up)	Dummy	0.6196	0.4860	0.0000	1.0000
Experience (technical)	Dummy	0.0866	0.2815	0.0000	1.0000
<b>Entrepreneur's <i>guanxi</i></b>					
Business connection	Dummy	0.7130	0.4529	0.0000	1.0000
Political connection	Dummy	0.7699	0.4214	0.0000	1.0000
<b>Firm characteristics</b>					
Size (medium)	Dummy	0.2711	0.4450	0.0000	1.0000
Firm age	No. of years	11.0911	4.7682	1.0000	23.0000
Exports	% of total sales	0.0263	0.0747	0.0000	1.0000
Credit access	% of total capital	0.2251	0.2101	0.0000	1.0000
R&D	% of total sales	0.0315	0.1172	0.0000	1.7010

Source: Author's summary of the data for the sample extracted from the 2012 Private Enterprises Survey.

**Table 7.6 Summary statistics for non-eastern private manufacturing SMEs in China**

Variable	Unit	Mean	Std. Dev.	Min	Max
<b>Observation Number: 225</b>					
<b>Output</b>					
Turnover (level in RMB)	RMB000,000	80.2433	363.7262	0.0300	5,000.0000
Turnover (level in US\$)	\$000,000	12.7118	57.6200	0.0048	792.0792
Turnover (logarithm)	Natural Logarithm	9.4811	1.9808	3.4012	15.4249
<b>Labour Input</b>					
Employee number (level)	No. of people	158.4622	678.3481	1.0000	10,000.0000
Employee number (logarithm)	Natural Logarithm	3.9526	1.4368	0.0000	9.2103
<b>Capital Input</b>					
Current capital (level in RMB)	RMB000,000	28.4204	100.4670	0.0300	1,200.0000
Current capital (level in US\$)	\$000,000	4.5022	15.9156	0.0048	190.0990
Current capital (logarithm)	Natural Logarithm	8.5409	1.8308	3.4012	13.9939
<b>Intermediate Input</b>					
Intermediate input (level in RMB)	RMB000,000	70.5293	352.7250	0.0090	4,900.0000
Intermediate input (level in US\$)	\$000,000	11.1730	55.8772	0.0014	776.2376
Intermediate input (logarithm)	Natural Logarithm	9.0835	2.2064	2.1972	15.4028
<b>Entrepreneur's motivation</b>					
Motivation (opportunity)	Dummy	0.9467	0.2252	0.0000	1.0000
<b>Entrepreneur's personal characteristics</b>					
Age	No. of years	47.8978	8.2399	25.0000	72.0000
Male	Dummy	0.8178	0.3869	0.0000	1.0000
Education (Bachelor)	Dummy	0.3244	0.4692	0.0000	1.0000
Experience (manager)	Dummy	0.4311	0.4963	0.0000	1.0000
Experience (start-up)	Dummy	0.2578	0.4384	0.0000	1.0000
Experience (technical)	Dummy	0.0933	0.2915	0.0000	1.0000
<b>Entrepreneur's <i>guanxi</i></b>					
Business connection	Dummy	0.7022	0.4583	0.0000	1.0000
Political connection	Dummy	0.6356	0.4823	0.0000	1.0000
<b>Firm characteristics</b>					
Size (medium)	Dummy	0.1733	0.3794	0.0000	1.0000
Firm age	No. of years	9.0667	5.0718	1.0000	22.0000
Exports	% of total sales	0.0092	0.0637	0.0000	0.9121
Credit access	% of total capital	0.1907	0.1893	0.0000	0.8500
R&D	% of total sales	0.0124	0.0379	0.0000	0.3000

Source: Author's summary of the data for the sample extracted from the 2012 Private Enterprises Survey.

The significance of differences in entrepreneur and firm characteristics between eastern and non-eastern SMEs are shown in Table 7.7.

**Table 7.7 Differences between the mean value of eastern and non-eastern groups**

Variable	Unit	Eastern	Non-eastern	Differences
<b>Observation number</b>		<b>439</b>	<b>225</b>	
<b>Output and inputs</b>				
Turnover	\$000,000 RMB	107.7741	80.2433	27.5308* (20.9082)
Employee number	No. of people	201.4282	158.4622	42.9660 (35.8751)
Current capital	\$000,000 RMB	46.2909	28.4204	17.8705 (14.7161)
Intermediate input	\$000,000 RMB	91.0599	70.5293	20.5306 (20.0306)
<b>Entrepreneur's motivation</b>				
Motivation (opportunity)	Dummy	0.9704	0.9467	0.0237* (0.0156)
<b>Entrepreneur's personal characteristics</b>				
Age	No. of years	48.0068	47.8978	0.1090 (0.6772)
Male	Dummy	0.9226	0.8178	0.1048*** (0.0257)
Education (Bachelor)	Dummy	0.2437	0.3244	-0.0807** (0.0364)
Experience (manager)	Dummy	0.4351	0.4311	0.0040 (0.0407)
Experience (start-up)	Dummy	0.6196	0.2578	0.3618*** (0.0386)
Experience (technical)	Dummy	0.0866	0.0933	-0.0067 (0.0234)
<b>Entrepreneur's <i>guanxi</i></b>				
Political connection	Dummy	0.7130	0.7022	0.0108 (0.0373)
Business connection	Dummy	0.7699	0.6356	0.1343*** (0.0363)
<b>Firm characteristics</b>				
Size (medium)	Dummy	0.2711	0.1733	0.0978*** (0.0348)
Firm age	No. of years	11.0911	9.0667	2.0244*** (0.3995)
Exports	%	0.0263	0.0092	0.0171*** (0.0058)
Credit access	%	0.2251	0.1907	0.0344** (0.1667)
R&D	%	0.0315	0.0124	0.0191*** (0.0080)

Source: Author's summary from Table 7.5 and Table 7.6.

Note: The significance of difference of each variable between eastern and non-eastern regions is tested by the mean difference (MD) t-test for two independent samples by *STATA 14.0*. A positive coefficient for difference means the number of eastern regions is larger than that of non-eastern regions. Standard errors of the estimated coefficients are reported in parentheses. \*\*\*, \*\* and \* indicate a significance level of 1%, 5% and 10% respectively.

Generally, private manufacturing SMEs in more developed eastern regions were performing better as shown in Table 7.7. They obtained significantly (27.5308 million RMB) more turnover but they did not use significantly more labour, capital or intermediate inputs compared to non-eastern SMEs. This suggests that private SMEs in eastern regions are producing with higher efficiency, which is confirmed by the estimated technical efficiency scores for these two regions as discussed in the next section.

Eastern SMEs were significantly larger (9.78 per cent more of them were medium enterprises than were small and micro firms) and operated two years longer on average in the market. Eastern private manufacturing SMEs had higher export intensity with 2.63 per cent of their total sales contributed by exports, which is significantly higher than the 0.92 per cent for non-eastern SMEs. They also have more investment in innovation through R&D expenditure. In 2012 the ratio of R&D expenditure to the total sales of eastern private SMEs reached 3.15 per cent, which was 1.91 per cent more than that of non-eastern SMEs. Also, eastern private manufacturing SMEs obtained significantly more credit access with 22.51 per cent of their capital coming from bank loans, while this ratio for non-eastern SMEs was only 19.07 per cent.

In terms of entrepreneur characteristics, around 97.04 per cent of SME entrepreneurs in eastern regions were opportunity-driven. This ratio was significantly higher than that of SME entrepreneurs (94.67 per cent) in less developed non-eastern regions. As discussed in Chapter 4, it is the opportunity to necessity entrepreneurs (O/N) ratio, rather than the total entrepreneur numbers, which best relates to the development stage of an economy (Wong *et al.*, 2005; Acs, 2006). Thus, the opportunity to necessity ratio is expected to be higher in the more developed eastern regions of China, which is confirmed by the findings of this study (see Table 7.7). The average age of entrepreneurs for eastern and non-eastern SMEs was around 48 years for both. However, eastern regions have a significantly higher ratio of male entrepreneurs (92.26 per cent) than non-eastern regions (81.78 per cent). This confirms the findings of Zhu and Chu (2010) that more females are involved in entrepreneurial activities in less developed non-eastern regions due to restricted opportunities in the labour market compared to those in eastern regions.

Based on Table 7.7, the human capital level of entrepreneurs varies between eastern and non-eastern SMEs. The ratio of entrepreneurs with a bachelor's degree in non-eastern regions is significantly (8.07 per cent) higher than that for eastern entrepreneurs as shown in Table 7.7. In both eastern and non-eastern regions around 43% of entrepreneurs had management experience and 9% had experience as a technical member of staff. But with a longer history of entrepreneurial activities (see details in Chapter 3) the start-up experience of eastern entrepreneurs was much richer. 61.96 per cent of eastern entrepreneurs in the sample had start-up experience prior to establishing their business, while this ratio in non-eastern regions was only 25.78 per cent.

As the best way to connect with the Chinese government, both eastern and non-eastern entrepreneurs have a high level (70 per cent) of political connections. A significant difference exists, however, in terms of the business connections of entrepreneurs. With more business associations due to deeper economic decentralisation (Zhang, 2007), about 76.99 per cent of entrepreneurs in the eastern region have built business connections by joining the All-China Federation of Industry and Commerce (ACFIC). This ratio was only 63.56 per cent for non-eastern entrepreneurs (see Table 7.7).

From the above discussion it can be concluded that private manufacturing SMEs in the eastern and non-eastern regions have significantly different performances, entrepreneur characteristics and firm characteristics. Thus, SMEs in these two regions should be studied separately.

### **7.3.3 Empirical results**

Using *FRONTIER 4.1* the maximum likelihood estimation (MLE) of the regional one-stage SFA models for 439 eastern SMEs and 225 non-eastern SMEs in the sample is estimated respectively. As for the estimation of the aggregate one-stage SFA conducted in Section 7.2, the LR test is utilised to test the null hypotheses about (1) the validation of the Cobb-Douglas production functional form, (2) the absence of technical inefficiency effects, (3) the absence of stochastic inefficiency effects and (4) the insignificance of joint inefficiency variables for each regional frontier.



The results are shown in Table 7.8. According to the results, all four hypothesis tests are rejected at the 5 per cent significance level for both eastern and non-eastern frontiers. These results confirm the appropriateness of utilising a Translog production function form (Equation (7.5)) and one-stage SFA model for regional frontiers in this research. The model shown as Equation (7.6) is also supported to be valid.

**Table 7.8 Hypothesis tests for region-specific one-stage SFA model**

	(1)	(2)	(3)	(4)
<b>Eastern region</b>				
<b>LLR</b>	$H_0$ : -56.1122; $H_1$ : 90.9350	$H_0$ : 70.1065; $H_1$ : 90.9350	$H_0$ : 79.7476; $H_1$ : 90.9350	$H_0$ : 70.6027; $H_1$ : 90.9350
<b>LR statistics</b>	294.0945	41.6570	22.3749	41.7446
<b>Critical Value (at <math>\alpha = 5\%</math>)</b>	12.592	28.219*	6.483*	23.685
<b>Decision</b>	Reject $H_0$	Reject $H_0$	Reject $H_0$	Reject $H_0$
<b>Non-eastern region</b>				
<b>LLR</b>	$H_0$ : -129.8365; $H_1$ : -47.3220	$H_0$ : -62.1409; $H_1$ : -47.3220	$H_0$ : -51.4637; $H_1$ : -47.3220	$H_0$ : -69.5714; $H_1$ : -47.3220
<b>LR statistics</b>	165.0289	29.6379	8.2835	44.4988
<b>Critical Value (at <math>\alpha = 5\%</math>)</b>	12.592	25.689*	5.138*	23.685
<b>Decision</b>	Reject $H_0$	Reject $H_0$	Reject $H_0$	Reject $H_0$

Source: Author's estimation.

Note: \* indicates a mixture of a chi-square distribution as shown in Kodde and Palm (1986).

### ***Region-specific Translog stochastic production function model***

The results of the region-specific Translog stochastic production function model and technical inefficiency effect model for eastern and non-eastern SMEs are shown in Table 7.9 and Table 7.10 respectively. As for the aggregate model, all three kinds of inputs are found to have a positive and significant relationship with the production of private manufacturing SMEs in both regions (see Tables 7.9 and 7.10). SMEs in both eastern and non-eastern regions of China operate under decreasing return to scale (DRS). The RTS of non-eastern SMEs was (97.26 per cent) smaller than that of eastern ones (99.30 per cent). This confirms that the excess capacity problem is more serious in non-eastern regions, which mainly focus on capital-intensive industries (Fan, 2015).

**Table 7.9 Maximum likelihood estimates for parameters of the one-stage SFA under region-specific frontiers for eastern SMEs in the sample**

Variables	Model 1	Model 2	Model 3	Model 4
<b>Translog Stochastic production function model</b>				
Constant	1.8299***	1.7517***	2.0541***	2.0745***
lnL	0.7868***	0.7919***	0.8414***	0.8421***
lnK	0.2369***	0.2601***	0.2311***	0.2268***
lnIM	0.2131***	0.2104***	0.1634***	0.1656***
1/2lnL*lnL	0.0885***	0.0986***	0.0840***	0.0898***
lnL*lnK	0.0337***	0.0336***	0.0351***	0.0288***
lnL*lnIM	-0.1318***	-0.1375***	-0.1366***	-0.1338***
1/2lnK*lnK	0.0121	0.0116	0.0081	0.0118
lnK*lnIM	-0.0448***	-0.0464***	-0.0415***	-0.0415***
1/2lnIM*lnIM	0.1579***	0.1620***	0.1614***	0.1596***
<b>Technical inefficiency effects model</b>				
Constant	-4.1203***	-2.9410***	-1.2344***	-1.1347***
<b>Entrepreneur's motivation</b>				
Motivation (opportunity)	-0.6863*	0.2321	-0.0987	-0.1019
<b>Entrepreneur's personal characteristics</b>				
Age	0.0503**	0.0321***	0.0216***	0.0191***
Male		0.0848	0.0653	0.1578
Education (Bachelor)		-0.5539***	-0.7036***	-0.7226***
Experience (manage)		-0.0893*	-0.0467	0.0346
Experience (startup)		-0.0587	-0.0343	-0.0260
Experience (technical)		-0.3107***	-0.2569**	-0.1019
<b>Entrepreneur's <i>guanxi</i></b>				
Political connection		0.5125**	0.3286***	0.3575***
Business connection		-0.4753***	-0.3872***	-0.2977***
<b>Firm characteristics</b>				
Firm size (medium)			-0.5993***	-0.5399***
Firm age			-0.0217***	-0.0173***
Export				-1.1510***
Credit access				-0.6576***
R&D				-0.2835**
<b>Variance parameters</b>				
Sigma-square	0.2156***	0.0083***	0.1240***	0.1132***
Gamma ( $\gamma^j$ )	0.8403***	0.0945***	0.7463***	0.7296***
Log-likelihood function	81.1124	86.9440	88.2518	90.9350
<b>Return to scale</b>				0.9930

Source: Author's estimation of Equations (7.5) and (7.6) for 439 eastern SMEs by *FRONTIER 4.1*.

Note: For the technical inefficiency effects model, a positive coefficient indicates a lower regional technical efficiency level; \*, \*\*, \*\*\* indicate that coefficients are statistically significant at 10%, 5% and 1% respectively.

**Table 7.10 Maximum likelihood estimates for parameters of the one-stage SFA under region-specific frontiers for non-eastern SMEs in the sample**

Variables	Model 1	Model 2	Model 3	Model 4
<b>Translog Stochastic production function model</b>				
Constant	0.8298*	0.9680**	0.9470**	1.0742**
lnL	0.5006***	0.4387***	0.5006***	0.4763***
lnK	0.4484***	0.4533***	0.4623***	0.4836***
lnIM	0.3384***	0.3340***	0.3239***	0.2967***
1/2lnL*lnL	0.0007	0.0000	-0.0206	-0.0214
lnL*lnK	0.0395***	0.0338**	0.0349**	0.0354**
lnL*lnIM	-0.0779***	-0.0664***	-0.0672***	-0.0655***
1/2lnK*lnK	0.0868***	0.1009***	0.0934***	0.0946***
lnK*lnIM	-0.1344***	-0.1450***	-0.1393***	-0.1432***
1/2lnIM*lnIM	0.2066***	0.2111***	0.2067***	0.2123***
<b>Technical inefficiency effects model</b>				
Constant	-6.6426	1.6250***	0.8811***	0.8976***
<b>Entrepreneur's motivation</b>				
Motivation (opportunity)	-6.4253**	-0.7769*	-0.5032***	-0.3867***
<b>Entrepreneur's personal characteristics</b>				
Age		-0.0108	-0.0005	-0.0011
Male		-0.5772*	-0.1072	-0.0256
Education (Bachelor)		-0.8439**	-0.3761***	-0.3426***
Experience (manage)		-0.7731**	-0.3015**	-0.3162**
Experience (startup)		-1.9958**	-0.6785***	-0.5915***
Experience (technical)		-1.2429**	-0.5671***	-0.5243***
<b>Entrepreneur's <i>guanxi</i></b>				
Political connection		-1.1358***	-0.4880***	-0.4140***
Business connection		-0.2677	-0.0789	-0.0099
<b>Firm characteristics</b>				
Firm size (medium)			-2.7668***	-2.5401**
Firm age			-0.0062	-0.0059
Export				-3.7384***
Credit access				-1.0912***
R&D				-3.3369**
<b>Variance parameters</b>				
Sigma-square	2.5982*	0.5507***	0.3086***	0.2989***
Gamma ( $\gamma^j$ )	0.9757***	0.8958***	0.8278***	0.8270***
Log-likelihood function	-60.2084	-51.5608	-49.1160	-47.3220
<b>Return to scale</b>				0.9726

Source: Author's estimation of Equations (7.5) and (7.6) for 225 non-eastern SMEs by *FRONTIER 4.1*.

Note: For the technical inefficiency effects model, a positive coefficient indicates a lower regional technical efficiency level; \*, \*\*, \*\*\* indicate that coefficients are statistically significant at 10%, 5% and 1% respectively.

### ***Region-specific technical inefficiency effects model***

The second half of Tables 7.9 and 7.10 shows the estimated results derived from the technical inefficiency effects model for eastern and non-eastern SMEs respectively. As for the aggregate technical inefficiency effect model, the dependent variable in the models is the inefficiency levels ( $U_{ij}$ ). The signs of the estimated coefficients of each entrepreneur and internal-firm factor must be interpreted conversely for their relationship with the regional frontier technical efficiency. The results are interpreted as follows.

### ***Internal firm-specific factors***

The regional relationship of firm size with an SME's technical efficiency is the same as for the aggregate model (see Section 7.2.3). The advantage of larger medium-sized firms in the less developed non-eastern regions is found to be more obvious than that in eastern regions (see Tables 7.9 and 7.10). The scale economies of larger firms are especially important in less developed regions, where most of these are in the efficiency-driven development stage (Liu & Gao, 2012). But SMEs in innovation-driven eastern regions rely less on scale economies, and thus firm size is less significant (Liu & Gao, 2012). This research has provided empirical evidence for this. Unlike firm size, firm age is found to have different relationships in the eastern and non-eastern regions. A positive and significant relationship between firm age and technical efficiency, as shown in the aggregate model, is only found in the eastern regions. With more operational experience, older SMEs in eastern regions may have more knowledge stock which is important in efficient production (Admassie & Matambalya, 2002; Aggrey *et al.*, 2010). But in the less developed non-eastern regions, advanced technology is not as abundant and widespread as in the eastern regions (Liu & Gao, 2016). The disadvantage of young firms in terms of operational experience can be overcome by their advantage in flexibility to adjust to new production methods and technology (Admassie & Matambalya, 2002). This may explain the insignificant relationship of firm age with a firm's technical efficiency in the non-eastern regions as shown in Table 7.10.

Besides firm size and age, the relationships of export intensity, credit access and R&D intensity are also all identified as statistically significant in the eastern and non-eastern regions respectively. According to Tables 7.9 and 7.10, in both the eastern and non-eastern regions, private manufacturing SMEs with higher export intensity, more bank

loans and higher R&D expenditure intensity can produce more technically efficiently relative to regional frontiers. These results are the same as for those found in the aggregate model (see Section 7.2.3). For these three factors the magnitude of relationships in non-eastern regions is much higher than in the eastern regions. With lower international integration, capital abundance and innovation level (Liu & Gao, 2016; NBS, 2017b), the advantage of exporting firms with the ability to access more bank loans and engage in more R&D activities would be more obvious in non-eastern regions.

### ***Entrepreneur factors***

#### *Start-up motivation*

Without considering regional differences the results for the aggregate model showed that opportunity-driven entrepreneurs can produce more efficiently (see Section 7.2.3). However, in the regional models the relationship of an entrepreneur's start-up motivation is found to be different across regions. The results for eastern region SMEs are shown in Table 7.9. When using only the start-up motivation and age of the entrepreneurs as independent variables as in Model 1, opportunity-driven entrepreneurs are found to have a significantly higher efficiency level relative to the eastern frontier than their necessity-driven counterparts. But this significance disappears after controlling for the entrepreneur's gender, human capital and networks in Models 2, 3 and 4 in Table 7.9. This confirms that, in more developed eastern regions, the better efficiency performance of opportunity-driven entrepreneurs is mainly due to higher capability and more resources (Block & Sandner, 2009; Verheul *et al.*, 2010). If necessity-driven entrepreneurs have the same level of human capital and networks, they are not necessarily less efficient under technology available to eastern regions. This is consistent with the statement of Shane (2009) that necessity entrepreneurs are not necessarily less successful. However, in the less developed non-eastern region, a significant and positive relationship of opportunity-driven motivation with technical efficiency relative to the regional frontier is found in all four of the models (see Table 7.10). After controlling for the other characteristics of entrepreneurs and firms, SMEs built by opportunity-driven entrepreneurs are still more technically efficient due to their higher incentives (see Chapter 4). This is consistent with the view that the better performance of opportunity-driven entrepreneurs is obvious in underdeveloped economies, such as the non-eastern region of China (see Chapter 4).

### *Age*

In terms of the entrepreneur's age, an insignificant relationship with technical efficiency is found for the aggregate model that includes all regions of China, but the results for the regional models are very different. Younger entrepreneurs are found to have a significantly higher efficiency level relative to the regional frontier for eastern SMEs in all of the four models (see Table 7.9). The advantage of younger entrepreneurs is their energy, motivation, ambition, flexibility, ability to adopt and apply advanced technology and ability to adapt to China's rapidly developing market economy (see details in Chapter 4). This is more obvious in the innovative eastern provinces, which leads to a better efficiency performance for them (Prasad *et al.*, 2015).

Nevertheless, the significance of an entrepreneur's age is not apparent for the less developed non-eastern regions (see Table 7.10). A possible reason for this is that advanced knowledge in more developed eastern regions cannot be easily spilled over to non-eastern regions due to the spatial dimension of knowledge production (Audretsch & Feldman, 2004). Therefore, the advantage of older entrepreneurs with more knowledge stock (Allaire & Marsiske, 1999; Shaw *et al.*, 2009) is more obvious in non-eastern regions. This may overcome their disadvantages in creativity, ambition, flexibility and attitude to risk, resulting in the insignificance of an entrepreneur's age for non-eastern SMEs. This is consistent with empirical studies on small businesses in other economies, such as Greece (Daskalopoulou & Petrou, 2008) and Nigeria (Amaechi *et al.*, 2014).

