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WHEN DO WHOLLY OWNED SUBSIDIARIES PERFORM BETTER THAN JOINT VENTURES?

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This study explores when wholly owned subsidiaries outperform joint ventures with local partners. In order to avoid the endogeneity problem inherent in foreign subsidiaries' operating mode decisions that might confound performance measurement, we employ the propensity score matching method, along with the difference-in-differences approach, and compare the performances of joint ventures turned wholly owned subsidiaries vis-à-vis continuing joint ventures. Based on foreign subsidiaries' financial data in China for 1998–2006, we find strong evidence that converted wholly owned subsidiaries outperform continuing joint ventures in industries characterized by high levels of intangible assets such as technology or brand, after controlling for factors that may affect the conversion decision. This finding is consistent with the prediction of transaction cost theory. Copyright © 2012 John Wiley & Sons, Ltd.

INTRODUCTION

Conventional wisdom in strategy research suggests that when multinational firms possess intangible resources such as technology or brand, they should enter a foreign country via wholly owned subsidiaries rather than joint ventures. According to transaction cost theory, the use of a partially owned venture or a contractual mode to transfer tacit or proprietary intangible assets is subject to the considerable risks of free riding and other opportunistic behavior (Hennart, 1982). Despite abundant research on *ex ante* mode choice at the time of entry, little is known about the *ex post* relative performance of operating mode. That is, do wholly owned subsidiaries indeed perform better than joint ventures after entry, as their *ex ante* mode choice would predict (Brouthers, Brouthers, and Werner, 2003; Shaver, 1998), or vice versa? The absence of work in this area takes root in both endogeneity issues inherent to examining post-entry performance and the lack of financial data for foreign subsidiaries. We overcome both limitations by employing two recently developed empirical techniques and using financial data for foreign subsidiaries in China.

The choice of operating mode is central to a firm's foreign investment strategy.[1] Depending on the need to maintain control, firms can use contracts (e.g., licensing), joint ventures with local partners, or wholly owned subsidiaries. Transaction cost theory provides several reasons why wholly owned subsidiaries might perform better than joint ventures under certain circumstances. First, foreign parents may transfer more intangible

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[1] Brouthers and Hennart (2007) review research on international entry modes.

resources, such as more sophisticated technology or brands, to wholly owned subsidiaries than they do to joint ventures because they are more concerned about local joint venture partners appropriating their intangible resources. Second, the performance of a joint venture depends not only on the congruence of the partners' goals but also on whether opportunism by partners can be contained. When a firm uses a wholly owned subsidiary, it does not have such concerns. In contrast, transaction cost theory suggests that a joint venture may be preferable when a local partner offers complementary knowledge, such as a deep understanding of local markets or access to distribution channels and natural resources, which cannot be easily purchased on the market (Hennart, 2009). Thus, transaction cost theory indicates that the optimal choice of operating mode is contingent upon various factors. Our study focuses on one of those contingencies by examining whether wholly owned subsidiaries perform better than joint ventures in industries characterized by high levels of intangible and tacit resources.

Previous attempts to evaluate post-entry subsidiary performance of different mode choices have been limited in two important ways. First, because a firm's choice about whether to use a joint venture or a wholly owned subsidiary is, in part, a function of the firm's own characteristics, the endogeneity of this choice must be considered when the subsidiary's post-entry performance is evaluated. For instance, Shaver (1998) demonstrates that the apparently higher survival rate of greenfield investment vis-à-vis acquisition disappears when the self-selection aspect of entry mode is incorporated into the model. Second, financial data for subsidiary-level performances are seldom available, as most foreign subsidiaries are privately held, and thus not required to disclose performance data. As a consequence, previous studies have been limited to the use of subsidiary exit, sales growth, or subjective evaluation as a proxy for subsidiary performance (Delios and Beamish, 2001; Shaver, 1998).

This study overcomes these limitations. First, we employ two recently developed techniques: propensity score matching and the difference-in-differences approach. It would be ideal to compare the performance of a joint venture and that of a wholly owned subsidiary from the *same* firm, but it is impossible to observe performance for an operating mode that the subsidiary did not choose (i.e., counterfactual performance). The propensity score matching technique provides a way to create counterfactual performances for the sake of comparison. Second, we use foreign subsidiaries' financial data in China from 1998 to 2006. The *Annual Industrial Survey Database* of the Chinese National Bureau of Statistics provides financial information for all industrial firms, including foreign subsidiaries above a certain size. These data allow us to track financial performance.

In order to choose an empirical setting that can handle the endogeneity issue, we focus on subsidiaries that converted from joint ventures to wholly owned subsidiaries. This focus allows us to match a joint venture that did not change its operating mode even though its *ex ante* likelihood of doing so (i.e., its propensity score) is roughly equal to that of the converted wholly owned subsidiary. In order to do so, we control for factors that may affect the conversion decision based on the joint venture termination/instability literature, including ownership structure (Blodgett, 1992; Dhanaraj and Beamish, 2004), changes in environmental and firm-specific conditions (Kogut, 1991), and the nontransferable complementary resources of local partners (Hennart, 2009). We are then equipped to harness the performance of a matched joint venture as an appropriate counterpart, even if we cannot observe the counterfactual performance had the converted subsidiary remained a joint venture. Once we match all the converted subsidiaries with subsidiaries that continued as joint ventures, we examine whether their performance diverges from the moment of conversion by using the difference-in-differences approach.