### *Gender*

According to the results shown in Table 7.9, in the more developed eastern regions the disadvantages of female entrepreneurs in terms of efficiency performance, as discussed in Chapter 4, appear not to be significant. But the underperformance of female entrepreneurs in terms of efficiency is found to be significant for non-eastern SMEs as shown in Model 1 of Table 7.10 without controlling for internal firm-factors. However, as emphasised by many studies (e.g. Marlow & Patton, 2005; Carter *et al.*, 2007; Sabarwal & Terrell, 2008), the underperformance of SMEs founded by female entrepreneurs is mainly due to their smaller size, which is usually related to a lower efficiency level. After controlling for firm size, the underperformance of female entrepreneurs is found to disappear in many empirical studies (Loscocco & Robinson, 1991; Carter *et al.*, 1997; Du

Rietz & Henrekson, 2000). This is also the case for non-eastern private manufacturing SMEs in China. After controlling for the firm's size and age in Model 2 the significance of an entrepreneur's gender for the efficiency performance of non-eastern SMEs is found to no longer exist (see Table 7.10).

Therefore, female entrepreneurs in China's manufacturing sector are not necessarily underperforming in terms of efficiency in both eastern and non-eastern regions. But female entrepreneurs in non-eastern regions do operate smaller firms compared to their male counterparts, and these firms do tend to have lower efficiency levels.

### *Education*

According to the results in Tables 7.9 and 7.10, a significant and positive relationship of an entrepreneur's education level with technical efficiency relative to the regional frontier is found for both the eastern and non-eastern regions. As discussed in the aggregate model in Section 7.2.3, an entrepreneur with a bachelor's degree could have a better performance because of their higher knowledge level, especially knowledge obtained from an entrepreneurship education at a university. Therefore, the university education received by entrepreneurs is shown to be significant for better efficiency performance in both eastern and non-eastern SMEs.

### *Experiences*

Results for the relationship of an entrepreneur's experience are found to be different in the eastern and non-eastern regions of China. For non-eastern SMEs the significance of an entrepreneur's management, start-up and technical experience are all found to be strongly significant in determining a firm's efficiency level under regional technology (see Model 2, 3 and 4 in Table 7.10). In the more developed eastern regions, only management experience and technical experience are found to be significant for a firm's technical efficiency under regional technology (see Model 2 in Table 7.9). But after controlling for a firm's size and age, the significance of management experience disappears (see Model 3 in Table 7.10). The relationship of technical experience also becomes insignificant after further controlling for a firm's export, credit access and R&D activities (see Model 4 of Table 7.9). The results indicate that the significant relationships of management and technical experiences are mainly due to the fact that an experienced

entrepreneur can operate a firm with larger size and for longer (Cooper *et al.*, 1989; Bates, 1990) and have more exports and R&D investment (Barker III & Mueller, 2002; Ganotakis & Love, 2012), which relate to higher efficiency levels. If these firm factors are controlled, management, start-up and technical experiences are all shown to have insignificant relationships with the efficient production of SMEs in eastern regions under eastern technology (see Model 4 of Table 7.9). Some possible explanations for the different relationships in these two regions are discussed as follows.

First, in the more developed eastern regions with a higher entrepreneurship level and more entrepreneurial activities (All-China Federation of Industry and Commerce, 2017), entrepreneurs may access knowledge and skills from other resources. This could make entrepreneurs less reliant on their previous experiences in operating their businesses efficiently. Therefore, an entrepreneur's experiences could have an insignificant relationship with the technical efficiency of the firm in these more developed regions as shown in Table 7.9. However, in less developed regions with less entrepreneurship knowledge spillover (All-China Federation of Industry and Commerce, 2017), an entrepreneur's knowledge and skills on starting a business, managing a business and productive technology may have to be derived mainly from their previous experiences via a learning by doing process. Thus, these experiences could have a significant role in achieving a better efficiency performance for the firm as shown in Table 7.10.

Another possible reason is that the doing business environments are significantly different across China. According to the World Bank (2008), although the laws and regulations are basically the same across the regions of China, the eastern coastal cities have a much friendlier business environment. Entrepreneurs in the non-eastern regions, facing a more challenging business environment, may have to depend more on their own experiences to perform better. In the more developed eastern regions, with a higher business knowledge stock and friendlier business environment, the relationships of previous experiences with the efficient production of entrepreneurial SMEs could be less obvious. Moreover, the more rapidly developing business environment in the eastern provinces may also imply that past experiences become more rapidly outdated or obsolete, and thus exert an insignificant relationship with a firm's efficiency performance.



### *Political connections*

In the aggregate model shown in Table 7.3 the political connections of entrepreneurs did not have a significant relationship with a firm's efficient production. However, the results for the regional models shown in Table 7.9 and 7.10 indicate that this insignificance in the aggregate model is due to the different relationships of political connections in the eastern and non-eastern regions. For SMEs in the less developed non-eastern regions, entrepreneurs who have networks with the Chinese government and the Communist Party are shown to have significantly higher productive efficiency under their regional technology level (see Model 2 of Table 7.10). This significantly positive relationship still exists after controlling for firm-specific factors such as a firm's size, age, finance access, export and innovation activities (see Models 3 and 4 of Table 7.10). This result is consistent with the empirical findings of other studies in China that politically connected firms can gain better access to more scarce resources, information and advice, which can have an important relationship with firm performance (Park & Luo, 2001; Li *et al.*, 2009; Qian *et al.*, 2010).

However, in the more developed eastern regions the relationship of political connections is different from what might be expected. SMEs built by politically connected entrepreneurs are shown to have a significantly lower efficiency level relative to the regional frontier (see Models 2, 3 and 4 of Table 7.9). As stated by Li *et al.* (2008b), the positive relationship of political connections is more prominent in less developed regions of China due to their immature market and legislative system. In the more developed eastern regions, with a better business environment and less government intervention in markets, entrepreneurs can rely on market, instead of political, connections to obtain resources or information (Li *et al.*, 2008a). Under this circumstance the disadvantages of political connections may be more obvious. First, building and maintaining a government network can result in a substantial opportunity cost in terms of both time and financial expenditure for efficient production (Watson, 2007; Li *et al.*, 2009; Stam *et al.*, 2014). This cost could outweigh the benefits obtained from political connections resulting in a negative relationship with firm performance as shown in this research for eastern regions. Moreover, in the special context of China, politically connected entrepreneurs may have to appoint unqualified employees to important positions, simply because they are related to government officers (Warren *et al.*, 2004; Li *et al.*, 2009). The conflict of interest

between a government's social/political objectives and maximising firm performance is another possible disadvantage of politically connected entrepreneurs (Fan *et al.*, 2007; Wu *et al.*, 2012). Fan *et al.* (2007) found politically connected firms have lower growth rate. This research has provided evidence of a negative relationship of an entrepreneur's political connections with a firm's technical efficiency in eastern SMEs.

### *Business connections*

In terms of the business networks (*guanxi*) of entrepreneurs, a positive and significant relationship with technical efficiency relative to the group-specific frontier of private manufacturing SMEs has been found in eastern regions as expected from Chapter 4 (see Models 2, 3 and 4 in Table 7.9). In the eastern region those SMEs with business connections arising from attending All-China Federation of Industry and Commerce (ACFIC) events can produce more efficiently. One possible reason for this is that business connected entrepreneurs can have more channels through which to obtain scarce resources, insider information and more efficient suppliers, as pointed out by Lin *et al.* (2001), Li *et al.* (2009) and Chang (2011). This result is consistent with some studies on China's private enterprises using other firm performance indicators, such as sales growth (Park & Luo, 2001) and return on assets (Li *et al.*, 2009). However, in the less developed non-eastern regions of China the business connections of an entrepreneur are found to have little relationship with a firm's efficiency under regional technology (see Models 2, 3 and 4 in Table 7.10). In these regions, SMEs do not rely heavily on business networks in the promotion of firm performance.

From the results on the relationships of political and business connections with technical efficiency relative to the regional frontier in eastern and non-eastern regions respectively, it can be seen that SMEs in eastern regions, which have a relatively better market environment and less government intervention in market activities, rely on business connections rather than political connections for their efficient production. But SMEs in non-eastern regions, in which government intervention in market activities persists, still rely mainly on political connections rather than business connections for achieving a better firm efficiency performance. The market and usage of business networks should be further developed in these less developed non-eastern regions of China.

### ***Regional technical efficiency scores***

For eastern and non-eastern private manufacturing SMEs,  $TE_i^j = \exp(-U_{ij})$  are computed and the results are summarised in Table 7.11. Under technology available to the eastern region (east-specific frontier), eastern SMEs were 91.41 per cent technically efficient on average in 2012. They could still increase their output by 8.59 per cent without any increase in inputs to produce on the eastern-specific frontier. The average level of technical efficiency relative to the regional frontier for non-eastern SMEs was estimated to be 81.11 per cent. 18.89 per cent more output could be achieved using current technology available to non-eastern regions without any increase in inputs.

**Table 7.11 Technical efficiency relative to the regional frontier of private manufacturing SMEs in the sample**

	<b>Mean</b>	<b>Std.</b>	<b>Min</b>	<b>Max</b>	<b>Obs. number</b>
<b>Eastern SMEs</b>	0.9141	0.0581	0.2578	0.9780	439
<b>Non-eastern SMEs</b>	0.8111	0.1368	0.2704	0.9741	225

Source: Author's estimation from Equation  $TE_i^j = \exp(-U_{ij})$  by *FRONTIER 4.1*.

As discussed in Chapter 5, however, the estimated technical efficiency relative to different group-specific frontiers cannot be compared directly. The LR test result shown in Table 7.12 supports the view that eastern and non-eastern SMEs are producing under different technology. Thus, the estimated technical efficiency relative to the regional frontier discussed above cannot be compared between eastern and non-eastern regions.

**Table 7.12 Hypotheses tests for eastern and non-eastern SMEs using the same technology**

<b>LLR</b>	$H_0: -18.9284; H_1: 90.9350-47.3220=43.6130$
<b>LR statistics</b>	125.0828 ( $df = 25$ )
<b>Critical Value</b>	40.113 (5%)
<b>Decision</b>	Reject $H_0$

Source: Author's estimation following Battese *et al.* (2004).

Note:  $\log[L(H_0)]$  is the log-likelihood value for the aggregate one-stage SFA model shown in Table 7.3;

$\log[L(H_1)]$  is the sum of log-likelihood values of the two regional one-stage SFA models shown in Table 7.9 and Table 7.10.

Instead, the meta-production function for both eastern and non-eastern private manufacturing SMEs in China and their technology gaps to the metafrontier (national

technology) need to be estimated, in order to compute the comparable technical efficiency relative to the metafrontier (Battese *et al.*, 2004). This is conducted in the next section.

## 7.4 Technology gap ratio of eastern and non-eastern Chinese private manufacturing SMEs

After obtaining the regional frontiers by one-stage SFA in Section 7.3, the metafrontier for SMEs in all regions of China can be constructed by means of the fully parametric stochastic metafrontier function (SMF) model (Huang *et al.*, 2014) (see details in Chapter 5). By constructing a metafrontier, the technology gap ratio ( $TGR_i^j$ ) can be estimated, which indicates the level of technology used by firms in the two regions relative to national technology. Using the one-stage SFA technique the determinants of the technology gap ratio can also be identified. The empirical model to be used for constructing a metafrontier and estimating the scores and determinants of the technology gap ratio in this study are now discussed.

### 7.4.1 Empirical model

Pooling SMEs in both eastern and non-eastern regions, the metafrontier for all 664 private manufacturing SMEs in China can be estimated using the fitted value of estimated group-specific frontiers as the output for the meta-production function, and regards the technology gap as the one-side error item. The SMF-one-stage SFA model includes: (1) the stochastic meta-production function model and (2) the technology gap effects model (see details in Chapter 5). The stochastic meta-production function model in logarithmic form using the gross output approach and assuming a Cobb-Douglas functional form can be expressed as follows (Huang *et al.*, 2014):

$$\ln \hat{f}^j(x_i \beta^j) = \beta_0^M + \beta_1^M \ln(L_i) + \beta_2^M \ln(K_i) + \beta_3^M \ln(IM_i) + V_i^M - U_i^M. \quad (7.7)$$

The Translog functional form for the meta-production function can be written as:

$$\begin{aligned} \ln \hat{f}^j(x_i \beta^j) = & \beta_0^M + \beta_1^M \ln(L_i) + \beta_2^M \ln(K_i) + \beta_3^M \ln(IM_i) + 1/2 \beta_4^M \ln(L_i)^2 \\ & + \beta_5^M \ln(L_i) * \ln(K_i) + \beta_6^M \ln(L_i) * \ln(IM_i) + 1/2 \beta_7^M \ln(K_i)^2 \\ & + \beta_8^M \ln(K_i) * \ln(IM_i) + 1/2 \beta_9^M \ln(IM_i)^2 + V_i^M + U_i^M \end{aligned} \quad (7.8)$$

where:

$\hat{f}^j(x_i\beta^j)$  = the fitted value of region  $j$  frontier of firm  $i$  in the pooled sample;

$\beta^M$  = parameters of the metafrontier to be estimated;

$V_i^M$  = random error ( $V_i^M \sim iidN(0, \sigma_{V^M}^2)$ );

$U_i^M$  = non-negative technology gap effect ( $U_i^M \sim iidN^+(0, \sigma_{U^M}^2)$ );

the  $L_i$ ,  $K_i$  and  $IM_i$  are employee numbers, total capital value and intermediate inputs in 2012 for firm  $i$  in the pooled sample, respectively;

$i = 1, \dots, N$ ,  $j = 1, 2$ ,  $N^1 = 225$ ,  $N^2 = 439$ ,  $N^1 + N^2 = N = 664$ .

The obtained technology gap effect ( $U_i^M$ ) can be expressed as a function of the explanatory variables as follows, which is estimated simultaneously with the stochastic meta-production function model (Huang *et al.*, 2014):

$$\begin{aligned} U_i^M = & \delta_0^T + \delta_1^T Opportunity_i + \delta_2^T Age_i + \delta_3^T Male_i + \delta_4^T Edu_i + \delta_5^T Exp_{manage}_i \\ & + \delta_6^T Exp_{startup}_i + \delta_7^T Exp_{technical}_i + \delta_8^T Guanxi_{political}_i + \delta_9^T Guanxi_{business}_i + \delta_{10}^T Size_{medium}_i \\ & + \delta_{11}^T Firmage_i + \delta_{12}^T Export_i + \delta_{13}^T Credit_i + \delta_{14}^T R \& D_i + \delta_{15}^T GDP_i + W_i^T \end{aligned} \quad (7.9)$$

where:

all the variables used are the same as those explained in Equation (7.3) for firm  $i$  in the pooled sample;  $W_i^T$  is the random error ( $W_i^T \sim N(0, \sigma_{W^T}^2)$ );  $GDP_i$  is the GDP per capita of the region that firm  $i$  is located in.  $i = 1, \dots, N$ ,  $j = 1, 2$ ,  $N^1 = 225$ ,  $N^2 = 439$ ,  $N^1 + N^2 = N = 664$ .

As discussed in Chapter 5, the technology gap  $U_i^M$  is estimated by pooling the sample of eastern and non-eastern SMEs together. Using the variable  $Noneast_i$  in Equation (7.3) as an indicator of firm location in Equation (7.9) would cause an endogeneity problem in the regression. This could lead to biased results. Therefore, an instrumental variable  $GDP_i$  is utilised instead of  $Noneast_i$  to show the development level of a firm's location.

## 7.4.2 Empirical results

The SMF-one-stage-SFA model allows simultaneous estimation of the SMF model and technology gap effects model using the software *FRONTIER 4.1*. As for the aggregate frontier and regional frontiers model, four LR tests have been conducted to confirm: (1) the appropriateness of the Cobb-Douglas functional form for the metafrontier ( $H_0 : \beta_4^M = \beta_5^M = \dots = \beta_9^M = 0$ ), (2) the significance of the technology gap effect in the metafrontier ( $H_0 : \gamma^M = \delta_0^T = \dots = \delta_{15}^T = 0$ ), (3) the absence of the stochastic technology gap effect ( $H_0 : \gamma^M = \delta_0^T = 0$ ), and (4) the significance of joint variables in explaining the technology gap ( $H_0 : \delta_0^T = \dots = \delta_{15}^T = 0$ ). The results of these LR tests are shown in Table 7.13. All of these four hypotheses are rejected at the 5 per cent significance level for the meta-production function model. They confirm that it is appropriate to use the Translog production function (Equation 7.8) and there is a significant technology gap effect in the metafrontier for private manufacturing SMEs in China. The one-stage SFA model should be utilised to estimate this model and the technology gap effect model shown by Equation (7.9) is also evident to be valid.

**Table 7.13 Hypotheses tests for the stochastic meta-production function (SMF) model for pooled SMEs in the sample**

	(1)	(2)	(3)	(4)
<b>LLR</b>	$H_0 : -81.0959;$ $H_1 : 848.7402$	$H_0 : 713.4431;$ $H_1 : 848.7402$	$H_0 : 738.9238;$ $H_1 : 848.7402$	$H_0 : 816.1724;$ $H_1 : 848.7402$
<b>LR statistics</b>	410.1605	37.4337	13.1509	37.8640
<b>Critical Value</b> (at $\alpha = 5\%$ )	12.592	28.268*	5.138*	24.996
<b>Decision</b>	Reject $H_0$	Reject $H_0$	Reject $H_0$	Reject $H_0$

Source: Author's estimation.

Note: \* indicates a mixture of a chi-square distribution as shown in Kodde and Palm (1986).

The empirical results for the Translog stochastic meta-production function (SMF) model (Equation (7.8)) and the technology gap effects model (Equation (7.9)) for all SMEs in the sample are shown in Table 7.14. The estimates of the variance ratios (gamma parameter)  $\gamma^M = \sigma_{u^M}^2 / (\sigma_{v^M}^2 + \sigma_{u^M}^2)$  are found to be 0.9826 (see Table 7.14), which is close to 1 and statistically significant at the 1 per cent level. This indicates that a majority of the variation in the composite error term in the meta-production function can be

explained by technology gap effects ( $U_i^M$ ) (Huang *et al.*, 2014; Huang *et al.*, 2015). The complement of variance ratios  $\gamma^M (1-\gamma^M)$  are estimated to show the significance of random error in the model (Huang *et al.*, 2014). It is estimated to be 0.0174 and also significant at the 1 per cent level (see Table 7.14). This indicates the biasness of the traditional deterministic metafrontier model proposed by Battese *et al.* (2004) without considering the sampling error in the meta-production function, thus confirming the advantage of using the SMF model (Huang *et al.*, 2014).

### ***Translog stochastic meta-production function (SMF) model***

Based on the results in Table 7.14 for the meta-production function of private manufacturing SMEs in all regions of China, labour, capital and intermediate inputs are all found to have a significant (at the 1 per cent level) and positive relationship with output as expected. The value of returns to scale under the national technology is estimated to be 0.9659 (see Table 7.14), which indicates decreasing returns to scale. This provides further evidence for the excess capacity problem in China's manufacturing sector, which is similar to that in the aggregate and regional production frontiers (see Sections 7.2.3 and 7.3.3).

### ***Technology gap effects model***

The second part of Table 7.14 shows the estimated results for the technology gap effects model (Equation (7.9)), which provides evidence of the determinants of the technology gap ratio of private manufacturing SMEs in China.

Similar to the aggregate and regional technical inefficiency effect models (see Sections 7.2.3 and 7.3.3), the dependent variable in the technology gap effect model is the technology gap level ( $U_i^M$ ), rather than the technology gap ratio. Therefore, the estimated positive signs imply an increase in the technology gap and a decrease in the technology gap ratio. To find the determinants of the technology gap ratio, the estimated signs shown in Table 7.14 must be interpreted conversely.

**Table 7.14 Maximum likelihood estimates of the parameters of the SMF - one-stage SFA for private manufacturing SMEs in all regions of China**

Variables	Coeff.	Std.	t-ratio
<b>Translog Stochastic meta-production function model</b>			
Constant	1.4449***	0.0638	22.6606
lnL	0.7302***	0.0189	38.5852
lnK	0.3538***	0.0154	22.9154
lnIM	0.2360***	0.0119	19.8065
1/2lnL*lnL	0.0633**	0.0035	17.9532
lnL*lnK	0.0263***	0.0029	9.2169
lnL*lnIM	-0.1153***	0.0023	-49.4295
1/2lnK*lnK	0.0824***	0.0026	31.8500
lnK*lnIM	-0.1166***	0.0018	-66.0590
1/2lnIM*lnIM	0.2150***	0.0024	88.9524
<b>Technology gap effects model</b>			
Constant	1.2112***	0.1247	9.7096
<b>Entrepreneur's motivation</b>			
Motivation (opportunity)	-0.4465***	0.0551	-8.0980
<b>Entrepreneur's personal characteristics</b>			
Age	-0.0002	0.0010	-0.2433
Male	-0.4200***	0.0490	-8.5664
Education (Bachelor)	-0.0947***	0.0214	-4.4220
Experience (manage)	0.0377**	0.0165	2.2771
Experience (startup)	-0.1189***	0.0210	-5.6682
Experience (technical)	0.1794***	0.0295	6.0787
<b>Entrepreneur's <i>guanxi</i></b>			
Political connection	0.0498**	0.0201	2.4826
Business connection	-0.0343*	0.0205	-1.6780
<b>Firm characteristics</b>			
Firm size (medium)	0.1053***	0.0932	3.5143
Firm age	-0.0067***	0.0044	-3.1162
Exports	-0.7237***	0.0300	-11.6769
Credit access	-0.3918***	0.0021	-5.3067
R&D	-0.1909***	0.0620	-3.0819
GDP per capita	-0.1370***	0.0738	-7.9127
<b>Variance parameters</b>			
Sigma-square	0.0648***	0.0083	7.8297
Gamma ( $\gamma^M$ )	0.9826***	0.0043	229.6696
$\gamma^{\sim M} (1-\gamma^M)$	0.0174***	0.0043	4.0465
Log-likelihood function			848.7402
<b>Returns to scale</b>			0.9659

Source: Author's estimation of Equations (7.8) and (7.9) simultaneously by *FRONTIER 4.1*.

Note: For the technology gap effects model, a positive coefficient indicates a lower technology level \*, \*\*, \*\*\* indicate statistical significance at 10%, 5% and 1% respectively.



#### 7.4.2.1 Internal firm-specific factors

Based on the results shown in Table 7.14, firm size is found to be negatively and significantly related to the technology gap ratio. Compared with medium-sized enterprises the technology level of small and micro-sized enterprises in China's private manufacturing sector is significantly higher. Although larger firms can be more capable of engaging in innovation and having access to more technological knowledge, smaller firms can be more flexible in adopting new technology or taking part in innovation activities (Van Dijk *et al.*, 1997; Withers *et al.*, 2011). The negative relationship of firm size with the technology gap ratio found in this research is consistent with its inverse relationship with a firm's innovation as found by Hansen (1992). This result provides empirical evidence that small and micro firms are the main drivers of technological progress in the manufacturing sector (State Council, 2016b).

Firm age is found to be positively and significantly related to the technology gap ratio. This indicates that older SMEs in China's private manufacturing sector adopt more advanced technology, with a higher technology gap ratio than for younger SMEs. This is consistent with Hansen's (1992) conclusion that, although young entrants tend to have a higher level of product innovation, older firms focus more on process innovations which mainly involve incrementally improving the means of production and the technology level involved in this. Older firms are likely to have specific niche products. Their focus may not be on new products but rather on improving the way in which established and well-developed products are produced (Hansen, 1992). Hence, technology would be more important to them.

Export participation is shown to have a significant and positive relationship in Table 7.14 as might be expected. This result is consistent with results from many empirical studies, which show that exporting firms can obtain technology transfer and higher innovation levels (e.g. Westphal, 2002; Blalock & Gertler, 2004; Salomon & Shaver, 2005; Aw *et al.*, 2007). In emerging economies like China, export-related learning is a major channel for technology spillovers to domestic firms (Liu & Buck, 2007; Liao *et al.*, 2012). It has been argued that learning from foreign buyers via exporting can facilitate technology diffusion and transfer (Greenaway & Yu, 2004). Foreign purchasers would transmit their advanced technology to exporters to fulfil their requirements for high quality products

(Liu & Buck, 2007). Exporting firms may also obtain diverse knowledge which facilitates the development of new technology (Salomon & Shaver, 2005). Moreover, they may face more competitive international markets, thus needing to update their technology to maintain their competitiveness in order to survive (Blalock & Gertler, 2004; Liu & Buck, 2007). This research provides evidence that, in China's manufacturing sector, SMEs with a higher ratio of exports to total sales enjoyed a higher technology level.

Access to credit is also found to have a positive relationship with a firm's technology gap ratio. Private manufacturing SMEs with a higher ratio of bank loan value to total assets would utilise more advanced technology in production than their counterparts. With more bank loans a firm could have higher financial capability to invest in innovation related activities (O'Sullivan, 2005; Agénor & Canuto, 2017). This result is consistent with the findings of Ayyagari *et al.* (2011) that external financing, mostly bank loans, is related to greater firm innovation when studying 19,000 firms in 47 developing countries. With limited capital, bank loans have been proved to be a significant source of technology improvement in private SMEs in China's manufacturing sector based on the results of this study.

Moreover, SMEs with more R&D expenditure relative to total sales are found to have a higher technology level in production, as might be expected. The significance of R&D expenditure for technological upgrading has been widely discussed in the literature. Endogenous economic growth models utilise R&D investment as a proxy for new knowledge perception which drives economic growth. At the firm level, empirical studies have found that R&D spending or intensity is related to internal new knowledge acquisition and the innovation ability of a firm (e.g. Hall & Van Reenen, 2000; Frenkel *et al.*, 2001; Shefer & Frenkel, 2005; Thornhill, 2006; Lin *et al.*, 2012). R&D expenditure can also provide firms with the absorptive capability to utilise technical development obtained outside the firm (Tilton, 1971; Cohen & Levinthal, 1989; 1990). Therefore, the R&D spending of a firm could help it adopt new technology developed both internally and externally, thereby leading to a higher productive technology level. The results found in this research provide empirical evidence for this in China's manufacturing private SME sector.

#### 7.4.2.2 Entrepreneurial factors

##### *Start-up motivation*

As shown in Table 7.14, SMEs established by opportunity-driven entrepreneurs have a significantly higher technology gap ratio than their necessity-driven entrepreneur counterparts. This indicates that opportunity-driven entrepreneurs can build their firms by utilising more advanced technology available to Chinese SMEs. This is consistent with the argument that opportunity-driven entrepreneurs are the main drivers of technology improvement (Verheul *et al.*, 2010). The empirical findings of Acs and Varga (2005) also showed that opportunity-driven entrepreneurship exerts a positive relationship with technological change at the macro level while necessity-driven entrepreneurship has no relationship. This result provides empirical evidence that opportunity-driven entrepreneurs are strongly correlated with knowledge creation, innovation and high technology enterprises (Reynolds *et al.*, 2002; Wong *et al.*, 2005; Hechavarria & Reynolds, 2009; Verheul *et al.*, 2010) in China's manufacturing sector.

##### *Age*

The age of the entrepreneur is found to have an insignificant relationship with the technology gap ratio of private manufacturing SMEs (see Table 7.14). One of the possible reasons for this could be that younger and older entrepreneurs have their own advantages in utilising advanced technology. Although younger people are more likely to undertake risky innovative activities and be closer to new developments in technology, older entrepreneurs usually have more knowledge stock about technology and have more experience (Roberts, 1991b).

Also, workers or researchers who have innovative technology knowledge and want to leave their current jobs and become entrepreneurs to commercialise this new knowledge (Audretsch & Keilbach, 2007) may have worked in incumbent firms and laboratories for several years, and thus they may be the relatively older entrepreneurs (Roberts, 1991a). Due to the potential advantages for both younger and older entrepreneurs, Aevermaete *et al.* (2004) found that an entrepreneur's age is not significantly related to innovation in small food manufacturing firms in the EU. This is consistent with the empirical results shown in this research.

### *Gender*

The results in Table 7.14 also show a significant relationship of an entrepreneur's gender with a firm's technology gap ratio. One of the possible reasons for this is that female entrepreneurs still face many constraints in terms of accessing advanced technology. Female entrepreneurs usually face many obstacles with regards to unequal access to finance and complementary inputs in relation to adopting new technology (Doss & Morris, 2001; Sandee & Rietveld, 2001). They also may have limited information on the new production techniques due to their underdeveloped networks (Sandee & Rietveld, 2001). Also, due to constraints on finance, female entrepreneurs usually only enter sectors with low technology levels (Lee & Marvel, 2014). Moreover, Doss and Morris (2001) pointed out that female entrepreneurs could have a lower technology level adoption even without these constraints as they are more risk averse (Carland & Carland, 1991; Storey & Tether, 1998). The empirical results of this study confirm that SMEs built by male entrepreneurs tend to use a significantly higher level of technology in production than those built by female entrepreneurs (Shi, 2015).

### *Education*

An entrepreneur's education level is found to have a significant and positive relationship with a firm's technology gap ratio. SMEs built by entrepreneurs with a bachelor's degree would adopt more advanced technology than those without a bachelor's degree. This result is consistent with the findings of many other empirical studies that find the education level of entrepreneurs is crucial for the innovative activities and technology levels of firms (Cohen & Levinthal, 1989; Roberts, 1991a; Marvel & Lumpkin, 2007). With a higher education level, the ability of an individual to acquire, absorb and implement new technologies increases (Bartel & Lichtenberg, 1987; Chander & Thangavelu, 2004). A university education can provide basic knowledge for adopting a new technology and transferring knowledge from university to industry (Yusuf & Nabeshima, 2007). A university entrepreneurship education can also encourage potential entrepreneurs to utilise higher technology and provide technological training to their workers (Siegel & Phan, 2005). Therefore, a university education is of crucial importance in encouraging entrepreneurs to utilise a higher technology level in China's manufacturing sector.

### *Experiences*

Besides generic human capital, the relationships between a firm's technology gap ratio and specific human capital, such as prior management experience, entrepreneurial experience and the technical experience of entrepreneurs, are also shown in Table 7.14. According to the results, only the start-up experiences of entrepreneurs are shown to have a significantly positive relationship with the technology level adopted by their SMEs. This indicates that entrepreneurs with previous start-up experience could adopt more advanced technology for firm production. But SMEs built by entrepreneurs with experience as a technical member of staff or with management experience were producing with a lower technology level (see Table 7.14). This is consistent with the findings of Stuart and Abetti (1990) that only the start-up experiences of entrepreneurs are significant for better firm performance and that the importance of management and technical experiences are usually over-emphasised, especially in a rapidly developing economy like China where knowledge of technology and management is updated quickly and continuously.

The negative relationships of technical and management experiences with a firm's technology level seem to be counterintuitive. A possible reason for this result can be derived from Kesting's (2007) argument that innovation and new technology adoption involve departure from the established routine. With more technical and management experience, entrepreneurs may be more familiar and confident with the established routine and technology they had utilised in their previous jobs. They may be subject to technology 'lock in' and more capable of improving the existing technology than of adjusting to a new system (Weinberg, 2004). When they have obtained experience in the old technology and operational routines, entrepreneurs could find it increasingly difficult to adapt to new changes in technology (Brynjolfsson *et al.*, 1997; Weinberg, 2004). The results of this study confirm this in China's manufacturing sector.

### *Political connections*

According to Table 7.14, entrepreneurs with political connections that involve the Chinese Communist Party and its organisations were found to have a significantly lower productive technology level. One of the possible reasons for this is that the transaction costs associated with building political connections would be relatively high (Li &

Atuahene-Gima, 2001). They may need to provide gifts, free shares and entertainment to government officials in building and maintaining these networks (Li & Atuahene-Gima, 2001; Vanhonacker, 2004; Gu *et al.*, 2008), which may drain the time and finance needed to explore and adjust to new advanced technology. In China the rapidly developing market-oriented economy has reduced the value of information provided by political contacts, so that the cost of maintaining them outweighs the benefits (Gu *et al.*, 2008).

Another possible reason is related to the comparative advantage obtained by politically connected SMEs (Kaynak *et al.*, 2013). With a political connection, private SMEs can have advantages in accessing credit (Johnson & Mitton, 2003; Cull & Xu, 2005; Dinç, 2005; Faccio, 2006; Li *et al.*, 2008a), reduced tax burdens (Adhikari *et al.*, 2006; Faccio, 2006; Li *et al.*, 2008a; Wu *et al.*, 2012) and more regulatory protection (Kroszner & Stratmann, 1998; Faccio, 2006; 2010), and obtain more government contracts (Goldman *et al.*, 2008; Faccio, 2010). With these comparative advantages, politically connected private SMEs may not need to level up their productive technology under intense competition, thus utilising a lower technology level than their non-connected counterparts.

In studying the difference between politically connected and non-connected firms across different countries, Faccio (2010) found that connected firms had significantly lower productivity. The result of this research provides empirical evidence that connected entrepreneurs would build a firm with a lower technology level.

### *Business connections*

In contrast to political connections, the business connections of an entrepreneur are found to have a positive and significant relationship with the technology level relative to the national available technology (see Table 7.14). SMEs built by entrepreneurs with business connections adopt more advanced technology in their production. This is consistent with the findings of many empirical studies that firms with business networks have a higher technology and innovation level (e.g. Landry *et al.*, 2002; Ritter & Gemünden, 2003). As stated by Kaynak *et al.* (2013) the relationships with customers, suppliers and competitors can develop trust between players within the network, encouraging them to share resources, such as new knowledge and technology. They can also access information on new technology and have higher possibility for inter-

organisational technological collaborations via business connections (Ritter & Gemünden, 2003; Walter *et al.*, 2007; Wu, 2008). This result supports the view that business connections are a significant source for attaining advanced technology for private manufacturing SMEs in China.

### ***Technology gap ratio scores***

After estimation of the stochastic meta-production function and the value of the technology gap ( $U_i^M$ ), the technology gap ratio of each firm can be estimated by  $TGR_i = \exp(-U_i^M)$  to show the technology level relative to the national technology (metafrontier) (Huang *et al.*, 2014). The technology gap ratio scores of private manufacturing SMEs in all regions, eastern and non-eastern regions of China, are shown in Table 7.15. The mean technology gap ratio for SMEs in all regions of China is found to be 0.9367. In general, Chinese SMEs can increase their maximum output by 6.33 per cent if they utilise the most advanced technology available in China. Private SMEs in China's manufacturing sector still have the potential to improve their technology levels. The maximum technology gap ratio value is 0.9943. This shows that currently there is no private manufacturing SME using the most advanced technology available to them.

**Table 7.15 Technology gap ratio of private manufacturing SMEs in the sample obtained from SMF model**

<b>Regions</b>	<b>Mean</b>	<b>Std.</b>	<b>Min</b>	<b>Max</b>	<b>Obs. number</b>
All regions	0.9367	0.0715	0.4098	0.9943	664
Eastern SMEs	0.9556	0.0400	0.6869	0.9921	439
Non-eastern SMEs	0.9000	0.0997	0.4098	0.9943	225
Mean difference	0.0556***				

Source: Author's estimation from  $TGR_i = \exp(-U_i^M)$  by *FRONTIER 4.1*.

Note: The significance of difference in the mean technology gap ratio level of eastern and non-eastern SMEs is tested by the mean difference t-test for two independent samples using *STATA 14.0*. The positive coefficient shows that the number for eastern regions is larger than that for non-eastern regions. \*\*\* indicate statistical significance at 1% level.

Considering the regional difference, the average technology gap ratios of eastern and non-eastern private manufacturing SMEs are 0.9556 and 0.9000 respectively. This shows that the current technology used by SMEs in eastern and non-eastern regions allow them to produce 95.56 per cent and 90.00 per cent of potential output respectively if they apply the most advanced technology in China. The average technology gap ratio of eastern

SMEs was 0.0556 higher than that of non-eastern SMEs and this difference is shown to be significant at the 1 per cent level (see Table 7.15). The results confirm the higher technology level of private manufacturing SMEs in the more developed eastern regions of China. This is consistent with the findings in the *Annual report of regional innovation capability of China 2016* that the technology and innovation levels of eastern regions, such as Beijing, Shanghai, Zhejiang, Jiangsu and Guangdong, are much higher than those of the central and western regions (Liu & Gao, 2016). For example, the number of invention patent applications in the eastern regions (Jiangsu, Guangdong, Zhejiang, Shandong and Beijing) in 2014 account for 54.41 per cent of the total number in China (Liu & Gao, 2016). The less developed non-eastern regions are still behind the eastern regions in terms of technology level.

## **7.5 Technical efficiency relative to the metafrontier of private manufacturing SMEs in China**

### **7.5.1 Technical efficiency scores relative to the metafrontier**

Based on the SMF model proposed by Huang *et al.* (2014), technical efficiency relative to the metafrontier ( $MTE_{ji}$ ) is the product of the technology gap ratio ( $TGR_i^j$ ) and technical efficiency relative to the group-specific frontier ( $TE_i^j$ ) as estimated in Sections 7.4 and 7.3. A statistical summary of the estimated technical efficiency relative to the regional frontier, technology gap ratio and technical efficiency relative to the metafrontier of private manufacturing SMEs in China are presented in Table 7.16.

In aggregate, private SMEs in the Chinese manufacturing sector are 82.72 per cent technically efficient, on average, under the national technology. Private SMEs can increase their output by 16.56 per cent without any additional inputs to achieve production on the metafrontier. When considering SMEs in eastern and non-eastern regions, respectively, the mean metafrontier technical efficiency are 87.38 per cent and 73.62 per cent. Without an increase in inputs, eastern private manufacturing SMEs can still increase their output by 12.62 per cent if they use the most advanced technology available in China, while non-eastern ones can improve their output by 26.38 per cent on average.



As pointed out by Battese *et al.* (2004), the technical efficiency scores estimated relative to the metafrontier are comparable. These estimated results indicate that private manufacturing SMEs in the more developed eastern regions of China are significantly more technically efficient than those in the less developed non-eastern regions. There is, therefore, a major regional disparity in terms of the efficiency performance of private SMEs in the manufacturing sector of China.

**Table 7.16 Summary statistics for  $TE_i^j$ ,  $TGR_i^j$  and  $MTE_{ji}$  from regional one-stage SFA models and an SMF-one-stage-SFA model**

Region	Mean	Std. Dev.	Min	Max	Obs. No.
<b>Private manufacturing SMEs in eastern regions</b>					
Regional TE	0.9141	0.0581	0.2578	0.9780	439
Technology gap ratio	0.9556	0.0400	0.6869	0.9921	439
Metafrontier TE	0.8738	0.0682	0.2271	0.9618	439
<b>Private manufacturing SMEs in non-eastern regions</b>					
Regional TE	0.8111	0.1368	0.2704	0.9741	225
Technology gap ratio	0.9000	0.0997	0.4098	0.9943	225
Metafrontier TE	0.7362	0.1620	0.1212	0.9487	225
<b>Difference in metafrontier TE between eastern and non-eastern regions</b>					
	0.1376***	0.0090			
<b>Aggregation</b>					
Regional TE	0.8792	0.1046	0.2578	0.9780	664
Technology gap ratio	0.9367	0.0715	0.4098	0.9943	664
Metafrontier TE	0.8272	0.1272	0.1212	0.9618	664

Source: Author's estimation and summary. The statistics for regional technical efficiencies and technology gap ratios are summarised from Tables 7.11 and 7.15.

Note: The significance of differences in the mean metafrontier technical efficiency level of eastern and non-eastern SMEs is tested by the mean difference t-test for two independent samples using *STATA 14.0*. A positive coefficient shows that the metafrontier technical efficiency of eastern SMEs is larger than that of non-eastern SMEs. \*\*\* indicates statistical significance at the 1% level.

### 7.5.2 Determinants of metafrontier technical efficiency from a Tobit model

After the estimation of metafrontier technical efficiency, the relationship between entrepreneurial factors with the metafrontier technical efficiency scores for private manufacturing SMEs in China can be estimated using a two-limit Tobit model as discussed in Chapter 5. The empirical two-limit Tobit model utilised in this research is shown as follows:

$$\begin{aligned}
MTE_{ji}^{M*} = & \delta_0^M + \delta_1^M Opportunity_{ji} + \delta_2^M Age_{ji} + \delta_3^M Male_{ji} + \delta_4^M Edu_{ji} + \delta_5^M Exp_{manage_{ji}} \\
& + \delta_6^M Exp_{startup_{ji}} + \delta_7^M Exp_{technical_{ji}} + \delta_8^M Guanxi_{political_{ji}} + \delta_9^M Guanxi_{business_{ji}} \\
& + \delta_{10}^M Size_{medium_{ji}} + \delta_{11}^M Firmage_{ji} + \delta_{12}^M Export_{ji} + \delta_{13}^M Credit_i + \delta_{14}^M R\&D_i + \delta_{15}^M GDP_i + W_i^M
\end{aligned}$$

$$MTE_{ji} = \begin{cases} MTE_{ji}^* & 0 < MTE_{ji}^* < 1 \\ 0 & MTE_{ji}^* \leq 0 \\ 1 & MTE_{ji}^* \geq 1 \end{cases} \quad (7.10)$$

where:

$MTE_{ji}^*$  and  $MTE_{ji}$  are unobserved and observed metafrontier efficiency scores respectively of firm  $i$  in group  $J$ ;  $W_i^M$  is the random error ( $W_i^M \sim N(0, \sigma_w^2)$ ); all the explanatory variables are the same as in Equation (7.9).

Equation (7.10) is estimated by *STATA 14.0* and the results are shown in Table 7.17. In order to test the significance of joint variables, including all entrepreneurial and firm-specific factors, in explaining technical efficiency relative to the metafrontier, an LR test on the null hypothesis that there is no joint effect of explanatory variables needs to be conducted. As shown in Table 7.17 the P-value of the LR tests is equal to 0. This shows that the metafrontier technical efficiency can vary significantly (at 1 per cent) across SMEs with different entrepreneurial and firm characteristics in the Chinese manufacturing sector. The model shown by Equation (7.10) is valid.

Table 7.17 shows the determinants of technical efficiency relative to the metafrontier for pooled private manufacturing SMEs in both eastern and non-eastern regions of China. According to the results, opportunity-driven entrepreneurs, younger entrepreneurs, male entrepreneurs, entrepreneurs with a bachelor's degree and those with start-up experience are associated with a higher technical efficiency level relative to the metafrontier, which represents the national technology available to all private manufacturing SMEs in China. However, an entrepreneur's management and technical experiences and political connections are found to have insignificant relationships with private manufacturing SMEs' metafrontier technical efficiency.

Besides entrepreneurial factors, firm-specific factors also have an relationship with metafrontier technical efficiency for private manufacturing SMEs in China. Medium-sized older SMEs with more export density, credit access and greater R&D intensity are found to produce more technically efficiently relative to the metafrontier. Moreover, SMEs located in more developed regions with a higher GDP per capita level were found to produce significantly more technically efficiently relative to the metafrontier. This further indicates implicitly that eastern SMEs had a higher metafrontier technical efficiency level than non-eastern regions, because eastern regions have a much higher GDP per capita level in China (see Chapter 3 for a detailed discussion).

**Table 7.17 Metafrontier-Tobit model results for private manufacturing SMEs in China**

<b>Variables</b>	<b>Coeff.</b>	<b>Std.</b>	<b>t-ratio</b>
Uncensored observations	664		
Total observations	664		
<b>Constant</b>	0.5379***	0.0335	16.0700
<b>Entrepreneur's motivation</b>			
Motivation (opportunity)	0.0890***	0.0216	4.1200
<b>Entrepreneur's demographic characteristics</b>			
Age (startup)	-0.0013**	0.0005	-2.3800
Male	0.0330***	0.0131	2.5300
Education (Bachelor)	0.0252***	0.0092	2.7400
Experience (manage)	-0.0023	0.0086	-0.2700
Experience (startup)	0.0319***	0.0086	3.7000
Experience (technical)	0.0027	0.0148	0.1800
<b>Entrepreneur's guanxi</b>			
Political connection	-0.0081	0.0102	-0.8000
Business connection	0.0285***	0.0103	2.7600
<b>Firm characteristics</b>			
Firm size (medium)	0.0495***	0.0101	4.9000
Firm age	0.0020**	0.0009	2.2600
Export	0.1060*	0.0573	1.8500
Credit access	0.1077***	0.0207	5.2100
R&D	0.0766*	0.0417	1.8400
GDP per capita	0.0157***	0.0017	9.5200
Log-likelihood function	559.5424		
LR chi-square	264.2200		
Probability>chi-square	0		

Source: Author's estimation of Equation (7.10) by *STATA 14.0*.

Note: A positive coefficient indicates a higher metafrontier technical efficiency level; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5% and 1% respectively.

## 7.6 Results on the proposed hypotheses testing

Because  $MTE_{ji}$  is the product of the  $TGR_i^j$  and regional  $TE_i^j$ , the relationship of entrepreneurial and firm-specific factors with metafrontier technical efficiency can be decomposed into their relationships with regional technical efficiency and relationships with the technology gap ratio. Results for the relationship of entrepreneurial factors with a firm's technical efficiency relative to the regional technology (from Tables 7.9 and 7.10), technology level (from Table 7.14) and technical efficiency relative to the national technology (from Table 7.17) are summarised in Table 7.18.

**Table 7.18 Relationships of entrepreneurial and firm-specific factors with regional technical efficiency, technology gap ratio and metafrontier technical efficiency (signs and significance)**

	Regional TE		TGR	Metafrontier TE (Regional TE*TGR)
	Eastern	Non-eastern		
<b>Entrepreneur's motivation</b>				
Motivation (opportunity)	+	+***	+***	+***
<b>Entrepreneur's demographic characteristics</b>				
Age (startup)	-***	+	+	-**
Male	-	+	+***	+***
<b>Entrepreneur's human capital</b>				
Education (bachelor)	+***	+***	+***	+***
Experience(manage)	-	+**	-**	-
Experience(startup)	+	+***	+***	+***
Experience(technical)	+	+***	-**	+
<b>Entrepreneur's guanxi</b>				
Political connection	-***	+***	-**	-
Business connection	+***	+	+	+***
<b>Firm characteristics</b>				
Firm size (medium)	+***	+**	-***	+***
Firm age	+***	+	+***	+**
Export	+***	+***	+***	+
Credit access	+***	+***	+***	+***
R&D	+**	+**	+***	+
GDP per capita			+***	+***

Source: Author's summary from Tables 7.9, 7.10, 7.14 and 7.17.