Our empirical context of joint ventures in China from 1998 to 2006 provides an ideal setting for our research questions. When China adopted a 'reform and open-door policy' in 1978, it required foreign multinationals to take interests in joint ventures in order to enter the market. The joint venture requirement was relaxed in most industries, excluding strategic industries like automotive and steel, as the country prepared itself to join the World Trade Organization (WTO). As a consequence, many joint ventures were converted to wholly owned subsidiaries. Yet a substantial number of joint ventures continued even after this requirement was lifted, thus providing an opportunity to apply the propensity score matching and the difference-in-differences methods, which require both converted wholly owned subsidiaries

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(the treatment group) and continuing joint ventures (the control group).

Our findings confirm transaction cost theory's key prediction for post-entry performance: converted wholly owned subsidiaries demonstrate superior financial performance in industries characterized by high levels of intangible assets like technology or brand. We also explore which mechanisms may enhance performance when ownership changes. To do so, we examine temporal changes of key strategic variables including sales, intangible assets, and fixed assets. We find that converted wholly owned subsidiaries invest more in intangible assets and increase sales revenue faster than continuing joint ventures.

THEORY AND HYPOTHESES

Literature review

Internalization theory, an early attempt to explain foreign operation mode choice, holds that a parent firm's need to internalize intangible resources dictates the choice between exporting, licensing, and foreign direct investment (Dunning, 1988). Several other researchers subsequently proposed that as firms gain experience in foreign operations, they perceive less uncertainty and therefore tend to use wholly owned subsidiaries rather than contractual or partial ownership modes (Johanson and Vahlne, 1977).

Transaction cost theory pushes the internalization logic further by specifying the conditions for market failures, including asset specificity and information asymmetry, coupled with uncertainty and opportunism (Hennart, 1982). According to this theory, multinational firms can efficiently transfer resources by using wholly owned subsidiaries rather than joint ventures when potential partners could free ride off their proprietary intangible assets and act in other opportunistic ways. Furthermore, because proprietary assets are typically tacit, the information asymmetry between transacting parties would make multinational firms more likely to exploit these assets via wholly owned subsidiaries. Several empirical investigations demonstrate that entry via outright ownership is preferred by multinational firms that possess higher amounts of intangible assets, which are often operationalized by research and development (R&D) and advertising intensities (e.g., Gatignon and Anderson, 1988).[2]

Considering its strategic importance, it is surprising that few studies evaluate the relationship between operating mode choice and subsidiary performance. Nitsch, Beamish, and Makino (1996) identify two reasons for the scant attention paid to this issue. First, it is very difficult to obtain subsidiary performance data because of different national financial reporting conventions, the reluctance of parent firms to divulge nonconsolidated data, and the problems of reconciling internal data from different firms, even when such data are available. Firms' use of internal transfer pricing and tax havens further complicates evaluations of subsidiary-level financial performance. Second, performance likely depends on mode choice; foreign parents evaluate the available mode choices on a risk-return basis and select the one with the highest expected performance. If this choice is optimal for a given firm *ex ante*, an *ex post* performance comparison among firms suffers from endogeneity issues unless we explicitly consider the choice of operating mode.

Despite such difficulties, several researchers have attempted to evaluate post-entry performance with exit rates, sales growth, or subjective managerial assessments as proxies for subsidiary performance. One such attempt is developed into the joint venture termination literature. Several researchers consider the termination (or more broadly instability) of joint ventures as an indication of failure. According to this view, joint ventures fail because multinational parents may reorient their organizational structure toward greater centralization (Franko, 1971), have difficulty in coordinating parent-joint venture product portfolio due to shared control (Killing, 1983), and be unable to manage cultural differences (Barkema, Bell, and Pennings, 1996). Similarly, several researchers argue that 'initial conditions,' including task definitions, partners' routines, and expectations, may create divergent learning and

[2] In contrast to our focus on the choice of ownership and control, others have studied how joint ventures and wholly owned subsidiaries are set up (i.e., via greenfield investment or acquisition; see Hennart and Park, 1993). When firms seek to exploit their superior organizational and technical expertise, they frequently prefer greenfield entry, which is the most efficient way to transfer these advantages to foreign countries. By way of contrast, a multinational firm will choose to acquire a firm if it is going to acquire complementary inputs that can be purchased more inexpensively as a bundled form in a going concern.

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frustrated expectations (Doz, 1996; Reuer, Zollo, and Singh, 2002). Blodgett (1992) further examines whether uneven ownership structure prompts joint venture instability. Finally, challenging the notion that joint ventures are inherently fragile, Hennart, Kim, and Zeng (1998) find that international joint venture instability might be comparable to that of wholly owned subsidiaries after controlling for age and size.

More recent studies, however, emphasize that joint venture termination should not be interpreted as a failure but as an optimal adjustment in response to changing environmental or firm-specific conditions. According to this view, foreign firms are likely to enter new markets via joint ventures because they confer an option to expand/divest under conditions of uncertainty. As uncertainty resolves, foreign firms can either divest joint ventures by exercising a put option or acquire them by exercising a call option (Kogut, 1991). Reuer (2001) further supports this option view, finding that joint venture buyouts positively impact multinational parents' abnormal stock returns, especially for firms with high R&D intensity.

Another line of work employs simple comparative analyses across different modes of foreign operation. As these works do not consider endogeneity, however, they tend to generate inconsistent results. Mixing the ownership decision, that is, joint ventures vs. wholly owned subsidiaries, with the mode of setting up their subsidiaries, that is, greenfield investment vs. acquisition, further complicates analysis. For instance, using a sample of Japanese firms entering the North American market, Woodcock, Beamish, and Makino (1994) discover that greenfield ventures offer the best performance, followed by joint ventures, and then acquisitions. In a similar empirical study based on data of Japanese foreign investments in the wholesale and retail sector, Anand and Delios (1997) suggest a different order: joint ventures, greenfield ventures, and acquisitions. Also using data on Japanese subsidiaries, Delios and Beamish (2001) find that the host country's experience directly and positively influences a subsidiary's survival, regardless of chosen entry mode. Yet the authors also suggest that host country experience influences subsidiary profitability for joint ventures less than it does for wholly owned subsidiaries, where profitability was subjectively assessed by managers.

Taking on this line of research, Shaver (1998) argues that studies examining the performance implications of mode choice fail to account for endogeneity. To demonstrate the importance of endogeneity, he uses a sample of foreign subsidiaries operating in the United States to determine whether entry mode (acquisition vs. greenfield investment) affects subsidiary performance, as set by the exit rate. Although he demonstrates that greenfield entries survive more often than acquisitions, he also shows that the significance of this effect disappears when he includes self-selection in his model. Brouthers *et al*. (2003) likewise address the endogeneity issue, as they employ the Heckman method. Based on data from large Dutch, German, and British firms entering Central and Eastern European markets via wholly owned subsidiaries or joint ventures, they find that firms using mode choices predicted by transaction cost theory perform significantly better than firms that choose entry modes inconsistent with transaction cost theory.

Economists, on the other hand, address the endogeneity issue more carefully. However, they typically do not distinguish joint ventures from wholly owned subsidiaries. Earlier empirical studies, most of which use cross-sectional and aggregate data, find that foreign subsidiaries are more productive and pay higher wages than domestic firms (Doms and Jensen, 1998; Ries, Globerman, and Vertinsky, 1994). Conyon *et al*. (2002), based on firm-level panel data, find a positive effect of foreign ownership on performance, after controlling for unobserved heterogeneity. More recent works counter these findings, arguing that panel regressions fail to control for all of the unobservable firm characteristics that likely influence subsidiary performance. For example, Girma and Görg (2007) employ the difference-in-differences estimation based on propensity score matching to identify substantial heterogeneity in post-acquisition wages. Similarly, employing the firm-level data from Indonesia and the difference-in-differences estimation with propensity score matching, Arnold and Javorcik (2009) find that foreign-owned plants demonstrate higher total factor productivity and labor productivity than their local counterparts.

To summarize, the management literature on subsidiary-level performance suffers from both a lack of data and measurement problems, while economics research on this topic has not paid due attention to the question of which foreign

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operations mode (e.g., joint ventures vs. wholly owned subsidiaries) generate superior performance. Building on the strengths of the management and economic literatures, this paper attempts to enhance our understanding of the subsidiary-level performance consequences of different modes by employing propensity score matching and the difference-in-differences approach.

Hypotheses

In this study, we examine whether wholly owned subsidiaries perform better than joint ventures in industries characterized by high levels of intangible assets such as technology and brand, as specified in the transaction cost theory. First, as intangible assets such as technology or trademarks are inherently subject to market failure (Arrow, 1974), multinational firms that transfer intangible assets will find it difficult to prevent joint venture partners from leaking knowledge or free riding on their reputation, or to price them due to information asymmetry. Second, joint ventures can also be more costly when there is a high level of 'asset specificity,' which refers to durable investments that cannot be easily redeployed to alternative uses or alternative users without a sacrifice of productive value (Williamson, 1991). High asset specificity may result in self-interested small-number bargaining and invite opportunism (Lin and Png, 2003). Third, most proprietary knowledge is uncodified, making it difficult for foreign parents to transfer it except through close, long-term relationships, which are difficult to set up and maintain in joint ventures.

Furthermore, wholly owned subsidiaries can make decisions more quickly, as they do not need to obtain consent from local partners. In addition, wholly owned subsidiaries can increase control by installing their own control mechanisms, most notably corporate culture and management systems. As industries with a high level of intangible assets frequently face rapid changes in technology and competition, which require quick decision making and implementation, the wholly owned option can be attractive. Consistent with the logic of transaction cost theory, previous studies find that wholly owned subsidiaries are preferred when parent firms' R&D and/or advertising intensities, which proxy for tacit and poorly protected intangible assets, are high (Gatignon and Anderson, 1988). Reuer's (2001) finding that positive abnormal stock returns from joint venture acquisitions for parent firms with high R&D intensity is also in line with the transaction cost logic.

Yet the benefits of joint ventures exist when the market for complementary assets owned by local partners fail. Joint ventures may generate superior performance in conditions where local partners' deep understanding of local markets and access to distribution channels and natural resources cannot be purchased on the market (Madhok, 1997). We thus need to control for a local partner's contribution that can help the performance of a continuing joint venture be superior to that of a converted wholly owned subsidiary.

To summarize, wholly owned subsidiaries perform better than joint ventures due to higher investment in intangible and tangible resources, fast decision making, and better control. Even when local knowledge or resources from local partners are critical, our empirical context provides a conservative test, as we expect wholly owned subsidiaries to outperform joint ventures. This leads us to the following two hypotheses:

Hypothesis 1: Wholly owned subsidiaries perform better than joint ventures in industries with a higher level of R&D intensity.

Hypothesis 2: Wholly owned subsidiaries perform better than joint ventures in industries with a higher level of advertising intensity.

METHODS

Data and sample

This study utilizes the *Annual Industrial Survey Database* (1998–2006) from the Chinese National Bureau of Statistics (NBS). The NBS collects financial information on industrial firms and publishes aggregate information in the official *China Statistics Yearbooks*. All firms in China are required to cooperate with the survey and submit the appropriate financial information. Before 1998, this database did not include information on private firms. In 1998, the NBS expanded its database coverage to all firms with annual sales of at least 5 million RMB (approximately USD 626,000 using the average exchange rate in 2006) in the year prior to the survey, including state-owned enterprises (SOEs), all non-SOE firms, and

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foreign firms. In China, foreign firms are legally defined by a variety of relevant laws. Article 4 of the Joint Ventures Law states that the foreign partner must hold at least 25 percent of the registered capital for equity investment. The database is confirmed accurate and consistent for statistical analysis (Chow, 1993), with several prior studies taking advantage of its data (e.g., Chang and Xu, 2008; Park, Li, and Tse, 2006).