Note: \*, \*\*, \*\*\* indicate statistical significance at 10%, 5% and 1% respectively.

The results about the relationship between each factor and the metafrontier technical efficiency shown in Table 7.18 provide evidences for whether the null hypotheses

proposed in Chapter 4 should be supported to be true or not in China's manufacturing sector. The results on the null hypotheses testing are summarised in Table 7.19.

**Table 7.19 Results on proposed hypotheses testing based on results obtained**

<b>Hypothesis</b>	<b>Result</b>
<i>H<sub>1</sub>: Opportunity-driven entrepreneurs operate firms with a higher technical efficiency level compared to that of their necessity driven counterparts.</i>	Supported
<i>H<sub>2</sub>: Older entrepreneurs operate a firm with a lower technical efficiency level than their younger counterparts.</i>	Supported
<i>H<sub>3</sub>: Female entrepreneurs operate a firm with a lower technical efficiency level than their male counterparts.</i>	Supported
<i>H<sub>4</sub>: Entrepreneurs with a higher education level operate their firms with a higher technical efficiency level than their less educated counterparts.</i>	Supported
<i>H<sub>5</sub>: Entrepreneurs with prior management experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.</i>	Not supported
<i>H<sub>6</sub>: Entrepreneurs with prior start-up experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.</i>	Supported
<i>H<sub>7</sub>: Entrepreneurs with prior technical experience can operate a firm with a higher technical efficiency level than their non-experienced counterparts.</i>	Not supported
<i>H<sub>8</sub>: Politically connected entrepreneurs operate firms with a higher technical efficiency level than their non-connected counterparts.</i>	Not supported
<i>H<sub>9</sub>: Business connected entrepreneurs operate firms with a higher technical efficiency level than their non-connected counterparts.</i>	Supported
<i>H<sub>10</sub>: Larger sized SMEs produce with a higher technical efficiency level than their smaller counterparts.</i>	Supported
<i>H<sub>11</sub>: Older SMEs produce with a higher technical efficiency level than their younger counterparts.</i>	Supported
<i>H<sub>12</sub>: SMEs with more export density produce with a higher level of technical efficiency than their counterparts with limited or no export activities.</i>	Supported
<i>H<sub>13</sub>: SMEs with more access to credit produce with a higher technical efficiency level than their credit constrained counterparts.</i>	Supported
<i>H<sub>14</sub>: SMEs with more investment in R&amp;D activities produce with a higher technical efficiency level than their less R&amp;D intensive counterparts.</i>	Supported
<i>H<sub>15</sub>: Entrepreneurial SMEs located in the eastern regions of China produce with a higher technical efficiency level than their non-eastern counterparts.</i>	Supported

Source: Author's summary according to the results shown in Tables 7.18.

Note: The results on hypothesis testing is 'supported' if the relationship between the factor and metafrontier technical efficiency is positive and significant and 'not supported' if the relationship is insignificant as shown in Table 7.18.

Results from this study demonstrated that the relationships of an entrepreneur's start-up motivation with the technical efficiency relative to the metafrontier were significant for China's private manufacturing SMEs. Opportunity-driven entrepreneurs were outperforming their necessity driven counterparts in terms of the metafrontier technical

efficiency in China's manufacturing SME sector, which supports hypothesis 1. This was mainly because opportunity-driven entrepreneurs had a significantly higher technology level (technology gap ratio) than necessity-driven entrepreneurs as found in this research. This result is consistent with the viewpoint that opportunity-driven entrepreneurs, rather than necessity-driven entrepreneurs, are the ones who can generate innovation and improve productivity, and thus are the main drivers of innovation and technological progress (Acs & Varga, 2005; Wong *et al.*, 2005; Vivarelli, 2013). This is also the case for private manufacturing SMEs in China. The relationships of an entrepreneur's start-up motivation with technical efficiency relative to the regional frontier was found to be mixed for eastern and non-eastern private manufacturing SMEs. In non-eastern regions, opportunity-driven entrepreneurs performed significantly more technically efficiently under their regional technology than their necessity-driven counterparts. However, in more developed eastern regions, opportunity-driven entrepreneurs were not necessarily more technically efficient under regional technology than necessity-driven entrepreneurs when controlling for an entrepreneur's gender, human capital and networks. This confirmed that necessity-driven entrepreneurs are not necessarily less successful, as pointed out by Shane (2009), in terms of technical efficiency performance under eastern technology. The outperformance of opportunity-driven entrepreneurs in terms of regional frontier technical efficiency was only obvious in non-eastern regions of China.

An entrepreneur's age was shown to have a significant and negative relationships with technical efficiency relative to the metafrontier for private manufacturing SMEs in China. Younger entrepreneurs produced more technically efficiently under national technology than older entrepreneurs in China's manufacturing SME sector. Hypothesis 2 was accepted. This relationship was mainly because eastern private manufacturing SMEs built by younger entrepreneurs produced with a significantly higher regional frontier technical efficiency level. The advantages of younger entrepreneurs in efficient production were found to be obvious in eastern regions. However, in less developed non-eastern regions the relationship of an entrepreneur's age with regional frontier technical efficiency for private manufacturing SMEs was found to be insignificant. In these less developed regions, where knowledge is updated relatively slowly, the advantages of young entrepreneurs in ambition and flexibility were counteracted by their disadvantage in knowledge stock (Daskalopoulou & Petrou, 2008; Shaw *et al.*, 2009). In terms of

technology adoption, the empirical results in this study showed that an entrepreneur's age has an insignificant relationship with the technology gap ratio of private manufacturing SMEs in China. As stated by Roberts (1991b), the advantage of young entrepreneurs in terms of the newness of their knowledge of advanced technology can be counterbalanced by their limited overall knowledge stock compared with older entrepreneurs. This is the case for China's private manufacturing SMEs.

Based on the results shown in Table 7.18, male entrepreneurs significantly outperformed female entrepreneurs in terms of metafrontier technical efficiency within private manufacturing SMEs in China. Therefore, hypothesis 3 was proved to be correct. This was mainly due to the superior performance of male entrepreneurs in terms of the production technology level they utilised (technology gap ratio). Female entrepreneurs may face many obstacles in regards to using advanced technology, such as limited access to finance and information (Sandee & Rietveld, 2001), or are more risk-averse to involvement in high-technology industries and engagement in innovative activities (Lee & Marvel, 2014). The results obtained from this research confirm the underperformance of female entrepreneurs in terms of the technology level used in China's manufacturing SME sector. However, the underperformance of female entrepreneurs of private manufacturing SMEs was not found in their regional frontier technical efficiency level in both eastern and non-eastern regions of China after controlling for firm factors (e.g. size, age). Therefore, if the technology performance of female entrepreneurs can be improved to catch up with that of male entrepreneurs, the underperformance of female entrepreneurs in terms of technical efficiency relative to the metafrontier can be addressed.

An entrepreneur's education level was found to have a positive and significant relationship with technical efficiency relative to the metafrontier for private manufacturing SMEs in China. Entrepreneurs with a bachelor's degree produced more efficiently under national technology within China's private manufacturing SMEs, supporting hypothesis 4. This positive relationship was caused by the positive relationships of education level with both the regional frontier technical efficiency and the technology gap ratio. First, entrepreneurs with a bachelor's degree performed significantly more technically efficiently under regional technology for both eastern and non-eastern SMEs in the manufacturing sector of China. This result confirmed that a

university education can provide entrepreneurs with basic knowledge needed for efficient production under the current technology (Honig, 1998; Unger *et al.*, 2011; Li *et al.*, 2016). Also, entrepreneurs with a bachelor's degree used more advanced technology in their production for private manufacturing SMEs in both eastern and non-eastern regions. Besides providing knowledge about efficient production, a university education can also provide entrepreneurs with knowledge about innovation and the most advanced available technologies (Chander & Thangavelu, 2004; Yusuf & Nabeshima, 2007). Therefore, a university education plays a significant role in promoting more quality entrepreneurial activities with a better efficiency and technology performance in China.

The results for the relationship of management experience, start-up experience and technical staff experience, with metafrontier technical efficiency are mixed for private manufacturing SMEs in China. Start-up experience, which can provide entrepreneurs with knowledge about starting up and conducting a business, was found to have a significant and positive relationship with the metafrontier technical efficiency of private manufacturing SMEs. Hypothesis 5 was supported by the results of this study. Although the relationship of an entrepreneur's start-up experience with the regional frontier technical efficiency was insignificant in eastern regions, this relationship was found to be significant and positive for non-eastern SMEs. In less developed non-eastern regions, entrepreneurs with knowledge obtained from previous start-up experience can produce significantly more efficiently under non-eastern technology. In addition, an entrepreneur's start-up experience was related to a significantly higher technology gap ratio as shown in Table 7.18. Thus, the start-up experiences of an entrepreneur can lead to higher regional frontier technical efficiency in non-eastern regions and a higher technology level for China's private manufacturing SMEs.

The relationships between an entrepreneur's management experience and technical experience, however, were insignificant with the metafrontier technical efficiency of private manufacturing SMEs in China. Hypotheses 6 and 7 were not supported. As for start-up experience, their relationships with the regional frontier technical efficiency for SMEs were insignificant in eastern regions, in which entrepreneurs can access knowledge from various sources due to the well-developed doing business environment. But in non-eastern regions, where entrepreneurs rely heavily on their own experiences to obtain



knowledge, entrepreneurs with management and technical experiences were found to produce significantly more technically efficiently relative to the regional frontier than those without such experience in private manufacturing SMEs. However, entrepreneurs with management and technical experience had a lower technology level than those without such experiences in the manufacturing SME sector of China. They preferred to 'lock in' their existing technology and not adopt new technology with which they were not familiar (Weinberg, 2004).

In general, combining the relationships with both regional frontier technical efficiency and the technology gap ratio, only start-up experience can be significantly related to a higher metafrontier technical efficiency level for private manufacturing SMEs in China. This is consistent with the findings of Stuart and Abetti (1990) that only the start-up experience of entrepreneurs can generate a better firm performance, while the roles of management and technical experiences are usually over-valued.

An important research question addressed in this study is whether, and which kind of, social networks possessed by the entrepreneur are significant for the technical efficiency performance of private manufacturing SMEs in China. The results of this study showed that only business connections lead to a significantly higher metafrontier technical efficiency level, while political connections had an insignificant relationship. Hypothesis 9 was proved to be supported, while the results of this study do not support hypothesis 8.

The significantly positive relationship of business connections with technical efficiency was due to its positive relationships with both regional frontier technical efficiency for eastern regions and the technology gap ratio of private manufacturing SMEs in China. First, entrepreneurs with business connections, which can provide information about new technologies and channels for technological exchanges (Walter *et al.*, 2007; Wu, 2008; Kaynak *et al.*, 2013), were found to adopt more advanced technology than those without business connections. Second, although business connections did not improve the regional frontier technical efficiency effectively for non-eastern SMEs, eastern entrepreneurs with business connections were found to enjoy a significantly higher regional frontier technical efficiency than those without business connections. This demonstrated that business connections, which can also help entrepreneurs get access to

scarce resources and information that is useful for efficient production (Lin *et al.*, 2001; Chang, 2011), are used effectively by eastern entrepreneurs.

The insignificant relationship of political connections with the metafrontier technical efficiency was caused by its mixed relationships with the technology gap ratio and regional frontier technical efficiency. First, entrepreneurs with political connections may enjoy advantages in access to resources and information from government (Cull & Xu, 2005; Faccio, 2006; Kaynak *et al.*, 2013), and thus have less motivation to use the latest technology. This research found empirical evidence to support that politically connected entrepreneurs used a significantly lower level of technology than those without political connections. The relationship of an entrepreneur's political connections with regional frontier technical efficiency was also mixed. In less developed non-eastern regions this relationship was found to be positive. This indicated that in non-eastern regions, where the market and legal systems are less developed, entrepreneurs still need to rely on political connections to obtain scarce resources and information for efficient production. However, in eastern regions which have more developed market and legal systems, being politically connected usually does not carry advantages in obtaining scarce resources for producing efficiently (Li *et al.*, 2008). But the financial and time cost of maintaining political connections may lead to a negative relationship with regional frontier technical efficiency for eastern private manufacturing SMEs (see Fan *et al.*, 2007; Watson, 2007; Wu *et al.*, 2012; Stam *et al.*, 2014), which was found to be the case in this research.

In general, this study provided empirical evidence that eastern SMEs rely on business connections for more efficient performance under regional technology, while non-eastern SMEs still have a heavy reliance on political connections. Meanwhile, it is the business connections, rather than the political connections, of entrepreneurs that can generate a higher technology level in private manufacturing SMEs in China.

Firm size was found to have a significantly positive relationship with metafrontier technical efficiency, supporting hypothesis 10. Private medium sized enterprises produced more technically efficiently relative to the national frontier than private small and micro enterprises in China's manufacturing sector. This was mainly because medium sized enterprises had a significantly higher regional frontier technical efficiency level for

both eastern and non-eastern regions, but they were found to use lower level technology than small and micro enterprises within private manufacturing SMEs in China.

This study has shown that a firm's age had a significant and positive relationship with the metafrontier technical efficiency of private manufacturing SMEs in China. Hypothesis 11 is supported by these results. Older enterprises with more knowledge from *learning-by-doing* were shown to produce with more advanced technology. Although the relationship of firm age with regional frontier technical efficiency was insignificant for non-eastern SMEs, older SMEs in eastern regions were found to have a significantly higher regional frontier technical efficiency level than their younger counterparts.

The exporting, credit access and R&D activities of private manufacturing SMEs in China were all shown to have significant and positive relationships with their metafrontier technical efficiency performance, which supported hypotheses 12, 13 and 14. Exporting, better credit access and R&D activities can make private manufacturing SMEs use more advanced technology. They can also help these SMEs produce more technically efficiently under regional technology in both eastern and non-eastern regions of China. Also, SMEs in more developed regions were shown to produce more efficiently relative to the metafrontier because they utilised more advanced technology, supporting hypothesis 15 to be true in China's manufacturing sector.

The results obtained in this study provide a detailed account of the relationships of entrepreneurial and firm factors with technical efficiency under regional technology and aggregate technology level, and of their synthesised relationships with the metafrontier technical efficiency of private manufacturing SMEs in China. Utilising these results, policy suggestions that can help promote more quality entrepreneurial activities with a higher efficiency level utilising more advanced technology are given in the next chapter. This can help China achieve its goals as outlined in the 'Mass Entrepreneurship and Innovation' program, improve its manufacturing sector for 'Made in China 2025' and thus successfully transition to an innovation-driven economy. These recommendations and possible outcomes are discussed in detail in the following chapter.

## 7.7 Conclusion

This chapter aimed to measure technical efficiency relative to the regional frontier, the technology gap ratio and eventually the comparable technical efficiency scores relative to the metafrontier of private manufacturing SMEs in the eastern and non-eastern regions of China, followed by an identification of the relationships of entrepreneurial factors with these estimated scores. The data statistics for all SMEs in the sample (Table 7.1) show that private manufacturing SMEs in China produced on average about US\$15.59 million in output with 187 employees, had US\$6.37 million in capital and utilised US\$13.32 million in intermediate inputs in 2012. Most of the entrepreneurs are opportunity-driven, are male with management and start-up experience and have established business and political connections. 27 per cent of entrepreneurs had a bachelor's degree and 8.89 per cent had experience as technical staff members. 23.8 per cent of SMEs in the sample are medium-sized enterprises and had operated for around 10 years in the market. They had 2.05 per cent of their sales contributed to by exports, 21.35 per cent of their capital came from bank loans and they invested 2.51 per cent of their turnover in R&D activities. The estimation of the technical efficiency levels of aggregate SMEs in the sample, regardless of regional differences, showed that most of the entrepreneurial factors have an insignificant relationship with the efficiency level. It is argued that this may be due to the regional disparity in the characteristics of SMEs and entrepreneurial activities. According to Table 7.7, SMEs in eastern regions produced more output with a similar level of inputs, were larger in size, had operated longer in the market, had more access to bank loans and were more involved in export and R&D activities. Entrepreneurs of eastern region SMEs are more opportunity-driven for their start-ups, are more likely to be male, have a lower education level but had obtained more start-up experience and business networks. These differences can lead to different effects of entrepreneurial factors within China, and thus a regional estimation is required. The necessity to conduct regional estimation is confirmed by the LR test that SMEs in eastern and non-eastern regions were utilising different technology levels and thus had different production frontiers (see Table 7.12). This supports the need to estimate technical efficiency relative to a metafrontier for both eastern and non-eastern SMEs in China, which enables a comparison between groups with different technology (Battese & Coelli, 1995; O'Donnell *et al.*, 2008).

The estimated results for the scores of technical efficiencies relative to the regional frontier, technology gap ratio and technical efficiency relative to the metafrontier of eastern and non-eastern SMEs in the sample were summarised in Table 7.16. Private manufacturing SMEs in eastern regions were producing at 91.41 per cent technical efficiency under the technology available to eastern SMEs. Their technology is 95.56 per cent relative to the best technology in China. Combining their regional technical efficiency and technology level, they are found to be 87.38 per cent technically efficient relative to the metafrontier (best technology) of China's private manufacturing SMEs. In less developed non-eastern regions, private manufacturing SMEs are producing at 81.11 per cent technical efficiency relative to the non-eastern technology. The technology utilised by non-eastern SMEs is at the 90.00 per cent level relative to the best technology available in China. Therefore, non-eastern private manufacturing SMEs are estimated to be 73.62 per cent technically efficient relative to the best technology (metafrontier). Comparing the metafrontier technical efficiency scores between eastern and non-eastern regions, this research found SMEs located in less developed non-eastern regions are producing much less efficiently.

The determinants of the regional technical efficiency level, technology level and metafrontier technical efficiency level of private manufacturing SMEs in China are summarised in Table 7.18. Opportunity-driven entrepreneurs could enjoy a higher efficiency level ( $TE_i^j$ ) under a regional frontier and also have a higher technology level ( $TGR_i^j$ ). Combining these two relationships, opportunity-driven entrepreneurs could produce more efficiently relative to the metafrontier ( $MTE_{ji}$ ) as shown in Table 7.18. Although an entrepreneur's age is not important for the technology level adopted by the firm, it has a significantly negative relationship with regional frontier technical efficiency in eastern regions. These two relationships indicate that SMEs built by younger entrepreneurs could be more efficient relative to the metafrontier in China. Also, male entrepreneurs could outperform their female counterparts in terms of the efficiency level relative to the metafrontier for private manufacturing SMEs in China. This is because, although there is no gender difference in the efficiency level under the regional frontier, male entrepreneurs usually utilise more advanced technology which is much closer to the best technology (metafrontier) in China (see Table 7.18). With higher regional technical efficiency and more advanced technology, SMEs built by entrepreneurs with a university

education could perform more efficiently relative to the metafrontier. The relationship of experience is found to be different across experience types. An entrepreneur's start-up experience is significantly related to higher metafrontier technical efficiency due to higher regional technical efficiency in non-eastern regions and the technology level utilised by the firm. However, the management and technical experiences of entrepreneurs are associated with higher regional technical efficiency in non-eastern regions, but a lower technology level used in production. This results in insignificant relationships of these experiences with a firm's technical efficiency relative to the metafrontier for Chinese private manufacturing SMEs because one relationship offsets the other. The relationship of political connections with regional technical efficiency is different across regions. Politically connected entrepreneurs could perform more efficiently in non-eastern regions, but less efficiently in eastern regions which have a more mature market and legal system. However, politically connected entrepreneurs are found to utilise less advanced technology. Combining these two relationships, political connections are found to exert insignificant relationships with metafrontier technical efficiency for private manufacturing SMEs in China. In contrast to political connections, business connections are shown to exert significant and positive relationships with both regional technical efficiency and the technology gap ratio. Therefore, entrepreneurs with business connections are found to produce more technically efficiently (see Table 7.18).

Also, firm size is found to have mixed relationships with  $TGR_i^j$  and regional  $TE_i^j$ . Even though medium-sized firms could use a lower technology level in production than small and micro firms, their more abundant experience makes them produce more efficiently relative to regional technology. As a result, medium sized manufacturing firms are more technically efficient relative to the metafrontier (see Table 7.18). The other firm-specific factors are found to have a consistently positive relationship with  $TGR_i^j$  and regional  $TE_i^j$ . Therefore, firms with more operational years, export intensity, credit access and R&D expenditure intensity produce more efficiently relative to the metafrontier of China's private manufacturing SME sector (see Table 7.18).

Finally, private manufacturing SMEs located in more developed regions with a higher GDP per capita level could utilise more advanced technology and thus are more efficient relative to the best technology available in China (metafrontier). This result is consistent

with the findings shown in Table 7.18, where the metafrontier technical efficiency scores of eastern SMEs are significantly higher than those located in the less developed non-eastern regions of China.

According to the empirical results obtained for the metafrontier technical efficiency scores and determinants, 12 null hypotheses proposed in Chapter 4, including hypotheses 1-4, 6, 9-15, are supported, while hypotheses 5, 7 and 8 are not supported for the private manufacturing SMEs in China as summarised in Table 7.19.

The results found in this research have provided empirical evidence on the efficiency performance of entrepreneurial SMEs in different regions of China. Entrepreneurial SMEs in the manufacturing sector are still producing inefficiently, especially in non-eastern regions of China, and policies need to be implemented with the objective of promoting a better entrepreneurial performance. The channels for this promotion have been shown by the relationships of entrepreneurial and firm-specific factors with technical efficiency and the technology level in this research. Key policy recommendations based on the empirical results presented in this chapter are proposed in the next chapter.

## **Chapter 8 Policy recommendations**

### **8.1 Introduction**

As introduced in Chapter 3, the ‘Mass Entrepreneurship and Innovation’ program was proposed officially in 2015 to promote entrepreneurial activities in China, but it only provides a very general framework (State Council, 2015e). In the subsequent years the government has been attempting to compile specific policies to implement this program in practice (State Council, 2015e). The current main policy focus is to promote the quantity of entrepreneurs in China. The empirical results presented in Chapter 7 suggest, however, that private manufacturing SMEs are still not producing efficiently. Also, entrepreneurs with different characteristics, such as start-up motivation, age, gender, education level, experiences and networks, can have different firm efficiency and technology performances. Therefore, future policies should target improving the quality of entrepreneurial activities, instead of merely focusing upon the quantity of entrepreneurial activities. Moreover, there are significant differences in the efficiency and technology performance of private manufacturing SMEs and the determinants of their performances between eastern and non-eastern regions of China, indicating that policies should have more of a regional flavour. To address the market failures and provide a better business environment for private manufacturing SMEs in China, detailed policy recommendations based on the empirical results of this research are discussed in this chapter. These policies can help China promote more quality entrepreneurial activities, especially in non-eastern regions of China.

This chapter is structured as follows. Section 8.2 discusses the current policies implemented in the ‘Mass Entrepreneurship and Innovation’ program to support entrepreneurial activities and SMEs in China. Section 8.3 links these current policies to the empirical results found in this research in order to identify the issues that need to be further addressed in supporting more quality entrepreneurial activities. Section 8.4 discusses the role of government in promoting entrepreneurship, regional support for private SMEs development and the detailed policy recommendations to address the issues identified in Section 8.3. Section 8.5 summarises the key points from this chapter.