Beginning in 1978, China adopted a 'reform and open-door policy' to move to a market-based economy. With this policy, the Chinese government sought to increase the efficiency of local firms by privatizing and restructuring. It also allowed foreign firms to enter the market, beginning with the establishment of four special economic zones in 1980. In the early stages of this 'open-door' policy, foreign firms were required to form joint ventures with domestic firms in order to enter China. The Chinese government often designated local partners and dictated the exact terms for the initial contract (Puck, Holtbrügge, and Mohr, 2009). With China's accession to the WTO in 2001, however, this requirement was relaxed, as foreign firms were allowed to maintain full ownership and acquire local firms in most 'non-strategic industries.' As a consequence, foreign direct investment inflow via wholly owned subsidiaries increased dramatically, while many joint ventures converted to wholly owned subsidiaries.

We constrict our attention to joint ventures at the time they first appear in our dataset. We define a firm as a joint venture when the foreign partner holds between 25 percent and 95 percent of the venture's equity. We define a firm in which the foreign partner owns more than 95 percent of the venture's equity as a wholly owned subsidiary. Joint ventures can be further subdivided into majority joint ventures (where the foreign partner owns more than 50% of the equity) and minority joint ventures (where the foreign partner owns between 25% and 50% of the equity).[3] In our sample period, the number of foreign firms (i.e., the sum of minority and majority joint ventures and wholly owned subsidiaries) grew from 24,168 in 1998 to 55,819 in 2006 (see Figure 1a). Among

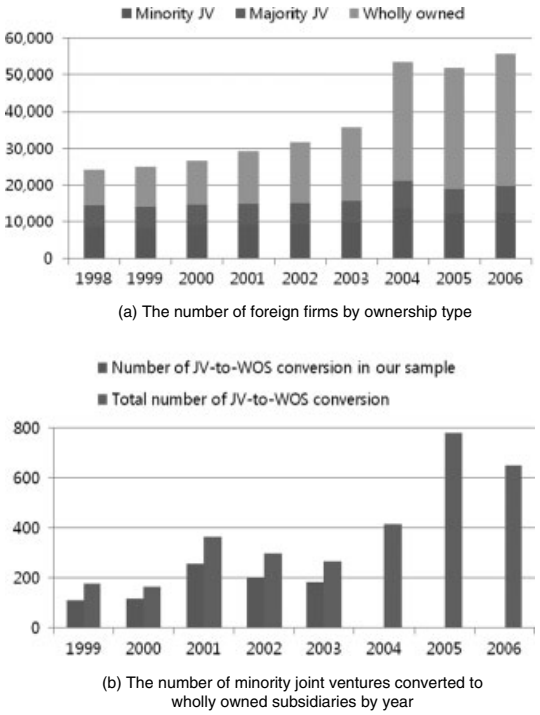

Figure 1. Ownership structure of foreign firms in China during 1998–2006

foreign firms, the fraction of wholly owned subsidiaries increased from 40.3 percent in 1998 to 64.9 percent in 2006.

We focus on minority joint ventures in order to maximize the contrast between before and after the conversion from joint ventures to wholly owned subsidiaries. We identify 31,435 minority joint ventures that appear during our sample period. Of these, 2,991 converted to wholly owned subsidiaries and 28,444 remained joint ventures, either until they disappeared from the database or until 2006, the end of our period of analysis. The number of conversions from minority joint ventures to wholly owned subsidiaries also grew, increasing from 177 cases in 1999 to 649 cases in 2006 (see Figure 1b).

Because we measure changes in performance from year t through year t+3 and because we include lagged explanatory variables when we calculate the propensity score, we restrict our sample to firms for which we have at least five consecutive years of observations, from year t−1 through year t+3, where the firm converted to a wholly owned subsidiary in year t. Among the 19,557 minority joint ventures lasting for at least five consecutive years, 840 firms converted to wholly owned

[3] Gatignon and Anderson (1988) use these criteria to distinguish among minority and majority joint ventures and wholly owned subsidiaries. We include 50 : 50 joint ventures in the category of minority joint venture.

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subsidiaries (see the distribution by the year of conversion in Figure 1b), which is 4.30 percent of all observations in our sample. As we require data for up to three years after conversion given the parameters outlined above, we consider only the cases in which conversion occurred by 2003. We match each of these firms with the most similar minority joint venture that did not convert throughout the sample period within the three-digit Standard Industrial Classification (SIC) code industry and same year.

Variables

We use return on assets (ROA), the most common measure of profitability, as our measure of financial performance. ROA is defined as net income divided by total assets. In order to address the concern that ROA may be sensitive to financial leverage or nonoperating income, for example, asset sales and tax payments, we also use operating return on assets (Operating ROA), which is defined as operating income divided by total assets. It is important to note that financial performance indicators based on subsidiary-level accounting data are susceptible to potential biases from transfer pricing, scope economies, and cross-selling. As far as transfer pricing is concerned, our research design poses a conservative test against any downward bias, as we expect higher profitability improvement in joint venture turned wholly owned subsidiaries than in continuing joint ventures. It is usually harder to repatriate profits via transfer pricing schemes in joint ventures compared to wholly owned subsidiaries, as joint venture partners can monitor multinational partners' transfer pricing schemes.[4] Because our analysis is limited to three years after conversion, we assume that scope economies and cross-selling practices do not change in this time frame. In fact, there is little change in export ratio after the conversion.

We include several firm indicators to predict ownership conversion. To control for any size-related factors leading to conversion, we measure *firm size* using the logarithm of assets (Hennart *et al*., 1998). We operationalize *firm age* as the calendar year since a firm's establishment. We include firm age in order to control for the local knowledge or resources gained from a firm's joint venture experiences, as well as to match converted wholly owned subsidiaries and continuing joint ventures with comparable joint venture experiences (Hennart, 1991). *Leverage* is defined as total debt divided by total assets. We measure *export ratio* as export sales divided by total sales, which reflects a firm's export orientation. In calculating the propensity score, we include ROA, leverage, and export ratio of a joint venture at one year prior to its conversion to control for any real option values (Kogut, 1991; Kogut and Chang, 1996). For instance, a multinational parent will be more likely to acquire a joint venture with higher profitability, a sound balance sheet, and export platform.

Intangible assets ratio measures the relative importance of a firm's intangible assets, defined as intangible assets divided by total assets. We believe that the intangible assets item in a foreign subsidiary's balance sheet is a key indicator of the transfer of intangible assets from multinational parents to foreign subsidiaries. R&D or advertising-related activities carried out in individual foreign subsidiaries would be regarded as current expenditures in subsidiaries' income statements, but technology, brands, and trademarks that are developed by multinational parents elsewhere and then transferred to their foreign subsidiaries are usually treated as investments in intangible assets that can be amortized over several years (Kieso, Weygandt, and Warfield, 2010; Chap. 12). *Fixed assets ratio*, defined as fixed assets divided by total assets, indicates the firm's capital intensity. We attend to foreign subsidiaries' fixed assets, as technology transfer often occurs in the form of more sophisticated machinery or equipment, which will show up as an increase in fixed assets. These intangible and fixed assets are important considerations for joint venture conversion decisions. They also serve as key strategic indicators to observe changes after the conversion.

The *Annual Industrial Survey Database* does not contain any information about individual firms' ultimate parents. In order to capture the characteristics of foreign parents and local joint venture partners, we look to the ownership structures of the joint ventures. Building from prior works that highlight the importance of initial conditions underlying the stability of joint ventures (Barkema *et al*., 1996; Blodgett, 1992; Dhanaraj

[4] While it is also possible to have the upward bias in performances of wholly owned subsidiaries via transfer pricing (i.e., multinationals use transfer pricing to shift profits from multinational headquarter to their Chinese subsidiaries), it is unlikely given the high corporate tax rates and regulations on profit repatriation in China.

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and Beamish, 2004; Doz, 1996), we categorize both multinational and local parents in our sample into two types of firms that likely have different initial conditions such as routines, interfaces, and expectations toward joint ventures. *Conventional local parent* refers to joint ventures in which local parent firms are conventional local firms such as state-owned enterprises or collectives, as opposed to modernized local firms like private enterprises or incorporated firms. This variable is coded as 1 if the ownership shares held by central or provincial governments and collectives are greater than those held by private individuals and incorporated firms, including shareholding firms or limited liability firms, and 0 otherwise. *HMT foreign parent* captures the differences in two types of foreign parents, that is, ethnic Chinese investors from Hong Kong, Macao, and Taiwan (HMT) and nonethnic Chinese foreign multinational parents. This variable is coded as 1 if the ownership shares held by ethnic Chinese investors are greater than those held by nonethnic Chinese foreign investors, and 0 otherwise. Finally, we control for the level of foreign ownership by including *foreign share*, which is the percentage share held by foreign parents, and its squared term. We expect that the likelihood of conversion to a wholly owned subsidiary will have an inverted U-shaped relationship with the level of foreign ownership, as a higher level of foreign ownership would obviate the need for conversion, while a lower level of foreign ownership would make conversion more challenging.

We also use the U.S. industry-level average R&D and advertising intensities for each three-digit SIC industry code (from Compustat data from 1998 to 2006) in order to create subsamples of relatively high/low levels of intangible assets like technology or brand. Our primary reason for using U.S. firms' R&D and advertising intensities is to classify industries with exogenous information unaffected by the sample firms' strategic R&D and advertising investment decisions, analogous to Rajan and Zingales (1998). We use the median points within our sample, that is, 1.19 percent for R&D intensity and 2.15 percent for advertising intensity. Thus, by design, we create two subsamples with roughly equal numbers of firms that are *relatively* higher or lower in the technological assets (or marketing know-how) to observe differential impact on performance associated with conversion.

Finally, we lag all explanatory variables by one year in order to help clarify causal relationships. In dealing with outliers, we delete observations with extreme ROA values, namely, those firms with an ROA greater than 100 percent or less than −50 percent. Table 1 provides the descriptive statistics and pairwise correlations for the variables used in our analysis.

Propensity score matching method and difference-in-differences approach

A key challenge in comparing the performance of joint ventures and wholly owned subsidiaries is that the choice of operating mode is endogenous (Shaver, 1998). Simple comparisons of performance between joint ventures and wholly owned subsidiaries are problematic because inherently better firms may have chosen a particular operating mode, thereby making it difficult to conclude that the performance difference is, in fact, caused by the choice of operating mode. The central question thus becomes how to construct more reliable comparison groups between joint ventures and wholly owned subsidiaries. We address this issue by using the propensity score matching methodology (Arnold and Javorcik, 2009; Imbens and Wooldridge, 2009; Rosenbaum and Rubin, 1983).