## 8.2 Current policies supporting entrepreneurial activities in China

The ‘Mass Entrepreneurship and Innovation’ program implemented in 2015 aims to increase entrepreneurial activities and popularise entrepreneurship among the general public, so as to stimulate the creativity of the whole Chinese society (State Council, 2016a; Liu *et al.*, 2017). The policies in this program involve various dimensions:

- (1) Improving the doing business environment by relaxing industry restrictions for the private sector, simplifying the market entry process and removing administrative burdens for enterprises.
- (2) Promoting and establishing more start-up clusters, entrepreneurial and innovation zones in all regions of China.
- (3) Improving entrepreneurial awareness and skills by enhancing entrepreneurship education and establishing innovation zones in universities and providing free entrepreneurship training–‘Start Your Business (SYB)’–to potential entrepreneurs. SYB programs are funded by local governments and conducted by local bureaus of social security, business associations and universities.
- (4) Providing assistance to special groups including the young, females, enrolled/graduate students, overseas returnees and researchers to encourage them to become involved in entrepreneurial activities.
- (5) Improving access to finance for private SMEs by encouraging banks to lend more to small firms through tax incentives, facilitating them to address the collateral issue, providing credit guarantee services and improving information and transparency to private SMEs. Promoting equity capital via government funds, private funds and the stock market to provide more finance for the development of start-ups and SMEs.
- (6) Using direct government intervention policies (e.g. tax reduction, surcharge exemption and government procurements) to support the development of start-ups and SMEs.
- (7) Encouraging enterprises innovation to be encouraged by providing tax incentives for R&D activities and transfer of technology by enterprises and improving the intellectual property rights (IPR) protection environment.

- (8) Providing free export credit insurance for SMEs to particularly encourage exporting activities by SMEs.

These current entrepreneurship and SMEs policies implemented in China to support the ‘Mass Entrepreneurship and Innovation’ program are summarised in the Appendix. As a result of these supporting policies, between 2014 and 2017 there were nearly 12.3 million entirely new private enterprises registered, equivalent to adding 15,600 entirely new private start-ups on a daily basis during this period (He, 2017; Meng, 2017).

### **8.3 Empirical evidence on the impact of current entrepreneurial policies in China**

The empirical results obtained from this thesis (see Chapter 7) provide evidence of the likely effectiveness of many of the current entrepreneurial policies that have been implemented in China and reviewed in the previous section. The relationships between the empirical results and current policies are summarised in Table 8.1.

#### *1. Policy orientation of ‘Mass Entrepreneurship and Innovation’: from quantity to quality (see Section 1 in Table 8.1)*

The main policy orientation of the ‘Mass Entrepreneurship and Innovation’ program is to increase the quantity of entrepreneurial activities and encourage the general public to participate in entrepreneurial activity. But the empirical results from this research do not support such a broad-brush policy orientation. In general, the mean technical efficiency level relative to the national best technology (metafrontier) of private manufacturing SMEs in China was only 0.8272. This indicates that private SMEs in China’s manufacturing sectors are still not efficient and have a substantial potential to improve their output level under current input usage. Also, the estimated relationships of entrepreneurial factors with the metafrontier technical efficiency indicate that not all entrepreneurs can have good post-entry performance. Entrepreneurial motivation, gender, age, education level, previous experiences and networks can have different relationships with the efficiency level of private manufacturing SMEs in China (see Table 7.17). Entrepreneur characteristics are significant in determining the performance of their

entrepreneurial activities. Therefore, the policy orientation of the ‘Mass Entrepreneurship and Innovation’ program should not only focus on increasing the total quantity of entrepreneurial activities. Policies to promote more quality entrepreneurs and improve the performance of entrepreneurial activities should also be considered.

## *2. Regional support (see Section 2 in Table 8.1)*

According to the empirical results shown in Table 7.17, the mean technical efficiency scores relative to the metafrontier of private manufacturing SMEs in eastern and non-eastern regions of China are predicted to be 0.8738 and 0.7362, respectively. The technology gap ratios of private SMEs in these two regions are 0.9556 and 0.9000 respectively. These results indicate that the efficiency and technology performance of private manufacturing SMEs in the more developed eastern regions of China is much better than that in non-eastern regions. The estimation results on the relationships of entrepreneurial and firm-specific factors with the technical efficiency level relative to the regional technology also show big regional differences. These results provide evidence that there is a significant regional disparity in terms of the performance and characteristics of entrepreneurial activities in China. Therefore, a one size fits all approach is not appropriate in promoting entrepreneurial activities. Policies should be implemented at the regional level to better address regional level issues by decentralising more power to local governments with the objective of boosting entrepreneurship and innovation.

### ***Specific regional policies in ‘Mass Entrepreneurship and Innovation’***

## *3. Opportunity or necessity-driven entrepreneurs (see Section 3 in Table 8.1)*

The motivation of an entrepreneur has been found in the empirical analysis to have significant relationships with the metafrontier technical efficiency of private manufacturing SMEs in China. At the aggregate level, opportunity-driven entrepreneurs utilised better technology. At the regional level, although opportunity-driven and necessity-driven entrepreneurs have similar technical efficiency levels under regional technology in eastern regions, opportunity entrepreneurs are found to have a better efficiency performance in non-eastern regions. Due to the different performance of opportunity and necessity-driven entrepreneurs,

- policies targeting opportunity and necessity entrepreneurs are needed and more opportunity entrepreneurs should be promoted.

Also, because necessity entrepreneurs are less efficient under regional technology in non-eastern regions,

- the efficiency of non-eastern necessity entrepreneurs should be improved.

However, in the ‘Mass Entrepreneurship and Innovation’ program no distinction has been made between opportunity and necessity entrepreneurs.

#### *4. Young entrepreneurs (see Section 4 in Table 8.1)*

As reviewed in Section 8.2, the current supporting policies under the ‘Mass Entrepreneurship and Innovation’ program emphasise the development of more young entrepreneurs by providing them with subsidies to reduce the cost (interest) of their loans. However, the empirical results of this study show that younger entrepreneurs are not adopting significantly better technologies, and only produce more efficiently under regional technology in the developed eastern regions after controlling for their access to credit. These results indicate that:

- supporting young entrepreneurs should not only consider their access to finance but also implementing policies targeted at improving their innovation and adoption of advanced technology.

Also,

- the efficiency of non-eastern young entrepreneurs should be improved.

#### *5. Female entrepreneurs (see Section 5 in Table 8.1)*

In China, females account for nearly half of the total labour force (World Bank, 2018c), but they only contribute around a quarter of entrepreneurial activities (China Association of Women Entrepreneurs, 2016). Females have significant potential in terms of entrepreneurial activities and should be further promoted. As for the policy supporting young entrepreneurs, current policy supporting female entrepreneurs focuses upon providing more and cheaper loans by providing subsidies on their interest cost. The empirical results presented in this research indicate, however, that, after controlling for access to credit, female entrepreneurs still produce with a lower technology level,

although they do not underperform in terms of regional technical efficiency in both eastern and non-eastern regions compared with male entrepreneurs. Therefore,

- promoting female entrepreneurs should not only focus on their access to credit but also on improving their technology level.

#### *6. Education (see Section 6 in Table 8.1)*

The importance of a university education for the entrepreneur of a private manufacturing SME and its performance was also found in Chapter 7 (see Table 7.17). According to the results the university education received by Chinese entrepreneurs is significantly important in terms of not only attaining a higher efficiency level but also for the technology level they adopt for both eastern and non-eastern manufacturing SMEs. These results support the view that China's universities have become a key incubator source of high quality young entrepreneurs (Li *et al.*, 2016). Thus,

- the role of universities in promoting entrepreneurial activities should be further promoted in all regions of China.

Policies aimed at improving entrepreneurial education in universities, building entrepreneurship and innovation zones in universities and encouraging enrolled and graduate university students, overseas talents and university researchers to become involved in entrepreneurial activities, as reviewed in the previous section, are strongly supported by the evidence presented in this research and the government should further improve these policies to make them more effective.

#### *7. Entrepreneurial experience and training (see Section 7 in Table 8.1)*

Representing entrepreneurial knowledge, the relationships of an entrepreneur's experiences with their regional efficiency and technology performance was also shown in Table 7.17. The empirical evidence for management, start-up and technical experiences was mixed. An entrepreneur's knowledge of management, starting a business and technology are only significant for the regional technical efficiency of non-eastern regions, where entrepreneurial knowledge remains limited. Such knowledge, however, is not significant in more developed eastern regions where there is a better doing business environment. Moreover, an important result from this study is that only start-up experience is shown to have a significant and positive relationship with the technology

level adopted by SMEs, but entrepreneurs with management and technical experience are found to use a lower-level technology. They tend to adopt the old technology they utilised in the firms for which they used to work and with which they are familiar. Currently, the only training program improving entrepreneurial ‘know-how’ skills is the ‘SYB’ which provides national free training on starting a business. Some improvements to policies promoting entrepreneurial knowledge are required:

- entrepreneur training should focus on non-eastern regions;
- besides the ‘SYB’ program, training programs relating to management and improving productive technology are also needed.

Also,

- policies encouraging entrepreneurs with management and technical staff experience to update their technology are needed.

8. *Political connections, government control and government protection (see Section 8 in Table 8.1)*

The business environment in China is subject to heavy government control of market activities. As reviewed in the previous section, China has gradually relaxed industry restrictions, simplified the market entry process and reduced administrative burdens for private enterprises aimed at reducing government bureaucracy and control. Despite this, the empirical results of this research find that the political connections of entrepreneurs remain a significant factor in the technical efficiency under regional technology of non-eastern SMEs. SMEs still rely heavily on political connections for a better technical efficiency performance in less developed non-eastern regions, where the market is less developed and subject to persistent government interventions. This indicates that:

- government controls over market activities should be further relaxed in non-eastern regions to improve the business environment.

However, in eastern regions, where a more mature market environment reduces the influence of political connections, politically connected entrepreneurs are found to produce less technically efficiently. Also, politically connected entrepreneurs utilised lower-level technology. Therefore,

- the importance of politically connections to enterprises success should be further reduced in China. This will force enterprises to emphasise market competitiveness and efficiency and avoid possible corrupt activity by government officials.

9. *Business connections (business associations) (see Section 9 in Table 8.1)*

To improve networking and collaboration between private enterprises, China has established entrepreneurial and innovative zones in all provinces of China. This research has provided evidence on the important role of business association participation in improving entrepreneurial networks. The empirical results show that entrepreneurs who improve their connections through business associations can enhance the quality of the technology that they utilise. Joining business associations can also improve the regional technical efficiency of private manufacturing SMEs in more developed eastern regions of China. Therefore,

- expanding the development of business associations should be supported in China.

The current ‘Mass Entrepreneurship and Innovation’ program does not contain policies targeting the development of business associations. However, joining a business association has an insignificant relationship with the regional technical efficiency of private manufacturing SMEs in non-eastern regions. This indicates that business associations have not, as yet, played a significant part in promoting entrepreneurial activities in non-eastern regions. This suggests that,

- policies aiming to expand and improve the effectiveness of business associations should be given particular emphasis in non-eastern provinces.

10. *Small and micro enterprises (see Section 10 in Table 8.1)*

Within the cohort of SMEs, small and micro enterprises usually face more obstacles to their development due to their smaller size and lower financial capability compared with medium-sized enterprises (Page, 1984; Diaz & Sanchez, 2008). As stated by the State Council (2015e), supporting small and micro enterprises in China is the most important part of the ‘Mass Entrepreneurship and Innovation’ program. The government provides many preferential fiscal policies for this group, such as tax reductions, surcharge exemptions and special consideration in government procurement (see Section 8.2). They

are also allowed to have more R&D expenditure deductions in their taxable income to support their innovation activity. But the empirical results of this study show that, although small and micro enterprises use better technology, they still produce less efficiently under regional technology than medium-sized enterprises despite these preferential fiscal policies. This finding indicates that supportive fiscal policies alone cannot effectively improve the efficiency performance of small and micro enterprises. Therefore,

- policies supporting the innovation activity of small and micro enterprises should be further implemented, and
- other policies, rather than fiscal subsidies, targeting efficiency improvement for small and micro enterprises are required.

*11-13. Exporting, credit access and R&D activities (see Section 11-13 in Table 8.1)*

As reviewed in Section 8.2, China's government has implemented many predictable and unimaginative policies aimed at facilitating SME access to bank loans by addressing issues relating to loan sources, collateral, guarantee and information transparency. The R&D activities of SMEs are encouraged by tax incentives and improvements relating to intellectual property rights, while SMEs are also encouraged to export by providing them with export credit insurance to minimise their risks in exporting. The empirical results in this research have provided evidence in support of these policies because exports, credit access and R&D activities are found to be related to a higher regional efficiency and technology performance of private manufacturing SMEs in both eastern and non-eastern regions of China. Hence, even more effective policies in these areas should be made to

- further improve the export, R&D activities and finance access of private manufacturing SMEs in all regions of China.

To address the empirical evidence-based issues discussed above which have not been covered by current entrepreneurial policies in China and to further improve the effectiveness of existing policies, further policy recommendations are proposed in the following section.



**Table 8.1 Current entrepreneurial policies in China and empirical results from this research**

<b>Empirical results</b>	<b>Evidence-based policy</b>	<b>Current policy coverage</b>
<b>1. Policy orientation</b>		
Inefficient production of private SMEs Performance related to entrepreneurial characteristics	Improve entrepreneurial quality	× (mainly focus on entrepreneurial quantity and not quality)
<b>2. Regional support</b>		
Non-eastern private SMEs produce less efficiently Efficiency determinants differ across regions	Tailored support required for eastern and non-eastern private SMEs Decentralise power to local governments	× (Nil.)
<b>3. Opportunity entrepreneur</b>		
Technology: use better technology Regional efficiency: east: insignificant difference non-east: more efficient	Promote opportunity entrepreneurs Improve efficiency of non-eastern necessity entrepreneurs	× (Nil.)
<b>4. Young entrepreneurs (after controlling for finance access)</b>		
Technology: insignificant difference Regional efficiency: east: more efficient non-east: insignificant difference	Improve their technology level Improve efficiency in non-eastern regions	× (finance access)
<b>5. Female entrepreneurs (after controlling for finance access)</b>		
Technology: use less advanced technology Regional efficiency: east: insignificant difference non-east: insignificant difference	Promote more female entrepreneurs Improve their technology level	× (finance access)
<b>6. University education</b>		
Technology: positive relationship Regional efficiency: east: positive relationship non-east: positive relationship	Improve the role of universities in promoting entrepreneurial activities	√ (entrepreneurship education and innovation zones in universities, encourage domestic and overseas university students & researchers to be entrepreneurs)
<b>7. Entrepreneurship skills (management, start-up and technical experiences)</b>		
Technology: start-up experience has a positive relationship management and technical experience has a negative relationship Regional efficiency: east: insignificant relationships non-east: positive relationships	Improve the technology for those with management and technical experiences Provide training in management, starting a business and access to technology, mainly in non-eastern regions	Partly (National 'SYB' training program on starting a business)

<b>8. Politically connected entrepreneurs</b>		
Technology: use less advanced technology	Remove government protection of them	Partly
Regional efficiency: east: less efficient Non-east: more efficient	Continue relaxing government control in non-eastern markets	(Improve Business environment in China)
<b>9. Business connected entrepreneurs (by business association)</b>		
Technology: use better technology	Promote business association development	×
Regional efficiency: east: more efficient non-east: insignificant difference	Improve the effectiveness of the business associations in non-eastern regions	(Nil.)
<b>10. Small and micro enterprises</b>		
Technology: use better technology	Promote their innovation activities	Partly
Regional efficiency: east: less efficient non-east: less efficient	Other policies besides fiscal support should be made to improve their efficiency	(promote their R&D activities)
<b>11. Exports</b>		
Technology: positive relationship	Promote exporting activities of SMEs	√
Regional efficiency: east: positive relationship non-east: positive relationship		(Provide export credit insurance)
<b>12. Credit access</b>		
Technology: positive relationship	Facilitate SME access to finance	√
Regional efficiency: east: positive relationship non-east: positive relationship		(Address the key problem sources, collateral, guarantee and information transparency problems)
<b>13. R&amp;D activities</b>		
Technology: positive relationship	Promote R&D activities of SMEs	√
Regional efficiency: east: positive relationship Non-east: positive relationship		(Provide tax incentives and improve IPR protection)

Source: Author's summary.

Note: ×, √ and partly denote whether the current entrepreneurial policies have, have not or only partly addressed these issues, respectively; the current policies relating to these issues are shown in parentheses.

## 8.4 The role of government and policy recommendations

### 8.4.1 The role of government in promoting quality entrepreneurial activities

The significance of entrepreneurial activities to an economy's development has been well identified both theoretically and empirically (see details in Chapter 4). They can help improve market competitiveness and regional comparative advantage and thus benefit broad-based and sustainable economic growth (Audretsch & Beckmann, 2007; Arshed *et al.*, 2014). In a market economy, government policies aimed at promoting entrepreneurial activities need to play a crucial facilitatory role in establishing the foundations and institutions for a conducive business environment in which entrepreneurial actions and decisions can take place (Minniti, 2008). Providing a more appropriate institutional and market environment can ensure that entrepreneurial resources and efforts are better allocated (Bowen & De Clercq, 2008; Boettke & Coyne, 2009). Entrepreneurial policies focusing on new ventures, together with SME policies supporting existing small businesses,<sup>28</sup> have been at the centre of China's transition to an innovation-driven market economy.

However, the significant contribution of entrepreneurial activities and the disadvantages faced by specific entrepreneur groups and SMEs do not necessarily justify public policy interventions (Audretsch, 2004). Some protectionist and interventionist policies without a sound economic rationale can also lead to market distortions (Harvie & Lee, 2005; Minniti, 2008). For example, direct and poorly targeted preferential policies related to small businesses can provide protection from failure for inefficient firms, which reduces overall market efficiency. These policies may in turn reduce the incentive for small businesses to perform more efficiently in order to survive. Also, the optimal firm size can be distorted by these policies because small businesses may be less motivated to grow to be large businesses as they would then not qualify for access to these preferential policies (Revesz & Lattimore, 1997; Harvie & Lee, 2005).

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<sup>28</sup> The differences between entrepreneurship and SME policies are emphasised by Audretsch (2004). Entrepreneurship policy focuses on new ventures and has multiple dimensions, from the individual to the enterprise, from clusters, to industry or the region. SME policy focuses on improving the performance of existing enterprises, and is only focused on the organisational level. But SME policy remains a core part of entrepreneurship policy because the SME is the most significant form for start-ups.

Government interventions should be mainly premised on the basis of fundamental market failures, which represents a situation where the market fails to achieve optimal social outcomes and an efficient allocation of scarce resources (Audretsch, 2004; Harvie & Lee, 2005; Audretsch *et al.*, 2007). For entrepreneurial activities, market failures are usually caused by market imperfections (e.g. information and capital market imperfections) relating to the private SME sector and externalities (e.g. networks and knowledge externalities). But even though such market failure exists, government direct interventions by means of tax and subsidy policies relating to private SMEs may not be necessary (Harvie & Lee, 2005). Some market-oriented policies that aim to build a conducive business environment that benefits all sectors and firms may be more productive. With these policies the role of government is to act as a facilitator of market-driven activities instead of intervening in and directing such activities. An approximate policy promoting entrepreneurship and SMEs in the context of an emerging market economy such as China's is likely to involve a judicious mix of market-oriented policies (facilitation of markets through establishing an appropriate institutional and legal framework) and government interventions (addressing market failures), as stated by Harvie and Lee (2005).

In order to address the issues relating to current entrepreneurship and SME policies demonstrated by the empirical results of this study, policy recommendations to improve the business environment and address market failures are now proposed with the aim of promoting more quality entrepreneurial activities.

#### **8.4.2 Policy recommendations**

In the context of deriving and implementing entrepreneurship policy, Audretsch (2004) argued that a fundamental problem relates to the lack of a ministry or agency mandated with the responsibility of promoting entrepreneurship in most countries. This is also the case in China. While the Department of SMEs in the Ministry of Industry and Information Technology (MIIT) is responsible for SME development, the promotion of entrepreneurial activities is a joint concern of, for example, the Ministry of Education (MOE), the Ministry of Technology (MOT), the State Administration of Industry and Commerce (SAIC), the State Administration of Tax (SAT) and the State Intellectual Property Office (SIPO). The actions of these agencies need to be organised and

coordinated to improve the effectiveness of entrepreneurship policies. Therefore, a specific agency for promoting entrepreneurship, similar to the Department of SMEs (MIIT) in promoting SMEs, should be established in China. The detailed policy recommendations to address the issues identified in Section 8.3 based on results of this study are detailed as follows.

#### 8.4.2.1 Regional support for entrepreneurial activities and SMEs

The empirical results show a regional disparity in the technical efficiency and technology performances of private manufacturing SMEs, and that there are different determinants of these performances between eastern and non-eastern regions in China. This requires regional level support of entrepreneurial activities and SMEs tailored to meet the different needs of different regions. In using government funds, such as the *SME Development Funds* and *National Emerging Industry Venture Capital Matching Fund*, the decision-making power of central government should be decentralised to local government rather than central government allocating these funds directly to start-ups and SMEs across China. This requires China's government to develop a fair environment and address the corruption problem to make sure funds are not misallocated. Local governments have more knowledge of start-ups, SMEs and the business environments in their own regions (State Council, 2015b), and thus can be more efficient in allocating these funds to promote more quality entrepreneurial activities. The transparency, efficiency and effectiveness of local governments in using these funds must be monitored by the National Development and Reform Commission (NDRC).

In the regional support of entrepreneurial activities and SMEs, the structure of the manufacturing sector must be considered. While eastern private SMEs are focused on labour-intensive and technology-intensive industries, most private SMEs in the less developed non-eastern regions are involved in resource-intensive manufacturing (Yan, 2017). In order to achieve balanced regional development, local governments in non-eastern regions should use the funds they obtain to build regional clusters of start-ups and SMEs based on their own regional comparative advantages. For example, regions with advantages in agricultural and pastoral resources (e.g. Xinjiang, Heilongjiang provinces) can build regional start-ups and SME clusters in innovative agricultural chemicals and agricultural products and process manufacturing. Regions with a traditional advantage in

the iron industry (e.g. Hebei, Shanxi, Sichuan) can build clusters in aerospace and high-end equipment manufacturing. Since enterprise clusters can generate network externalities and a better environment for (tacit) knowledge spillover, they have the potential to benefit the whole regional economy. In order to build these regional clusters successfully, local governments can use funds to develop talent (skilled labour) in local area or attract talent from developed regions, help local SMEs adopt advanced technology and build a better doing business environment by improving their infrastructure and logistics. This can be more effective in promoting quality entrepreneurial activities with better technology than directly providing subsidies to start-ups and SMEs. After building a better doing business environment, investment from eastern regions in target industries should be encouraged due to the lower labour and land cost in non-eastern regions (State Council, 2010). Eastern enterprises can be encouraged to build factories in non-eastern clusters; thus, they can spill over their knowledge of efficient production and advanced technology to non-eastern regions. These policies can facilitate non-eastern private SMEs to speed up their development convergence with those in developed eastern regions.