In propensity score matching, the treatment and control groups are constructed based on a scalar 'similarity' measure calculated from many different observable firm characteristics. According to Rosenbaum and Rubin (1983: 41), '[t]he propensity score is the conditional probability of assignment to a particular treatment given a vector of observed covariates. Both large and small sample theory show that adjustment for the scalar propensity score is sufficient to remove bias due to all observed covariates.' The propensity score is calculated as the predicted probability of treatment using the following probit estimation:

$$
\begin{aligned}
y_{it}^{*} &= X_{i,t-1}\beta + \varepsilon_{it},\ y_{it} = I(y_{it}^{*} > 0) \\
\Pr(y_{it} = 1 | X_{i,t-1}) &= \Pr(y_{it}^{*} > 0 | X_{i,t-1}) \\
&= \Pr(\varepsilon_{it} > -X_{i,t-1}\beta | X_{i,t-1}) \\
&= 1 - \Phi(-X_{i,t-1}\beta) = \Phi(X_{i,t-1}\beta)
\end{aligned}
$$

where y_{it}^{*} denotes the unobserved likelihood for treatment conditional on observable characteristics, $X_{i,t-1}$; y_{it} is a latent dummy variable that

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Table 1. Summary statistics and correlations

	Variables	Mean	S. D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Conversion (t) (%)	4.30	20.28	1.00												
2	Firm size (t−1)	10.26	1.34	−0.04*	1.00											
3	Firm age (t−1)	8.07	8.06	−0.04*	0.24*	1.00										
4	ROA (t−1) (%)	5.31	10.09	−0.03*	−0.03*	−0.04*	1.00									
5	Leverage (t−1) (%)	56.95	25.16	0.00	0.00	0.04*	−0.33*	1.00								
6	Export ratio (t−1) (%)	36.47	42.35	0.05*	−0.22*	−0.04*	0.00	0.08*	1.00							
7	Intangible assets ratio (t−1) (%)	1.98	4.24	0.01	0.11*	−0.02*	−0.06*	−0.10*	−0.07*	1.00						
8	Fixed assets ratio (t−1) (%)	32.15	18.48	0.00	0.17*	−0.02*	−0.13*	−0.19*	−0.10*	0.08*	1.00					
9	Conventional local parent (t−1)	0.42	0.49	−0.05*	0.08*	0.15*	−0.06*	0.01	−0.07*	−0.03*	0.04*	1.00				
10	HMT foreign parent (t−1)	0.51	0.50	0.04*	−0.02*	0.01	−0.07*	0.06*	−0.03*	−0.05*	0.00	0.01	1.00			
11	Foreign share (t−1) (%)	37.43	15.59	0.01	−0.02*	−0.05*	0.00	−0.07*	0.07*	−0.01	0.00	−0.09*	−0.01	1.00		
12	Industry R&D intensity (%)	3.58	8.50	−0.02*	0.06*	0.03*	0.06*	−0.05*	−0.10*	−0.01*	0.00	−0.01	0.03*	−0.01	1.00	
13	Industry Adv. Intensity (%)	3.29	6.11	0.00	−0.01	0.02*	0.03*	−0.04*	0.00	−0.02*	0.03*	−0.03*	0.04*	0.00	0.80*	1.00
14	Operating ROA (t−1) (%)	5.33	10.15	−0.01*	−0.05*	−0.05*	0.64*	−0.22*	0.01	−0.05*	−0.08*	−0.07*	−0.09*	0.01	0.04*	0.02*

[Note] N=19,557; * indicates that the correlation coefficient is statistically significant at the 5% level.

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equals 1 if treatment occurs at time t, and 0 otherwise; ε_{it} is the error term, which is assumed to be normally distributed; and $\Phi(\bullet)$ is the cumulative normal distribution function, which ranges from 0 to 1 and is symmetric around the midpoint of the distribution. In our study, the treatment group consists of joint ventures converted into wholly owned subsidiaries and the control group refers to the continuing joint ventures.

In order to calculate the propensity score, we draw on the joint venture termination literature to control for various 'known' factors for conversion. First, parent firm type and foreign firm share reflect the 'initial conditions' and cultural difference that may affect the stability of joint ventures (Barkema *et al*., 1996; Blodgett, 1992; Dhanaraj and Beamish, 2004; Doz, 1996). Second, we include profitability, as well as export and leverage ratios to explain the real-option related motivations for conversion (Kogut, 1991; Reuer and Tong, 2005), as multinational firms are more likely to acquire joint ventures with high profitability, sound balance sheets, and export platforms. Third, we include firm age to control for the number of years partners learn from each other. Fourth, intangible and tangible asset ratios capture asset specificity that may favor internalization (Hennart, 1982). Lastly, we include industry, region, and year fixed effects to control for their respective shocks.

Yet the explanatory variables included in our probit model may not capture every factor affecting the conversion decision. For instance, profitability and leverage and export ratios may not fully indicate the option value of a joint venture. Similarly, firm age may be an imperfect measure for the differential learning among partners. Some multinational parents may simply favor wholly owned subsidiaries due to their organizational change toward more centralization or changes in their business portfolios (Franko, 1971; Killing, 1983). There are also some unknown rational reasons. For example, even though multinational parents with high R&D/advertising intensity seek to convert joint ventures to wholly owned subsidiaries, the negotiation may stalemate if they have difficulty finding local managers to oversee operations or if local partners demand an exorbitant price in return for a breakup. Sometimes, the conversion decision can be driven by irrational factors. For instance, some joint ventures, particularly those in industries with low intensity in R&D and advertising, may favor conversion out of imitative or herd behavior, despite no clear benefits (DiMaggio and Powell, 1983; Yiu and Makino, 2002). Other joint ventures, on the other hand, may not convert despite being natural cases for conversion, for example, those in industries with high R&D and advertising. The propensity score matching method assumes that the treatment of ownership conversion is exogenous given the propensity score that is conditional upon observable firm characteristics. In other words, unknown rational or irrational factors are commonly held by all firms and are treated as the error term in the probit model.