#### 8.4.2.2 Promote more opportunity entrepreneurs

The empirical evidence presented in this research supports the idea that opportunity entrepreneurs are the key drivers for improving the technology level of entrepreneurial activities in China. They can contribute to the technological progress that can benefit all sectors in China's economy (Verheul *et al.*, 2010). Therefore, China's government should create a better environment to encourage more opportunity entrepreneurs to start businesses. In supporting opportunity entrepreneurs, the criteria for distinguishing between opportunity and necessity entrepreneurs need to be identified. This is important in enabling the government to have a better understanding of those to whom they should provide support. As shown in Chapter 4, the Global Entrepreneurship Monitor (GEM) classified entrepreneurs into opportunity-driven and necessity-driven based on whether they were involved in entrepreneurial activities due to unemployment. But Shane (2009) pointed out that not all jobless individuals involved in entrepreneurial activities are necessity entrepreneurs and not all individuals who quit their jobs to be entrepreneurs are opportunity ones. Instead of looking only at their situation in the labour market before starting a business, some other factors need to be considered, such as their capability and business plans (Shane, 2009). Therefore, SAIC can put forward criteria based on, for

example, (1) their previous job and entrepreneurial experiences, (2) education level and knowledge of the sector they are involved in, (3) initial capital and finance resources, (4) the technology level of the main products or services, and, mostly importantly, (5) the maturity level of the business plan and potential contribution to China's economy. The start-up motivation of the entrepreneur should be identified and recorded during the registration of a new private enterprise in local Administration of Industry and Commerce (AIC). Then resources promoting innovation from entrepreneurial activities, such as venture capital and innovation zones, should be allocated mainly to them. Opportunity entrepreneurs can also be encouraged by improving opportunity recognition and exploitation via better entrepreneurial education, training and networks and an improved doing business environment, which are discussed in detail in the following section.

#### 8.4.2.3 Improve the doing business environment

According to the empirical results of this research, China's government should promote more opportunity-driven, young, highly-educated and female entrepreneurs, improve the efficiency of young and necessity-driven entrepreneurs in non-eastern regions, continue to relax government controls in non-eastern regions, remove protection of politically connected enterprises and improve the credit access and export activities of private SMEs in China (see Section 8.3). Addressing these issues relates to building a good doing business environment, which is an important responsibility of government in a market-oriented economy. China has made considerable efforts in relaxing industry access restrictions, simplifying the market entry process and cancelling many administrative approval requirements. However, China still ranked only 78<sup>th</sup> out of 190 countries in terms of ease of doing business in 2018 (World Bank, 2018a). Considerable improvements are still required.

First, the market entry process needs to be further simplified. In terms of business start-up, China still has a complex procedure. For example, starting a limited liability company in Shanghai needs 22 days to complete, which is much longer compared than the nine days on average in OECD high income countries (World Bank, 2018a). The current 'Five Licences into one Business Licence Certificate' reform makes starting up a business in China much easier than before, but entrepreneurs still need to (1) obtain pre-approval of the company name, (2) get approval for and (3) make company seals, (4) apply for an

authorisation to print or purchase financial invoices, (5) register for recruitment, and (6) register the company's employees for social welfare insurance. These applications involve several agencies and numerous required materials, which can deter inexperienced entrepreneurs. This problem can be solved by further simplifying the registration process for new businesses. For example, the registration for recruitment can be included in the Business Licence Certificate. The establishment of a one-stop shop for business registration should be considered, where all of the procedures for registration can be completed under one roof. Also, an online business registration system can also be established. A good example is the online business registration in New Zealand, which takes only half a day to complete. This will require further development of China's internet infrastructure and a better combined internet with government functions.

Second, the market exit process should also be improved by means of a better bankruptcy law. An entrepreneur-friendly bankruptcy law is strongly related to the development of entrepreneurship (Peng *et al.*, 2010; Lee *et al.*, 2011). If the results of business failure are very severe and cannot be well-resolved, many risk-averse and less financially capable individuals, such as females and youth, may give up their entrepreneurial intentions. However, the *Enterprise Bankruptcy Law* in China is only applicable to corporations. Sole proprietorship enterprises and partnership enterprises, which most entrepreneurial small businesses are registered as, are not protected by it. If they fail, their entrepreneurs must repay all debts, even by means of selling their entire family properties. Without a formal bankruptcy system for these enterprises, banks and venture capitalists will also be less likely to finance them (Berger & Udell, 2006). To address this problem a personal bankruptcy law should be established to protect unincorporated enterprises in China, covering sole proprietorship and partnership enterprises.

Moreover, a good doing business environment must establish a level playing field to attract more entrepreneurial activities. In order to achieve this, China has enacted the *Anti-monopoly Law*, *Anti-unfair Competition Law* and *Law on the Promotion of Small and Medium-Sized Enterprises*. But the current *Anti-monopoly Law* and *Anti-unfair Competition Law* have a significant weakness due to their industry restrictions. They are not applied in some strategic sectors such as the petroleum and telecom industries. These sectors are still fully controlled by state-owned large enterprises and private businesses



are forbidden to enter. Also, heavy government control over key resources and market activities in China, especially in less developed regions, provides space for unfair competition in which state-owned, large and politically connected enterprises win out. These result in significant market failure and reduce market efficiency. To address these problems, the industry restriction should be further relaxed, not only by allowing the private sector to invest in state projects in these sectors, but by fully opening these sectors to private enterprises. Government control of key resources such as for finance, land, water, power, minerals and telecommunications, must be further relaxed, especially in non-eastern regions. The *Anti-monopoly Law* and *Anti-unfair Competition Law* should be improved to better protect private enterprises, SMEs and those without political connections by punishing corruption and reducing administrative power misuse.

This research also supports the suggestion that exporting activities by SMEs should be further encouraged because this can improve their efficiency and technology level. To encourage enterprises to export, the export process in China can be further simplified. The documents needed for exporting by enterprises are still complex, prohibitively expensive and time consuming for SMEs (see discussion in Chapter 3). This can lead to a significant non-tariff barrier to export activity by these enterprises. The Customs and Entry-Exit Inspection Bureau need to incorporate an internet export system via e-Government, which will allow enterprises to apply for approval, inspections and declarations over the internet. This can benefit all enterprises, especially less financially capable private SMEs, and thus encourage them to undertake more exporting activities.

#### 8.4.2.4 Promote highly-educated entrepreneurs and university-industry linkages

Improved entrepreneurial awareness by highly-educated individuals can help a country develop a quality knowledge-based economy. As supported by empirical results from this research, entrepreneurs with a university education can perform with better technology and efficiency levels. Therefore, an important part of the ‘Mass Entrepreneurship and Innovation’ program is to improve entrepreneurship education in universities and encourage domestic and foreign university students and researchers to start domestic businesses in order to generate more highly-educated, opportunity-driven, young and female entrepreneurs (see Section 8.3).

China started reform in its universities by making entrepreneurship education compulsory in the curriculum for students in all majors from 2016. But China's entrepreneurship education is in the early stage of development and needs much more improvement. The design of entrepreneurship education must relate to practice, instead of merely teaching the theory as in current entrepreneurship courses. A good example of helping university students understand what entrepreneurship is about by putting theory into practice is the student mini-company (SMC) program in the US and Europe. In the SMC program students take responsibility as a group for a short-term small business from setting it up to its liquidation. They undertake activities in the real business world such as marketing products, selling stock and electing officers. Each group is managed by business lecturers in universities and coached by voluntary businessmen. China can learn from this kind of program and help university students to improve their understanding of the business world, their problem-solving abilities and their opportunity recognition and exploration abilities. Such programs can improve the awareness and performance of young graduate entrepreneurs and benefit students who choose to work in the incumbent enterprises, thus benefitting all students.

Since 2016, China has also legally allowed university researchers, staff and postgraduate students to start businesses to encourage the commercialisation of their research outcomes (university spinoffs). A university spinoff is a significant way for knowledge spillovers to take place and thus can benefit the economy as a whole and is worthy of policy support (Link & Scott, 2005; Lockett *et al.*, 2005; Wennberg *et al.*, 2011). But the current motivation for researchers to establish private enterprises is still at a low level in China. As shown in the National Academy of Innovation Strategy (2017) survey, more than 60 per cent of academics in higher education institutions have entrepreneurship intentions, but only 2.5 per cent of them would engage in such activities. The biggest issue is in obtaining a license based on intellectual property (IP) rights they created in the university. There are still many universities that do not have specialised departments for managing their IP, making their commercialisation of research outcomes inefficient. Therefore, the technology transfer system from the university sector should be improved. Specific departments within universities should be developed to manage and license their patents to these spinoff companies and other enterprises directly or through IPR service agencies.

In addition to encouraging domestic talents, China has also encouraged talented individuals of Chinese descent living in foreign countries to come back and contribute to entrepreneurial activities, such as by the ‘*Thousands Talent Plan*’ program. Although returnee entrepreneurs have dramatically increased since the implementation of these programs, many obstacles to their return still exist (Ministry of Education, 2017). China has gradually addressed inconvenience in working and living in China for those without Chinese citizenship in developed cities. These policies should be further implemented, especially in non-eastern regions. Moreover, returnee entrepreneurs with a foreign nationality have major difficulties in accessing finance. Although many local governments provide them with a certain amount of incentive capital, this amount is usually insufficient. Financial markets in China are not sufficiently open. Bank loans available to foreigners are extremely limited and most foreigners are forbidden to access finance from the stock market, which limits their financial capability to begin or improve entrepreneurial activities. Therefore, China should encourage banks to establish special loan streams for returnee entrepreneurs and further open the stock market to returnees with a foreign nationality. These policies can help motivate more returnee entrepreneurs to contribute to the economic transition in China.

As shown by the empirical results of this study, the efficiency levels of young entrepreneurs and small and micro enterprises need to be improved, especially in non-eastern regions (see Section 8.3). A significant way to improve the role of universities in promoting more quality entrepreneurial activities is to establish business incubators in or beside the universities, which have network externalities and knowledge externalities, and thus need targeted policy support. Small new start-ups by young entrepreneurs who lack knowledge and financial capital for running a business and managing a firm, can be supported by these business incubators. They can provide cheap accommodation by the university, mentoring by university academics in management, access to technology, access to venture capital and business angels (Aernoudt, 2004). With such supports, more university students and researchers can be encouraged to start small new businesses with better technology and more efficient performance. China has begun to realise the importance of university business incubators, but the current 30 university *Entrepreneurship and Innovation zones* are based in only elite universities and are mainly

in developed eastern regions. China needs to further expand the coverage of university business incubators, especially in the less developed non-eastern regions.

Moreover, besides supporting start-ups, university-industry (U-I) collaboration should be encouraged in order to improve entrepreneurial networks and knowledge spillovers (Ponds *et al.*, 2009). Since the establishment of the *Program for Medium- and Long-Term Scientific and Technological Development 2006–2020* in 2005, many universities have established U-I departments or science parks to collaborate with enterprises and as a consequence the number of co-patents increased sharply (Fiaz, 2013). This U-I collaboration system can be further improved. First, most collaborations are with large state-owned or foreign-owned enterprises. Private small businesses are usually excluded due to their lower capability to invest in these collaborations. However, they are the group in greatest need of collaboration with universities for access to talent, information, advice, technology and skilled graduates. To address this problem, China's government needs to support collaborations between universities and small businesses. Subsidies can be provided to universities that collaborate with small businesses. The second issue is that most of the collaboration is on research partnership: collaborative R&D on joint projects. There are many more types of U-I collaborations that can be encouraged, such as research services (e.g. contract research, consulting, quality control, testing), shared research infrastructure (e.g. laboratories, equipment, technology parks), human resource training and transfer (e.g. employee training, internship programs, specialised talent development) and information transfer and social capital formation (e.g. conferences and meetings) (Perkmann & Walsh, 2007). These collaborations can help enterprises conduct R&D activities, utilise better technology and perform more efficiently with a higher level of human capital. This is especially important for small and micro enterprises, female and young entrepreneurs who have fewer networks and less finance to obtain advanced technology and better human capital in innovation and efficient production. This can also help entrepreneurs working as managers and technical staff to break their technology lock in, and thus utilise better technology. Thus, many issues identified in Section 8.3 based on the empirical results of this study can be addressed. In future development, China should support more universities to build comprehensive U-I collaboration systems.

#### 8.4.2.5 Entrepreneurial training: in non-eastern regions and for special groups

Besides education and mentoring services, another important way to improve the knowledge and skills of entrepreneurs is by means of entrepreneurial training. The empirical results reported in this research support the position that entrepreneurial training on starting a business, management and technology are significant for efficient SME production in non-eastern regions, especially for necessity-driven and young entrepreneurs. Also, necessity-driven, young and female entrepreneurs need training to better utilise of technology in their production. The current entrepreneurial training subsidised by government and organised by the Ministry of Human Resource and Social Security (MHRSS) is the SYB program for starting a business. The SYB program for youth (students), women and unemployed people is implemented by universities, women's associations and labour bureaus, respectively. This program is aimed at encouraging more young and female entrepreneurs and helping unemployed people become self-employed. The 'SYB' program, however, only provides training on starting a business. This is only one component in the entrepreneurial training package 'Start and Improve Your Business' (SIYB) proposed by the ILO. The other three training programs are 'Generate Your Business Idea' (GYB), 'Improve Your Business' (IYB) and 'Expand Your Business' (EYB). While GYB is important in recognising better opportunities and preparing better business plan for potential entrepreneurs, IYB and EYB focused more on management, technology and growth strategy (e.g. innovation and exporting) to help existing entrepreneurs perform better. Currently, however, the GYB, IYB and EYB programs have not been adopted in China.

In this context it is recommended that, first, the MHRSS should work together with the ILO to develop a more comprehensive entrepreneurial training system in China that includes all four step-by-step programs. With better business plans, capabilities and growth-oriented strategic thinking, entrepreneurs can perform more efficiently, use better technology, have more credit access and be better engaged in innovation and exporting activities. Thus, the related issues identified by the empirical results of this study can be addressed (see Section 8.3). Second, most of the entrepreneurial training programs are conducted in the developed eastern regions. However, the results of this research have found that non-eastern regions are in greater need of training in entrepreneurial knowledge. The government should provide subsidies to provide training programs in

non-eastern regions. Third, the design of these training programs needs to be more practical and related to the real business world. Surveys of entrepreneurs, especially female, young and necessity entrepreneurs, should be conducted periodically to identify the major obstacles they face in running their businesses and the knowledge that they wish to acquire. These should be incorporated in the training course design. Fourth, training program providers should collaborate with business incubators and innovation zones. Visiting tours to and communication activities with these incubators and zones can be organised to help aspiring entrepreneurs better understand how to start and operate a successful business. It can also help them build networks to obtain technology, advice and information, and find potential customers and suppliers. This is especially important for female, young and necessity entrepreneurs who are characterised by a lack of networks.

#### 8.4.2.6 Improve information and services for SMEs

Another way to improve the technology and efficiency level of SMEs is to provide them with quality information and professional services to avoid their information imperfection and address their lack of specialised expertise. In supporting services for SMEs, China began to establish 'one-stop shop' service online platforms, which are built, subsidised and managed by local governments. Since 2011 China has established 511 SME service platforms, covering all 34 provinces and municipalities. They target all SMEs in the market, provide them with policy information and direct them to services on (1) starting a business (e.g. business planning, coaching, training, office space, business registration and book keeping services), (2) technological innovation (e.g. U-I collaboration programs and technology consulting and transfer services), (3) intellectual property related issues (e.g. trademark registration, patent application, IP identification and transaction services), (4) market development (e.g. marketing, product inspection, customs declaration and export tax rebate services and information on government procurement, exhibitions and trade fairs), (5) human capital (e.g. talent information, recruitment consulting and employee training services), (6) finance (e.g. bank loans, equity financing, bill financing, financial leasing, insurance, credit evaluation and guarantee services), (7) management consulting, (8) financial audit and taxation, and (9) legal services. However, government ownership and management of this platform service has resulted in problems with low efficiency and market-orientation (Storey, 2003). The private sector should be allowed

and encouraged to be involved in SME service platform development, which can provide SMEs with more professional and efficient services. The development of private ‘one-stop shops’ can significantly benefit start-ups and SMEs, especially those in non-eastern regions, female, young and necessity-driven entrepreneurs that have a lack of finance, networks, information and talents. It can also benefit the development of the service industry in China and contribute to the economy as a whole.

Building more private ‘one-stop shop’ business service platforms can address most of the issues identified in Section 8.3 based on the empirical results of this study, including: (1) encouraging more opportunity-driven, young, female and highly-educated entrepreneurs, (2) improving the technology level of young, female and necessity-driven entrepreneurs, (3) helping entrepreneurs with management and technical staff experience break technology ‘lock in’, (4) improving the efficiency level of small and micro enterprises and non-eastern young and necessity-driven entrepreneurs, (5) improving the entrepreneurial knowledge level in non-eastern regions, and (6) helping private manufacturing SMEs gain access to finance and engage in exporting and R&D activities.

#### 8.4.2.7 Improve the development and effectiveness of business associations

Business associations can play a significant role in organising private entrepreneurs, promoting networks, facilitating communication between private firms and governments and lobbying governments in the interest of private firms to influence policies and resource allocations (Ma *et al.*, 2015). However, the empirical results in this study show that only business associations in eastern regions have effectively improved the efficiency level of private manufacturing SMEs. Indeed, most of the western style autonomous business associations, which can act on behalf of private entrepreneurs, are in the eastern regions, such as Zhejiang and Guangdong provinces. But in non-eastern regions most of the business associations are under the control of central and local governments and serve as the ‘aide of the Party and government’ in implementing economic policies (Pearson, 1994), like the *All-China Federation of Industry and Commerce* (ACFIC). These business associations are thus regarded as quasi-government organisations (Ma *et al.*, 2015). Some business associations, such as the *Individual and Private Enterprise Association*, are even directly under government authority such that they are actually government organisations. Under this circumstance, many business associations in non-eastern regions are involved

in political affairs and their activities are strictly controlled by the government, which make them unable to effectively service the interests of the entrepreneurs' group that they aim to serve (Jing & Li, 2014).

To address this problem, these business associations should be reformed in order to make them independent from government and give them full autonomy (General Office of the CPC Central Committee & State Council, 2015). The role of government should be changed from controller to facilitator and supervisor. At the same time, more business associations established by entrepreneur groups should be encouraged. Legislation on private business associations should be implemented, enabling them to register as formal organisations and allowing them to enter and exit the market freely. By removing the protection of government and encouraging more private business associations, competition can be improved and those with low effectiveness and efficiency can be eliminated from the market. Also, the service function of business associations should be emphasised. They need to be encouraged to organise more valuable activities for their entrepreneur members, such as learning about current policies and future policy trends, training for management skills and advanced technology, communication activities between entrepreneurs, product exhibitions and trade fairs. Government should also provide fewer subsidies to them and encourage them to take responsibility for their own profits and losses. This can in turn motivate them to provide more services to meet the growing needs of their members and to earn more profit. Moreover, the role of business associations in making policies needs to be improved. They should be given more power to lobby the government. Government can also entrust them to conduct periodical surveys to show the obstacles and demands of entrepreneurs in order to make more effective policies. In these ways the development of business associations can be promoted and the effectiveness of business associations in non-eastern regions can be improved, as highlighted in Section 8.3.

#### 8.4.2.8 Improving credit access by private SMEs

This research found that credit access is important for improving the efficiency and technology performance of SMEs. But SMEs usually have difficulties in getting bank loans. Information asymmetry between banks and private SMEs means that banks usually lack accurate information on the financial condition and performance of private SMEs



(Harvie & Lee, 2005). Also, the monopoly of state-owned large banks in the banking industry leads to limited resources and lower efficiency and expertise in providing private SME loans (Garnaut *et al.*, 2012; All-China Federation of Industry and Commerce, 2017).

To address these market failures, first, China's government should remove the state ownership monopoly in the banking industry with modification of the *Anti-Monopoly Law* as discussed in the previous section. More private and small financial institutions need to be allowed to be established and grow. They can provide a wider range of loan sources targeted to meet the needs of private SMEs. They also have more flexibility and expertise in lending to small businesses, which large banks usually lack, and can thus provide SMEs with loan services tailored to meet their individual needs more efficiently. To make sure SMEs use the funds they obtain efficiently, banks should be required to monitor their usage and prepare periodical reports. Also, the persistent discrimination against the private sector in obtaining bank loans needs to be further addressed. Banks should be supervised by the China Bank Regulatory Commission (CBRC) to treat state and private enterprises more equally. Bank loans should be evaluated based on their performance, financial conditions and risks based on a sound credit rating system, regardless of whether the firm is a private or a state-owned enterprise.

Second, to address the information asymmetry problem, a credit rating system should be further developed in China. Private enterprises that are rated by independent credit rating agencies can have a higher possibility of obtaining bank loans (Bai *et al.*, 2006). Currently, China's credit rating system is still in the early stages of development. The credit rating agencies are inadequate in the market and the cost of their services is high, which reduces the incentive for SMEs to have their creditworthiness officially rated. Therefore, more credit rating agencies should be encouraged to develop in the market, in order to increase the sources and lower the cost of credit rating services. Another issue associated with the credit rating system in China is the lack of a standard evaluating methodology across the country. Different agencies may use different methodologies for evaluating credit scores. It is difficult for banks to identify which methodology is more reliable and to compare the creditworthiness between firms. In later development, a national credit rating methodology and criteria should be developed by the People's Bank of China (PBC) and followed by all agencies. Moreover, there has been no specific regulator for credit rating

agencies in China. Without supervision, they usually have incentive to assign inflated ratings to attract more customers (Stolper, 2009). Therefore, a regulation organisation for credit rating agencies should be established, similar to the China Bank Regulatory Commission (CBRC) for regulating banks and the China Insurance Regulatory Commission (CIRC) for regulating insurance companies.

With less reliable information and higher risk, most private SMEs are required to provide additional collateral or guarantees for their loans. Due to a lack of physical assets, however, private SMEs usually cannot provide adequate collateral required by a bank. China has allowed enterprises to use intangible assets as collateral and encouraged insurance companies to act as guarantors for private SMEs' loans. In addition to this, more private guarantee service agencies should be promoted, backed by private capital under the supervision and regulation of the CBRC and CIRC. Also, enterprises should be allowed to use accounts receivable from core leading enterprises in the industry chain as pledges for bank loans. This can both increase the credit access of private SMEs and improve collaboration between SMEs and large enterprises.

#### 8.4.2.9 Improve the protection and commercialisation of intellectual property rights

To encourage more R&D activities by enterprises in China, the protection of intellectual property rights (IPR) needs to be further improved, besides direct government intervention through tax incentives. As a public good, knowledge is characterised by non-excludability, and thus knowledge created can be utilised and benefit others. This can reduce profitability from R&D outcomes. Private provision will create sub-optimal new knowledge, which needs to be addressed by protecting intellectual property rights to remove this non-excludability (Acs *et al.*, 2016). However, the awareness of IPR protection is still weak in China, especially among private SMEs. In order to assist private SMEs to gain more knowledge regarding IPR, the *SMEs Intellectual Property Training Base*, which is now located in the eastern Guangdong, Jiangsu and Zhejiang provinces, can be further developed to cover more regions and especially non-eastern regions. Also, private SMEs usually lack finance and talent to build specific IP departments to manage the protection and commercialisation of their IPR. Instead, they usually need to find intellectual property agencies for these activities. Therefore, the development of IP agencies should be further encouraged in all regions of China. In improving the IPR

protection environment, the development of talent and expertise in IPR is significant. This can be conducted via university courses.

These detailed policies can help government address the market failures faced by private SMEs in China and provide a good doing business environment for them. They can thus support quality entrepreneurs and improve the performance of private manufacturing SMEs in both eastern and non-eastern regions. With these targeted and effective policies, China can better achieve its goals as outlined in the ‘Mass Entrepreneurship and Innovation’ program. This can facilitate China improving its entrepreneurship and innovation levels and successfully finishing its transition to an innovation-driven economy, and form a sustainable comparative advantage for the manufacturing sector.

## **8.5 Summary**

This chapter has given detailed policy recommendations for the ‘Mass Entrepreneurship and Innovation’ program to improve quality entrepreneurial activities in China based on the empirical results presented in this study. First, it overviewed the current policies implemented in China aimed at supporting entrepreneurial activities and SMEs. These policies involve many dimensions, including: (1) improving the doing business environment in China, (2) establishing entrepreneurial and innovation zones to generate start-up clusters, (3) enhancing entrepreneurial awareness and skills by providing entrepreneurship education and business incubators in universities and free training (SYB) for potential entrepreneurs, (4) providing financial support to young and female entrepreneurs and encouraging more talents to be entrepreneurs, (5) helping SMEs obtain more bank loans using public funds, (6) providing preferential policies for SMEs in tax and government procurements, (7) improving intellectual property rights protection and providing tax incentives for R&D and technology transfer activities, and (8) providing free export credit insurance to small businesses to encourage their export activities. Arising from these support measures the number of entrepreneurial activities has increased sharply since 2014, with 15,600 private start-ups added daily (Meng, 2017).

Some of these policies have been supported by the empirical evidence presented in this research. However, there are still many improvements that need to be implemented in

order to better achieve the goals outlined in the ‘Mass Entrepreneurship and Innovation’ program. According to the empirical results presented in Chapter 7, private SMEs are still producing inefficiently and entrepreneurs with different characteristics have different efficiency and technology performances. Merely encouraging more entrepreneurs to build private SMEs, regardless of their capabilities and business plans, may not be appropriate in China. The policy orientation needs to be changed from encouraging more general entrepreneurs to more quality entrepreneurs.

Based on the empirical evidence obtained from this study, the issues needed to be addressed in order to achieve a better development of entrepreneurial activities in China are identified as follows. (1) The non-eastern private SMEs are shown to be less efficient and use less advanced technology in their production and have different determinants of their performances. Thus, central government should consider decentralising its power to local governments in supporting entrepreneurial SMEs with the aim of tailoring targeted support to meet the differing needs of different regions. (2) Opportunity entrepreneurs should be promoted because they produce with better technology, and the efficiency of non-eastern necessity-driven entrepreneurs should be improved. (3) In supporting young entrepreneurs, other policies besides financial support should be provided to improve their technology and efficiency levels in non-eastern regions. (4) Similarly, other policies besides financial support should be provided to female entrepreneurs to improve their technology level. (5) More highly-educated entrepreneurs should be promoted because they can achieve a better technology and efficiency performance. (6) Entrepreneurs who have prior experience as managers and technical staff need to be encouraged to adopt more advanced technology. Training in starting a business, management and technology usage is needed in non-eastern regions. (7) The protection of politically connected entrepreneurs needs to be removed in order to make them more motivated to update their technology and produce more efficiently. Government control over market activities should be further relaxed in non-eastern regions to remove entrepreneurs’ reliance on political connections to obtain resources and information. (8) Business associations need to be further developed and their effectiveness in facilitating a better entrepreneurial performance should be given high priority in non-eastern regions. (9) In supporting small and micro enterprises, other policies, besides preferential fiscal support, aiming to improve their efficiency level should be implemented. (10) Access to finance, R&D and

export related activities of private SMEs should be further promoted as they are significantly related to a better technology and efficiency performance.

In order to address these issues, the role of government needs to be emphasised to provide an appropriate institutional, legal and regulatory environment for entrepreneurial activities. Supporting policies should include government interventions that can address market failures and market-oriented policies to improve the business environment for the healthy development of entrepreneurial activities and private SMEs.

More detailed policies include the following: (1) address regional disparity by decentralising the allocation of government funds for promoting entrepreneurship and SMEs to local governments, building more regional SMEs clusters based on their regional comparative advantages and encouraging investment from eastern to non-eastern regions for knowledge spillover; (2) identify opportunity and necessity entrepreneurs based on their experiences, capabilities and business plans and then focus innovation policy on opportunity entrepreneurs; (3) further improve the doing business environment in China by simplifying the business registration process, improving the market exit process for small businesses via personal bankruptcy law and providing a level playing field for all kinds of enterprises; (4) promote more highly-educated entrepreneurs in universities by improving practical entrepreneurship education, encouraging spinoff start-ups with better IPR transfer management, creating a better living, working and finance environment for foreigners to attract returnee entrepreneurs, establishing more business incubators to facilitate start-ups, and encouraging university-industry linkages to provide innovation and human capital services for enterprises; (5) provide a free entrepreneurial training system that covers all ‘Generate Your Business Idea’, ‘Start Your Business’, ‘Improve Your Business’ and ‘Expand Your Business’ programs in non-eastern regions, especially for young, female and necessity entrepreneurs; (6) encourage more private-owned ‘one stop shop’ service platforms (covering information and services on policy, technology, intellectual property rights, market development, exporting, human capital, finance access, management consulting and legal services); (7) encourage more private business associations and reform government-controlled business associations to give them full autonomy, especially in non-eastern regions; (8) support credit access by the private sector, and SMEs in particular, by encouraging the establishment of more private and

small banks, developing an effective credit rating system and encouraging more private funds to provide guarantee services for bank loans; and (9) create a better IPR protection environment to further support the innovation activities of SMEs by developing more IPR training bases, service agencies and talents in China.

Utilising the empirical results presented in this study these policy recommendations can help China address the issues identified above, and thus better implement its 'Mass Entrepreneurship and Innovation' program by boosting entrepreneurial activities with better quality. With more quality innovation and entrepreneurial activities, China's manufacturing sector can move up the value-adding chain of global manufacturing and form a sustainable competitive advantage instead of one based on cheap labour. China can also achieve success in the transition from an efficiency-driven economy to an innovation-driven economy. In the future, more studies of the characteristics of entrepreneurs and the development of entrepreneurial SMEs should be conducted to help China better understand and support its entrepreneurial activities and private SME sector.

## Chapter 9 Summary and conclusions

### 9.1 Introduction

Since the implementation of the ‘Reform and openness’ policy in 1979, China has enjoyed extraordinary economic growth with an average annual real rate of growth of 9.59 per cent during the 1979-2017 period and has become the largest economy in the world (on a PPP base). Due to its comparative advantage in cheap labour, China’s economic development has been labour-intensive manufacturing-led (McKay & Song, 2010). It earned the name the ‘World’s Factory’ (Zhang *et al.*, 2011) and attracted large FDI inflows, which were mainly from Hong Kong, Macao and Taiwan. By 2017 it had become the largest exporting economy and the second largest recipient of FDI in the world. But now China is losing its competitiveness in global labour-intensive manufacturing due to the gradual ending of cheap labour (Butollo, 2014), with cheaper labour in other countries, such as Bangladesh, Vietnam, Myanmar, replacing that in China to become the new preferred labour-intensive outsourcing destinations (Enderwick, 2011; Witchell & Symington, 2013). China needs to upgrade its manufacturing sector and move its position up global value chains by placing more emphasis on efficiency improvement and innovation, in order to transition from ‘Made in China’ to ‘Designed in China’ (‘Made in China 2025’ strategy).

In the ‘Made in China 2025’ strategy the role of entrepreneurship has been emphasised. Entrepreneurial activities are the link between new knowledge and more sustainable endogenous economic growth (Audretsch *et al.*, 2006; Carree & Thurik, 2010). They can spill over new knowledge and commercialise innovative ideas and products. They can also introduce new entrants and ideas into the market resulting in increased efficiency through competition and diversity (see Chapter 4). To promote entrepreneurship in China, the ‘Mass Entrepreneurship and Innovation’ program was implemented in 2015 to encourage entrepreneurial activities by the general public. In this program, manufacturing SMEs, which are defined as enterprises with fewer than 1,000 employees or less than 400 million RMB in annual revenue, have been given a special focus because they are the most common form of entrepreneurial enterprise. SMEs dominate the number of private

industrial enterprises and contribute 89 per cent of employment, 88.05 per cent of industrial output and 82.92 per cent of exports created by private industrial enterprises.

Despite their importance, China's SMEs face many obstacles in accessing bank loans, human capital and technology, and have limited capabilities to export and innovate (see Chapter 3). Thus, China's SMEs usually perform poorly and have difficulties in surviving. The literature review in Chapter 4 stressed that not all entrepreneurial activities can generate innovation, perform well and survive, and thus lead to economic growth. The quality and performance of entrepreneurial activities matters. Therefore, the performance of private SMEs in China needs to be improved by means of better quality entrepreneurial activities, especially in the manufacturing sector. Also, there is a significant regional disparity in the development of private SMEs between eastern and non-eastern regions, a legacy of the preferential policies towards eastern regions during the 'Reform and openness' process. A regional focus will be required to improve the performance of private SMEs based on the specific doing business environment characteristics in eastern and non-eastern regions, respectively. However, no study has been carried out to compare the firm-level performances of private SMEs in eastern and non-eastern regions of China or to identify what are the relationships of entrepreneurial factors with their performance in terms of technical efficiency. This research filled these gaps to provide empirical evidence for policy makers with the objective of improving the performance and quality of entrepreneurial activities in China's manufacturing sector.

The objective of this study was to answer the following questions (see Chapter 1)

***about technical efficiency performance:***

- (1) How do eastern and non-eastern private manufacturing SMEs perform differently in terms of technical efficiency?

***about the relationships of entrepreneurial factors and other firm factors with the technical efficiency performance of eastern and non-eastern private manufacturing SMEs in China:***

- (2) What is the relationship of an entrepreneur's 'start-up motivation (opportunity-driven or necessity-driven)' with the technical efficiency of China's SMEs?



- (3) What is the relationship of an entrepreneur's '*age*' with SME technical efficiency?
- (4) Do '*male*' entrepreneurs outperform female entrepreneurs in terms of technical efficiency?
- (5) What is the relationship of an entrepreneur's '*education level*' with SME technical efficiency?
- (6) Which type of entrepreneur '*previous experiences*' (start-up, management and technical experiences) has significant relationship with SME technical efficiency?
- (7) Which type of entrepreneur '*guanxi*' (political and business connections) has a significant relationship with SME technical efficiency?
- (8) What are the relationships of other firm-specific variables, such as firm size, age, export density, credit access, and R&D activities, with SME technical efficiency?

Based on the answers to these questions, policy recommendations are proposed to improve the efficiency performance of eastern and non-eastern private manufacturing SMEs to effectively facilitate the 'Mass Entrepreneurship and Innovation' program. This chapter provides a summary of the key findings related to these questions. Section 9.2 summarises the findings on these research questions based on empirical results presented in Chapter 7. Then evidence-based policy recommendations for China's government to improve the quality of entrepreneurial activities presented in Chapter 8 are summarised in Section 9.3. The major limitations of this study and suggestions for further study are provided in Section 9.4.

## **9.2 Major findings in relation to research questions**

This research aimed to provide an empirical examination on the technical efficiency performance and the entrepreneurial determinants of this performance for private manufacturing SMEs in eastern and non-eastern regions of China by exploring the research questions shown above and in Chapter 1. To answer these questions, this research utilised data on 664 private manufacturing SMEs in China in 2012 obtained from the *2012 China private enterprises survey*. The main results for these research questions are summarised below and in Table 9.1:

### *Technical efficiency performance*

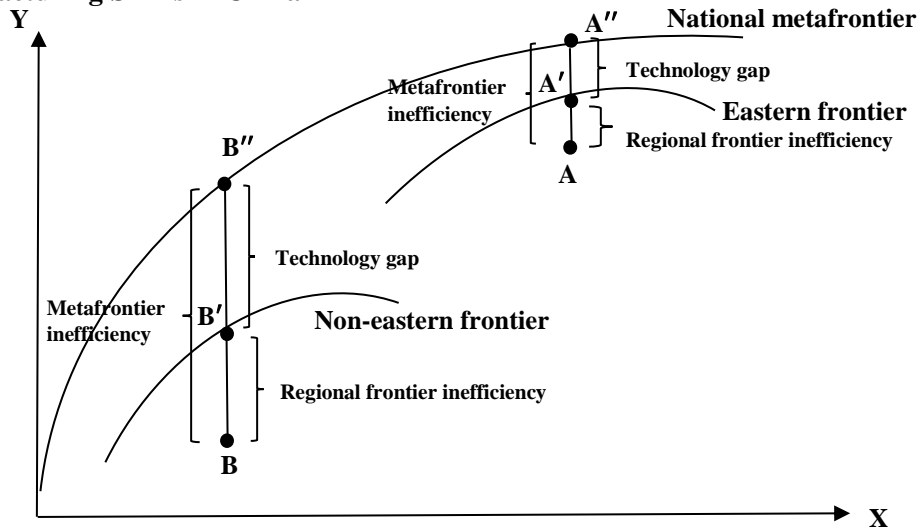
#### **(1) How do eastern and non-eastern private manufacturing SMEs perform differently in terms of technical efficiency?**

The first research question focused on the technical efficiency levels of private manufacturing SMEs in eastern and non-eastern regions of China. According to the empirical results shown in Chapter 7, private manufacturing SMEs in aggregate for all regions in China had a 0.8985 average technical efficiency score in 2012, indicating that they have not achieved their perfect technical efficiency level. They can still increase their output by 10.15 per cent without any increase in input. There is considerable room for improvement in the efficiency performance of private manufacturing SMEs in China.

When considering eastern and non-eastern regions respectively, the results of the LR test shown in Table 7.12 confirmed that eastern and non-eastern private manufacturing SMEs produced under different technology levels (frontiers). Therefore, in order to compare the technical efficiency performances between eastern and non-eastern private manufacturing SMEs, their technical efficiency scores relative to the national metafrontier were estimated. The metafrontier technical efficiency can be decomposed into the regional frontier technical efficiency and the technology gap ratio as shown in Figure 9.1.

For non-eastern private manufacturing SMEs, the average technical efficiency level relative to its regional frontier was 81.11 per cent in 2012. They can increase their output by 18.89 per cent (the distance BB' in Figure 9.1) on average without any increase in inputs under the technology available to the non-eastern region. The average technology gap ratio for non-eastern private manufacturing SMEs was estimated to be 90.00 per cent in 2012. They can increase their maximum output by 10.00 per cent (the distance B'B" in Figure 9.1) on average if they utilise the most advanced technology available in China. Combining the technical efficiency relative to the frontier for the non-eastern region and the technology gap ratio between non-eastern technology and national technology, the technical efficiency level relative to the metafrontier for non-eastern private manufacturing SMEs was computed to be 73.26 per cent on average in 2012. Under the current input level, they can still increase their output by 26.38 per cent (distance BB" in Figure 9.1) on average if they use the best technology available to them in China.

**Figure 9.1 Metafrontier technical efficiency of eastern and non-eastern private manufacturing SMEs in China**



Source: Author's summary.

The performance of private manufacturing SMEs in eastern regions was different from that of non-eastern SMEs. Their average regional frontier technical efficiency was estimated to be 91.41 per cent in 2012. 8.59 per cent (the distance AA' in Figure 9.1) more output can be achieved without any increase in inputs under the technology available to eastern SMEs. Their technology gap ratio was evaluated to be 0.9556 in 2012. They can increase their maximum output by 4.44 per cent (the distance A'A'' in Figure 9.1) if the best technology available in China is utilised. Combining the effect of regional frontier inefficiency and the technology gap between eastern and national technology, the metafrontier technical efficiency level for eastern private manufacturing SMEs was found to be 87.38 per cent in 2012 on average. Under national technology, private manufacturing SMEs in eastern regions can improve their output by 12.62 per cent (the distance AA'' in Figure 9.1) on average without increasing their inputs.

These results indicate that both eastern and non-eastern private manufacturing SMEs can further improve their efficiency performance. With a higher metafrontier technical efficiency level, eastern private manufacturing SMEs performed more efficiently than non-eastern SMEs ( $AA'' < BB''$ ). Eastern SMEs also utilised more advanced technology with a higher technology gap ratio than non-eastern SMEs ( $A'A'' < B'B''$ ). A disparity in the efficiency and technology performance of private manufacturing SMEs between eastern and non-eastern regions persists in China.

**Table 9.1 Empirical answers for research questions, issues and policy recommendations for promoting quality entrepreneurial activities in China**

<b>Answers for research questions</b>	<b>Issues</b>	<b>Policy recommendations</b>
<b>Question 1: Regional disparity</b>		
<ul style="list-style-type: none"> <li>• Non-eastern SMEs produced less efficiently</li> <li>• Efficiency determinants differ across regions</li> </ul>	<ul style="list-style-type: none"> <li>• Support for non-eastern SMEs needed</li> <li>• Decentralise power to local governments</li> </ul>	Decentralise government funding allocating power to local governments; build regional SME clusters based on regional comparative advantage; encourage investment from eastern to non-eastern regions
<b>Question 2: Opportunity entrepreneurs compared with necessity entrepreneurs</b>		
<ul style="list-style-type: none"> <li>• They used better technology</li> <li>• They produced more efficiently under regional technology only in non-eastern regions.</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage more opportunity entrepreneurs</li> <li>• Improve efficiency of non-eastern necessity entrepreneurs</li> </ul>	Classification on motivation; better market entry and exit system; level playing field for private sector; business incubators; U-I cooperation; ILO training package; ‘one-stop shop’ service platform; develop business associations
<b>Question 3: Young entrepreneurs compared with older entrepreneurs (after controlling for finance access)</b>		
<ul style="list-style-type: none"> <li>• They did not outperform in terms of the technology level</li> <li>• They produced more efficiently under regional technology only in eastern regions</li> </ul>	<ul style="list-style-type: none"> <li>• Improve their technology level</li> <li>• Improve their efficiency in non-eastern regions</li> </ul>	Better market entry and exit system; business incubators; entrepreneurship education; U-I cooperation; ILO training package; ‘one-stop shop’ service platform; develop business associations
<b>Question 4: Female entrepreneurs compared with male entrepreneurs (after controlling for finance access)</b>		
<ul style="list-style-type: none"> <li>• They used less advanced technology</li> <li>• They did not produce less efficiently under regional technology in both eastern and non-eastern regions</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage more female entrepreneurs</li> <li>• Improve their technology level</li> </ul>	Better market entry and exit system; business incubators; entrepreneurship education; U-I cooperation; ILO training package; ‘one-stop shop’ service platform; develop business associations
<b>Question 5: University education</b>		
<ul style="list-style-type: none"> <li>• Positive relationship with technology level</li> <li>• Positive relationship with regional frontier technical efficiency in both eastern and non-eastern regions</li> </ul>	<ul style="list-style-type: none"> <li>• Encourage more highly-educated entrepreneurs</li> <li>• Improve the role of universities in promoting entrepreneurship</li> </ul>	Practical entrepreneurship education; encourage spinoff enterprises by researchers; encourage overseas returnee entrepreneurs; U-I cooperation; business incubators
<b>Question 6: Entrepreneurship skills (management, start-up and technical experiences)</b>		
<ul style="list-style-type: none"> <li>• Start-up experience had a positive relationship with technology level, but management and technical experience had negative relationships with it</li> <li>• All three experiences had positive relationships with regional frontier technical efficiency only in non-eastern regions</li> </ul>	<ul style="list-style-type: none"> <li>• Improve the technology for those with management and technical experience</li> <li>• Training on management, starting a business and technology are all needed mainly in non-eastern regions</li> </ul>	U-I cooperation; technology & IPR service in ‘one-stop shop’ service platform; ILO training package: <i>GYB, SYB, IYB, EYB</i>

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**Question 7: Entrepreneur *guanxi* (political connections and business connections)****Politically connected entrepreneurs compared with non-connected entrepreneurs**

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"><li>• They used less advanced technology</li><li>• They produced more efficiently in non-eastern regions, but less efficiently in eastern regions under regional technology</li></ul> | <ul style="list-style-type: none"><li>• Remove their privilege in resource access from government</li><li>• Continue relaxing government control in non-eastern markets</li></ul> | Level playing field for all enterprises; relax the control of government on resources and market activities in non-eastern regions |
|---|---|--|

**Business connected entrepreneurs (by business association) compared with non-connected entrepreneur**

- |  |  |   |
|--|--|---|
| <ul style="list-style-type: none"><li>• They used better technology</li><li>• They produced more efficiently under regional technology only in eastern regions</li></ul> | <ul style="list-style-type: none"><li>• Promote business associations development;</li><li>• Improve the effectiveness of business associations in non-eastern regions</li></ul> | Legislation for private business associations; give them full autonomy; organise more beneficial activities for entrepreneurs; give power to lobby government |
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**Question 8: Other firm specific factors****Small and micro enterprises compared with medium enterprises**

- |  |  |   |
|--|--|---|
| <ul style="list-style-type: none"><li>• They used better technology</li><li>• They produced less efficiently in both eastern and non-eastern regions</li></ul> | <ul style="list-style-type: none"><li>• Promote their innovation activities</li><li>• Make other policies besides fiscal support to improve their efficiency</li></ul> | Level playing field for private and small businesses; business incubators; U-I cooperation; information and services by 'one-stop shop' platform; 'IYB' training; business associations |
|--|--|---|

**Export density**

- |   |  |   |
|---|--|---|
| <ul style="list-style-type: none"><li>• Positive relationship with technology level</li><li>• Positive relationship with regional frontier technical efficiency in both eastern and non-eastern regions</li></ul> | <ul style="list-style-type: none"><li>• Promote exporting activities of SMEs</li></ul> | Reduce approvals for export activities; 'EYB' training; export services in 'one-stop shop' service platform; trade fairs by business associations |
|---|--|---|

**Credit access**

- |   |   |  |
|---|---|--|
| <ul style="list-style-type: none"><li>• Positive relationship with technology level</li><li>• Positive relationship with regional frontier technical efficiency in both eastern and non-eastern regions</li></ul> | <ul style="list-style-type: none"><li>• Facilitate access to finance for SMEs</li></ul> | Bankruptcy law; finance services in business incubators and 'one-stop shop' service platform; more private banks; credit rating system, private guarantee service, accounts receivable as collateral |
|---|---|--|

**R&D activities**

- |   |  |  |
|---|--|--|
| <ul style="list-style-type: none"><li>• Positive relationship with technology level</li><li>• Positive relationship with regional frontier technical efficiency in both eastern and non-eastern regions</li></ul> | <ul style="list-style-type: none"><li>• Promote R&amp;D activities of SMEs</li></ul> | Business incubator; U-I cooperation; 'EYB' training; technology services from 'one-stop shop' service platform; better IPR environment; tax incentives |
|---|--|--|

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Source: Author's summary.