With the propensity score calculated from the probit model, we match converted, wholly owned subsidiaries with continuing joint ventures within the three-digit SIC industry code and within the same year using the STATA command psmatch2 (Leuven and Sianesi, 2003). It is also critical to assess how well the propensity score matching procedure created the comparable samples between the treatment and control groups (Dehejia and Wahba, 2002; Smith and Todd, 2005). We perform several widely used 'balancing tests' to ensure that firms in the treatment and control groups are not statistically different from each other prior to the treatment (i.e., conversion to wholly owned subsidiaries).[5]

After constructing the treatment and the control groups using the propensity score matching technique and confirming that these two groups are indeed comparable using various balancing tests, we employ the difference-in-differences method to compare the performance of joint ventures turned wholly owned subsidiaries (i.e., the treatment group) to the remaining joint ventures (i.e., the control group). Our adoption of the difference-in-differences approach exploits the panel nature of our dataset and eliminates the effect of unobservable nonrandom elements of the conversion

[5] First, we compare the sample means of all variables included in the matching procedures by performing individual t-tests. Second, we regress each variable k included in the propensity score regression on the quartic function of the propensity score of firm i in year t, and its interactions with the treatment variable. We then use the F-test with the null hypothesis that these interaction terms are jointly insignificant, as the treatment dummy should not provide any further information about the explained variable if the propensity score satisfies the balancing condition. Third, we perform a Hotelling T^2 test on a joint null hypothesis that the means of all the variables included in the propensity score calculation are equal. These balancing tests suggest that the treatment and control groups are comparable one year prior to the conversion. Results are available upon request.

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decision on performance, which is common to the treatment group and the control group. In doing so, we compare the differences in within-firm performance differences prior to and after treatment (i.e., conversion to a wholly owned subsidiary) between the treatment group and the control group. This design has an advantage over the simple cross-sectional regression approach because the effects of within-firm unobservable characteristics are neutralized by our estimations.

Why do we focus on the *conversion* of joint ventures, even though we are fundamentally interested in understanding the performance implications for joint ventures vis-à-vis wholly owned subsidiaries? Let us consider the performance function of a subsidiary i at time t, y_{it}, which is conditional on m_{it}, the mode choice of subsidiary i at time t where m_{it} is J (joint venture) or W (wholly owned subsidiary), and conditional on $X_{i,t-1}$, a vector of observable firm characteristics that also determines m_{it}. Previous studies using a simple comparative analysis without accounting for the endogeneity problem measured:

$$\Delta = \mathrm{E}[y_{it}|m_{it}(X_{i,t-1}) = W, X_{i,t-1}] - \mathrm{E}[y_{jt}|m_{jt}(X_{j,t-1}) = J, X_{j,t-1}]. \quad (1)$$

This approach does not account for the fact that mode choice m_{it} is conditional upon the observed firm characteristics, $X_{i,t-1}$. This oversight is problematic; even though the model identifies a positive difference in performance using Equation (1), this difference might be due to the fact that more competent firms chose to operate as wholly owned subsidiaries, not because the wholly owned subsidiary mode is the cause of superior performance. Such endogeneity would prevent us from concluding that the wholly owned subsidiary mode is fundamentally better than the joint venture mode, even though we obtained a positive and significant difference in performance, Δ.

The ideal way to identify comparative performance would be to measure the performance difference of the same firm with different mode choices, as in Equation (2):

$$\Delta^* = \mathrm{E}[y_{it}|m_{it}(X_{i,t-1}) = W, X_{i,t-1}] - \mathrm{E}[y_{it}|m_{it}(X_{i,t-1}) = J, X_{i,t-1}]. \quad (2)$$

Yet we cannot observe the counterfactual performance for the operating mode that a firm did not choose.

The propensity score matching technique provides a way to create counterfactual performance for the purpose of comparison. In order to control for endogeneity, this technique focuses on subsidiaries that converted from joint ventures to wholly owned subsidiaries at time t. We focus on the converted wholly owned subsidiary and compare its performance to that of a remaining joint venture that did not change its operating mode, even though its *ex ante* likelihood of conversion (i.e., propensity score) is almost identical to that of the converted subsidiary. Specifically, we can find a set of counterexample firms j such that $|P_c(X_{i,t-1}) - P_c(X_{j,t-1})| < \varepsilon$, where $P_c(X_{i,t-1})$ is the probability of conversion for firm i, and ε is a small positive number. As such, we measure the following difference, which we refer to the average treatment effect on the treated (ATT):

$$\Delta_{ATT} = \mathrm{E}[y_{it}|m_{it}(X_{i,t-1}) = W, X_{i,t-1}] - \mathrm{E}[y_{jt}|m_{jt}(X_{j,t-1}) = J, X_{j,t-1}] \quad \text{where } P_c(X_{i,t-1}) \approx P_c(X_{j,t-1}). \quad (3)$$

This comparison between Equations (1) and (3) highlights that our new empirical strategy allows us to focus on a restricted group of wholly owned subsidiaries (which converted at time t) and a restricted comparison group of joint ventures (which *ex ante* had a similar predicted probability of conversion) in order to control for the endogeneity problem inherent to the choice of foreign mode of operation. To be more specific, ATT is calculated using the formula below, where subscript k represents one, two, or three years since conversion, similar to Arnold and Javorcik (2009):

$$ATT_k = \frac{1}{n}\sum(ROA_{t+k}^{treated} - ROA_{t+k}^{control}) - \frac{1}{n}\sum(ROA_t^{treated} - ROA_t^{control}).$$