*Relationships of entrepreneurial factors and other firm factors with the technical efficiency performance of eastern and non-eastern private manufacturing SMEs in China*

Research questions (2) to (8) focused on examining the relationships of entrepreneurial factors with the technical efficiency performances of eastern and non-eastern private manufacturing SMEs in China, after controlling for firm-specific factors. Hypotheses on the relationship between these factors and firm technical efficiency were proposed based on the literature reviewed in Chapter 4. As discussed in question (1), the metafrontier technical efficiency can be decomposed into the technical efficiency relative to the regional frontier and technology gap ratio. Therefore, the relationships of entrepreneurial factors with regional frontier technical efficiency and the technology gap ratio were both identified. Then the relationships of entrepreneurial factors with the technical efficiency level relative to the metafrontier (national technology) were estimated. The key findings in relation to each question are as follows:

**(2) What is the relationship of an entrepreneur's 'start-up motivation (opportunity-driven or necessity-driven)' with the technical efficiency of China's SMEs?**

The empirical results presented in Chapter 7 showed that the relationship of an entrepreneur's start-up motivation with metafrontier technical efficiency was positive and significant for China's private manufacturing SMEs. This is mainly because opportunity-driven entrepreneurs had a significantly higher technology level than necessity-driven entrepreneurs for all SMEs and higher technical efficiency under regional technology for SMEs in non-eastern regions.

**(3) What is the relationship of an entrepreneur's 'age' with SME technical efficiency?**

An entrepreneur's age was shown to have a significant and negative relationship with the technical efficiency relative to the metafrontier for private manufacturing SMEs in China (see Chapter 7). This relationship is mainly because younger entrepreneurs were found to produce with a significantly higher technical efficiency level relative to the regional frontier in eastern regions. But they were not producing with a significantly higher technology level for all SMEs or significantly higher technical efficiency under regional technology for non-eastern SMEs.

**(4) Do 'male' entrepreneurs outperform relative to female entrepreneurs in terms of technical efficiency?**

Chapter 7 also provided empirical evidence that male entrepreneurs were significantly outperforming females in terms of technical efficiency relative to the metafrontier within the

private manufacturing SMEs of China. This was mainly due to the outperformance of male entrepreneurs in the production technology level utilised by them. But male entrepreneurs were not found to be outperforming female ones in terms of technical efficiency under regional technology in both eastern and non-eastern regions of China.

**(5) What is the relationship of an entrepreneur's 'education level' with SME technical efficiency?**

An entrepreneur's education level was shown to have a positive and significant relationship with technical efficiency relative to the metafrontier for private manufacturing SMEs in China. This positive relationship was caused by both the positive relationships of education level with the technical efficiency relative to the two regional frontiers and the technology gap ratio.

**(6) Which type of entrepreneur 'previous experiences' (start-up, management and technical experiences) has significant relationship with SME technical efficiency?**

The relationships of three kinds of experience, including management experience, start-up experience and experience as technical staff, with the metafrontier technical of private manufacturing SMEs in China were found to be mixed. Entrepreneurs with management experience and technical experience produced with a significantly lower technology level for all SMEs but significantly higher technical efficiency under regional technology for non-eastern SMEs, resulting in the insignificant relationship of an entrepreneur's management/technical experience with metafrontier technical efficiency of private manufacturing SMEs in China (see Chapter 7). Unlike management and technical experience, the start-up experience of an entrepreneur had a significant and positive relationship with the metafrontier technical efficiency of China's private manufacturing SMEs. This is because the start-up experience possessed by the entrepreneur helped non-eastern SMEs achieve a higher technical efficiency level under regional technology and use more advanced technology for SMEs in all regions of China. Therefore, only start-up motivation was shown to have significant relationship with SMEs' technical efficiency level in China's manufacturing sector.

**(7) Which type of entrepreneur 'guanxi' (political and business connections) has significant relationship with SME technical efficiency?**

As indicated by the empirical results in Chapter 7, the relationship of an entrepreneur's political connections with the metafrontier technical efficiency was found to be insignificant because its relationship with the technical efficiency under regional technology and the technology level

of private manufacturing SMEs in China were mixed and offsetting. Political connection helped non-eastern SMEs achieve significantly higher technical efficiency under regional technology, but it led to a lower technical efficiency level under regional technology for eastern SMEs. Also, it related to a lower technology level used by SMEs in all regions of China. The relationship of business connections with the metafrontier technical efficiency of private manufacturing SMEs in China was positive and statistically significant. Although business connection had an insignificant relationship with technical efficiency under regional technology for non-eastern SMEs, it helped eastern SMEs achieve higher technical efficiency under regional technology and use a higher technology level for all SMEs in the sample (see Chapter 7). Therefore, it is the business connection of entrepreneurs that can have significant and positive relationship with SME technical efficiency in China's manufacturing sector.

**(8) What are the relationships of other firm-specific variables, such as firm size, firm age, export density, credit access, and R&D activities with their technical efficiency?**

Chapter 7 showed that the size of a firm had a significant and positive relationship with its technical efficiency relative to the metafrontier. This is because medium enterprises had a significantly higher technical efficiency level relative to the regional frontier for both eastern and non-eastern regions. But medium enterprises used lower level technology than small and micro enterprises within overall private manufacturing SMEs in China. The firm age was also found to have a significant and positive relationship with technical efficiency relative to the metafrontier of private manufacturing SMEs in China (see Chapter 7). Older SMEs were shown to produce with more advanced technology. Although the relationship of firm age with technical efficiency under regional technology was insignificant for non-eastern SMEs, older SMEs in eastern regions were found to have a significantly higher technical efficiency level under regional technology than their younger counterparts. The exporting, credit access and R&D activities of private manufacturing SMEs in China were all shown to have significant and positive relationships with their metafrontier technical efficiency performance. Exporting, credit access and R&D activities resulted in private manufacturing SMEs using more advanced technology and producing more technically efficiently under regional technology in both eastern and non-eastern regions of China.



### **9.3 Policy implications and recommendations**

The empirical results obtained from this research have assisted in better understanding the efficiency performance of entrepreneurial activities, using data for private SMEs, in the eastern and non-eastern manufacturing sector of China. According to the results of this research, private manufacturing SMEs were producing inefficiently in both eastern and non-eastern regions. This suggests that the policy focus of the ‘Mass Entrepreneurship and Innovation’ program may need modification and fine tuning from merely focusing on increasing the quantity to also improving the quality of entrepreneurial activities. In supporting the development of entrepreneurial activities, especially private SMEs, the role of government is significant. As discussed in Chapter 8, government can apply interventional policies to address market failures and also market-oriented policies to improve the business environment for start-ups and private SMEs.

Based on the answers to the above research questions (1) to (8) a number of major issues, as shown in Table 9.1, need to be addressed including: (i) tackling the regional disparity in private SME performance between eastern and non-eastern regions, (ii) supporting the development of opportunity entrepreneurs and improving the performance of necessity entrepreneurs, (iii) improving the technology level of young entrepreneurs and help them perform more efficiently in non-eastern regions, (iv) supporting the development of female entrepreneurs and improving their technology level, (v) developing more highly-educated entrepreneurs and improving the role of universities in promoting entrepreneurial activities, (vi) helping entrepreneurs with management and technical experience to break technology ‘lock in’ and providing training in starting a business, managing a business and technology adoption for entrepreneurs mainly in non-eastern regions, (vii) reducing government protection of politically connected firms, continuing to relax government control of market activities in non-eastern regions and further developing and reforming business associations to make them more effective in facilitating entrepreneurial activities, especially in non-eastern regions, and meeting the needs of their members, and (viii) further improving the role of small and micro enterprises in innovation and helping them improve their efficiency, promoting exporting and R&D activities and helping them address obstacles relating to access to finance. To address these issues effectively, this research proposed detailed policy recommendations as follows (see Table 9.1):

- To address the issue of regional disparity, the allocation of government funds for promoting entrepreneurial activities and private SMEs should be decentralised to local governments in order to support start-ups and private SMEs in different regions more effectively. The use of these funds should be monitored by the National Development and Reform Commission (NDRC). Regional start-ups and SME clusters should be established based on regional comparative advantages to obtain a balanced and sustainable development of China. Also, the flow of investment and skilled labour from eastern regions to non-eastern regions should be encouraged because knowledge flows are usually bounded within geographic limits (Acs *et al.*, 2002), so that new knowledge and technologies created in more developed eastern regions cannot easily spill over to non-eastern regions. Eastern enterprises can be encouraged to establish factories or outsource their manufacturing to non-eastern SMEs due to cheaper labour and land. In this way, more job opportunities can be created in non-eastern regions to attract skilled labour and their knowledge can be spilled over from eastern to non-eastern regions.
- Specific classification criteria for opportunity-driven and necessity-driven entrepreneurs should be developed by SAIC according to their experience, capabilities and business plans. The type of entrepreneurs identified based on these criteria should be recorded during their registration. Government should mainly encourage opportunity-driven entrepreneurs to undertake innovation activities, because they can radically improve the technology level in China.
- The doing business environment in China should be further improved. First, the business registration process can be further simplified by combining certificates needed in the registration process and adopting an online registration system like New Zealand's. Second, the market exit process should be improved by developing a personal bankruptcy law to protect sole proprietorship enterprises and partnership enterprises. Third, government needs to provide a level playing field for all enterprises to remove the unfairness faced by private, small, female owned, non-eastern based and non-politically connected businesses in order to help them perform better. To achieve this the *Anti-monopoly Law* and *Anti-unfair Competition Law* should be modified in China. Also, government control over key resources should be further relaxed and approvals needed for market activities reduced, especially in non-eastern regions.

- In order to encourage more opportunity-driven, young, female and highly-educated entrepreneurs, entrepreneurship education in universities should be further developed with more practical activities, such as the student mini-company program (see Chapter 8). Researchers, staff and postgraduate students can be encouraged to start businesses based on their intellectual property rights (IPR) or licences transferred from universities, which will require universities to manage their IPR well. Also, more overseas returnee entrepreneurs can be encouraged by a better living, working and finance environment for returnees of Chinese descent but with foreign citizenship in China. Business incubators in universities should be further supported and established in all regions of China to provide technology, information and mentoring services for start-ups. Cooperation between universities and private small businesses should be encouraged to provide them with information, technology, research infrastructure sharing, training services and as a source of skilled graduates.
- A free entrepreneurial training program following the ILO entrepreneur training framework should be developed and provided to entrepreneurs in non-eastern regions, especially for some disadvantaged groups (e.g. young, female and necessity-driven entrepreneurs). It should cover ‘Generate Your Business Idea’, ‘Improve Your Business’ and ‘Expand Your Business’, as well as the current ‘Start Your Business’ training. It can be funded by local governments and conducted by universities, business associations and bureaus of human resources and social security. Such training should provide embryonic entrepreneurs with knowledge about developing a good business plan, starting a business, making a business perform better and developing business growth strategies (e.g. through technology acquisition, financial literacy, innovation activity, and exporting).
- A significant way to support start-ups and private SMEs is to address their information imperfections and lack of talent problems. Therefore, information and services for private small businesses should be improved by encouraging the establishment of more private-owned ‘one-stop shop’ service platforms, which have not been well-developed due to the dominance of government-owned SME service platforms in China. These platforms should comprehensively cover policy information on business start-ups, innovation and technology, IPR, market development, exporting, human capital development, finance, consulting and

legal services for enterprises. This can help China form a well-developed service industry for start-ups and SMEs.

- To promote business connections between entrepreneurs, legislation on private business associations relating to their establishment, autonomy and legal status needs to be developed. This can not only help the development of private business associations but also facilitate greater autonomy of government-controlled business associations. The effectiveness of business associations in supporting entrepreneurs and private SMEs needs to be improved by encouraging them to rely less on government subsidies for their survival, but to become more commercial in their activities. Their service role should be emphasised by encouraging them to provide members with policy information, seminars, conferences, trade fairs and training activities. Also, they should be given more power to lobby government on behalf of their members and to assist government to acquire a better understanding of the private sector and of the priorities and needs of its entrepreneur members.
- Access to bank loans by private SMEs should be supported due to credit market failure. This is caused by the monopoly in China's banking industry by state-owned banks, who prefer to lend to state-owned enterprises, and information asymmetry between banks and SMEs. Therefore, the establishment of more private banks should be encouraged to provide more loan sources for SMEs. A credit rating system should be developed in China with standard criteria and more service agencies to address the information asymmetry problem. Moreover, private sources of funds should be encouraged to offer guarantee services against loan repayment default for private SMEs. SMEs lacking collateral can also use accounts receivable from their buyers as their collateral.
- Innovation by private SMEs should be encouraged not only through tax incentives on R&D and transfer of technology activities, but also by having a better IPR environment in China. To provide SMEs with more knowledge of and services for IPR, more IPR training bases for SMEs should be established and the development of more IPR service agencies should be encouraged. This requires Chinese universities to develop more skilled labour talents with knowledge of IPR.

## 9.4 Research limitations and future studies

This thesis has provided an analysis of the technical efficiency performance of private manufacturing SMEs in China. In spite of the contributions of this study, it still has a number of limitations that leave possibilities for further research.

- (1) This thesis used the *China private enterprises survey* data for 2012, which contains the latest data available for researchers to use regarding private sector enterprises. It will be interesting to gain access to more recent survey data to further evaluate developments in private manufacturing SMEs when this becomes available.
- (2) The survey data series utilised did not cover the same individual firms in different years, so we cannot observe changes in firms over time. Therefore, this research was static, using cross-sectional data in 2012, and it is not possible to compute the productivity performance or compare the technical efficiency performances of private manufacturing SMEs over time using panel data. This can be considered in future studies using unbalanced panel data.
- (3) When the data after 2015 becomes available, a comparison of the efficiency performance of private manufacturing SMEs before and after the implementation of the 'Mass Entrepreneurship and Innovation' in 2015 can be studied, to identify whether this program has effectively improved the performance of SMEs.
- (4) The survey data used only covered a very small number of large enterprises in the manufacturing sector in 2012, which made estimation of their technical efficiency scores using the SFA technique impossible. This is the reason that large enterprises were excluded from this thesis. In future research, large manufacturing enterprises can also be included in order to obtain a broader understanding of the efficiency performance of all private manufacturing enterprises in China. Also, a comparison between large enterprises and SMEs can then be conducted to show whether SMEs have a lower efficiency level relative to that of large enterprises, and if the explanatory variables of efficiency for both these cohorts of firms are the same.
- (5) Estimating technical efficiency using SFA requires a relatively large sample size. With 664 private manufacturing SMEs in the sample it was not possible for this study to estimate, and compare, the technical efficiency performance of SMEs in

individual provinces, by manufacturing sub-sectors or by firm size (micro, small and medium), because the sub-sample size would have been too small to obtain robust results from SFA. With a bigger data base these issues can all be considered in future studies.

- (6) Moreover, the *2012 China private enterprises survey* also covered private SMEs in service sectors. Although the service sector was beyond the scope of this research, further studies can also be conducted to evaluate the technical efficiency performance of private service SMEs. This can provide a better understanding of China's service SMEs and help China develop policies to support their development.
- (7) This research utilised a parametric SFA technique in estimating the metafrontier technical efficiency scores of private manufacturing SMEs in China. But the non-parametric DEA technique, developed by Battese *et al.* (2004), can also be applied for such estimation for robustness tests on results obtained from SFA. The problem with the current metafrontier DEA method is that it is impossible to use the double-bootstrapping technique to obtain more robust results. But this can be considered in future studies.
- (8) Another limitation of this study is that it has not focused on causality but only on correlation. This is because the panel data required for causality study is not available for private manufacturing SMEs in China. It would be important in future empirical work in this area, when more data becomes available, to address the issue of causality.
- (9) The characteristics of the entrepreneurs and firms considered in this research were chosen based on data availability. In future studies more entrepreneurial and firm factors (e.g. an entrepreneur's family background, a firm's registration type and source of finance) can be used to identify their relationships with the technical efficiency performance of private manufacturing SMEs in China.
- (10) Future studies can also compare the technical efficiency performance of private manufacturing SMEs in China with that in other developing or developed countries using the metafrontier technique. This can help better understand differences in the performance of SMEs in China to that in other developing countries, as well as

highlight the varying importance of explanatory variables that contribute to this difference (e.g. the business environment, firm characteristics, entrepreneur characteristics, access to finance, types of innovation activity, access to skilled labour and so on).

In conclusion, the limitations discussed above are beyond the scope of the present study due to data unavailability, but they are all worthy of consideration and can be addressed in future research as more data becomes available.

## Appendix

**Table A1 List of current policies for promoting entrepreneurial activities and SMEs in China**

<b>Problem</b>	<b>Policy target</b>	<b>Description</b>	<b>Agencies/Bureaus</b>
Business Environment	Industry restriction	In traditional SOE monopolized industries (e.g. petroleum, gas, telecom, banking), private investment will be allowed to form mixed (state and private) owned enterprises.	NDRC, MIIT
	Market entry	Simplify the market entry process by integrating five licences and certificates for business registration <sup>29</sup> into one Business Licence.	SAIC
	Administrative burden	Promote government institutional reform; Reduce administrative approvals for market activities (e.g. export chemicals).	Bureaus relating to these approvals
Entrepreneurial and innovation zones	Start-up clusters	Until 2017, 62 <i>Entrepreneurship and Innovation Demonstration Bases</i> have been established across China; Start-ups located in these zones can enjoy subsidies, tax reductions, fee exemptions and services.	NDRC, MOF, SAT, MIIT, MLR
Entrepreneurial awareness and skills	Entrepreneurship education	Incorporate entrepreneurship courses as core subjects in all majors and provide various courses on entrepreneurial skills as elective subjects in all majors in universities.	MOE
	Innovation zones in universities	Develop entrepreneurship and innovation zones in 30 elite universities. These zones target practical projects in entrepreneurship education, business incubators and research outcome commercialization.	MOE, NDRC, MOF, MIIT
	Entrepreneurship training	Free entrepreneurship training programs for potential entrepreneurs: <i>Start Your Business</i> .	MOF, MHRSS

<sup>29</sup> These five licences include: Enterprise Business License, Organization Code Certificate, Tax Registration Certificate, Social Insurance Registration Certificate, and Statistical Registration Certificate.



Special groups	Youth	Provide a subsidy on the interest cost of small loans (up to 3 million RMB) for up to 3 years.	CYL, CDB
	Females	Provide a subsidy on the interest cost of small loans (up to 100,000 RMB) for up to 3 years.	ACWF, PBC, CBRC
	Enrolled or graduate students	Allow enrolled students to temporarily leave university study (for 2-8 years <sup>30</sup> ) to start a new business.	MOE
		Provide government guaranteed funds and subsidies on the interest cost of bank loans up to 100,000 RMB.	MOF, MOT, CBRC,
		Exempt administration fees and reduce income tax and surcharges (up to 8,000 RMB per year) for the first 3 years of a business.	SAT, SAIC, MOF
	Overseas returnees	Simplify the process of application for a working visa, residence permit and ' <i>hukou</i> '.	MOE, MHRSS, MPS
		Provide short-term free accommodation and subsidies (0.1-5 million RMB) for selected high-tech entrepreneurs.	MOF, MHRSS
Researchers	Legally allow them to temporarily leave their current job and start a business. If the business involves the intellectual property and technical personnel of the research institution they work in, contracts to clarify the allocation of rights and profits are needed.	MOT, MHRSS	
Finance support			
Bank loans	Sources	Tax exemption for banks on interest income they receive on small amount loans to small businesses (up to 10 million RMB).	SAT, PBC, CBRC
	Collateral	Allow enterprises to use intangible assets (patents/brands) as well as equipment (e.g. machines) as collateral.	SIPO, PBC, CBRC

<sup>30</sup>The suspension period allowed varies across provinces. For example, Shanxi province allows 2 years, Hainan province allows 5 years and Heilongjiang province allows 8 years for the suspension period of university study by students starting a new business.

Equity capital	Guarantee	Encourage insurance companies to provide insurance on the bank loans to the enterprises without collateral.	PBC, CBRC, CIRC
		Local governments to be able to act as guarantors for enterprises in their local area without collateral by the <i>National Financing Guarantee Fund</i> with 66.1 billion RMB.	MOF, PBC
	Transparency	Provide a small and micro business directory and portal online.	SAIC
		Disclose enterprise information, financial reports and credit records annually online by SAIC.	SAIC, CBRC, CSRC
	Government	Develop a government-backed business start-up capital pool (around US\$338 billion) consisting of many funds, such as the ‘National Emerging Industry Venture Capital Matching Fund’ and ‘SME Development Funds’ to support business start-ups.	NDRC, MOF, MOT, MIIT, SAT
	Private	Encourage more private venture capital companies and angel investors to invest in start-ups, especially SMEs, by, for example, allowing a deduction of 70% of their high-tech SMEs investment from taxable income.	NDRC, SAT, MOT, CBRC, CIRC
	Stock market	Establish an SME board and growth enterprise board in the stock market with more relaxed conditions for SMEs to IPO.	CSRC
Fiscal support	Tax	Enterprises with less than 1 million RMB annual avenue can enjoy a 20% enterprise income tax rate (lower than the normal 25% rate) and pay only half of their income taxes.	SAT
	Surcharges	Exemption from the national and local education surcharge, cultural business development levy and water conservancy projects levy for small businesses with less than 0.1 million RMB in monthly income.	SAT
	Government procurement	Allocate 18% of the local government procurement budget to purchases from SMEs.	MOF, MIIT

Innovation	Tax incentive	For SMEs, allow a deduction of 75% of their expenditure on R&D activities that do not result in intangible assets (e.g. patents, trademarks) from taxable incomes; and allow a deduction of 175% of their expenditure on R&D activities that results in intangible assets from taxable income.	SAT, MOF, MOT
		Tax reduction on the income from transfer of technology (TOT) by enterprises.	SAT
	Intellectual property right	Intellectual property rights legislation: <i>Trademark Law</i> (1982), <i>Patent Law</i> (1985) and <i>Copyright Law</i> (1991).	NPC
		Develop a patent and trademark query system.	SIPO, SAIC
		Develop an <i>SMEs Intellectual Property Rights Knowledge Training Base</i> in Guangdong, Jiangsu, Zhejiang provinces.	SIPO, MOF, MLR
		Enterprises with less than 0.3 million RMB annual revenue can enjoy a reduction in patent applications, substantive examination and patent annuities and review fees.	SIPO, MOF
Exports	Insurance	Provide small and micro exporting firms free one-year export credit insurance with up to US\$0.15 million in compensation if they cannot obtain the payment due to business risks and political risks.	MOF, CECIC

Source: Author's summary based on government policy documents. <http://www.gov.cn/zhengce/index.htm>

Note: ACWF: All-China Women's Federation; CBRC: China Banking Regulatory Commission; CDB: China Development Bank; CECIC (China Export & Credit Insurance Corporation); CIRC: China Insurance Regulatory Commission; CSRC: China Securities Regulatory Commission; CYL: Communist Youth League; GAC: General Administration of Customs; MFA: Ministry of Foreign Affairs; MHRSS: Ministry of Human Resources and Social Security; MIIT: Ministry of Industry and Information Technology; MLR: Ministry of Land and Resources; MOC: Ministry of Commerce; MOE: Ministry of Education; MOF: Ministry of Finance; MOT: Ministry of Technology; MPS: Ministry of Public Security; NDRC: National Development and Reform Commission; NPC: National People's Congress; PBC: People's Banks of China; SAIC: The State Administration of Industry and Commerce; SAT: State Administration of Tax; SIPO: State Intellectual Property Office.

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