The corresponding standard errors are calculated using the following method with STATA's psmatch2 command, where n is the number of matches (Leuven and Sianesi, 2003):

$$SE_k = \sqrt{\frac{1}{n}Var(ROA_{t+k} - ROA_t|treatment = 1) + \frac{1}{n}Var(ROA_{t+k} - ROA_t|control = 1)}.$$

Table 2. Probit models of conversion decision from joint ventures to wholly owned subsidiaries

Dep. variable: JV to WOS conversion	(1) All firms	(2) High R&D	(3) Low R&D	(4) High adv.	(5) Low adv.
Firm size (t−1)	−0.07***	−0.09***	−0.06**	−0.07***	−0.07***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
Firm age (t−1)	−0.02***	−0.01***	−0.02***	−0.02***	−0.01**
	(4.0×10^{-3})	(5.0×10^{-3})	(6.0×10^{-3})	(6.0×10^{-3})	(5.0×10^{-3})
ROA (t−1)	-4.5×10^{-3}**	-5.1×10^{-3}*	-4.3×10^{-3}	-9.8×10^{-3}***	0.3×10^{-3}
	(2.0×10^{-3})	(3.0×10^{-3})	(3.0×10^{-3})	(3.0×10^{-3})	(3.0×10^{-3})
Leverage (t−1)	0.5×10^{-3}	1.1×10^{-3}	-0.4×10^{-3}	-1.9×10^{-3}	2.6×10^{-3}**
	(1.0×10^{-3})	(1.0×10^{-3})	(1.0×10^{-3})	(1.0×10^{-3})	(1.0×10^{-3})
Export ratio (t−1)	0.08*	0.13*	0.06	0.01	0.17**
	(0.05)	(0.07)	(0.07)	(0.07)	(0.07)
Intangible assets ratio (t−1)	6.0×10^{-3}	1.2×10^{-2}**	-1.3×10^{-3}	3.0×10^{-3}	7.2×10^{-3}
	(4.0×10^{-3})	(6.0×10^{-3})	(6.0×10^{-3})	(6.0×10^{-3})	(5.0×10^{-3})
Fixed assets ratio (t−1)	2.7×10^{-3}**	3.2×10^{-3}**	2.5×10^{-3}*	2.8×10^{-3}*	2.5×10^{-3}
	(1.0×10^{-3})	(1.6×10^{-3})	(1.4×10^{-3})	(1.8×10^{-3})	(2.0×10^{-3})
Conventional local parent (t−1)	−0.20***	−0.23***	−0.18***	−0.21***	−0.19***
	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)
HMT foreign parent (t−1)	0.04	0.02	0.04	0.09*	−0.02
	(0.04)	(0.06)	(0.05)	(0.06)	(0.05)
Foreign share (t−1)	13.28***	12.94***	14.26***	16.76***	10.70***
	(1.78)	(2.62)	(2.50)	(2.80)	(2.23)
Foreign share squared (t−1)	−15.80***	−15.79***	−16.68***	−20.27***	−12.42***
	(2.33)	(3.47)	(3.25)	(3.69)	(2.90)
Industry fixed effects	Included	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included	Included
Region fixed effects	Included	Included	Included	Included	Included
Pseudo-R^2	0.14	0.14	0.15	0.18	0.11
Chi-squared	953.37***	446.40***	538.85***	619.31***	376.14***
(p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	19,557	9,195	9,603	8,757	10,262

[Note] Standard errors in parentheses; *,**,*** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

A simple t-test is then employed to confirm whether the accumulated difference between these two groups is significant. As we expect that the gains from conversion will be greater for firms in industries characterized by a high level of intangible assets as predicted by the transaction cost theory, we contrast the difference in two subgroups that are *relatively* high or low in intangible assets.

RESULTS

Operating mode choice and performance

Table 2 displays our probit regression results for the conversion decision from joint venture to wholly owned subsidiary. All regressions control for industry, year, and region fixed effects. The first column reports the coefficients from the regression using the full sample; the remaining four columns report coefficients from subsamples of high/low R&D and advertising-intensive industries. We conduct matching separately for each subsample of industries with high/low R&D or advertising intensity.[6] Despite being estimated with different subsamples, these regressions demonstrate generally consistent results.

Joint ventures with more assets are less likely to be converted, as the foreign partner requires more capital to buy out the local partner. Older joint ventures are less likely to be converted, contrary to the expectation of the learning perspective (Hennart, 2009). Joint ventures that are more profitable are less likely to be converted in the whole sample and in the subsample of high advertising intensity, as local joint venture partners are less willing to part with profitable joint ventures, as predicted by the

[6] As we conduct matching for each subsample, the number of observations in high and low R&D/advertising-intensive industries does not necessarily add up to that in the whole sample.

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real option perspective (Kogut, 1991). Leverage influences the conversion decision negatively only in the case of low advertising industries. Export ratio is positively associated with the likelihood of conversion in the whole sample, as well as the high R&D and low advertising-intensive industry samples, reflecting the real option value of export platform (Kogut and Chang, 1996). Ratios of intangible assets to total assets are positively associated with the likelihood of conversion in the high R&D-intensive industry, in line with the prediction of the transaction cost theory (Hennart, 1982). This thereby suggests that the higher the portion of intangible assets, the more likely it is that a venture in a high R&D-intensive industry will convert. The ratios of fixed assets to total assets have a significantly positive association with the likelihood of conversion in all samples except for the low advertising-intensive industry subsample, thereby suggesting that firms that require a high fixed asset investment are more likely to be converted to wholly owned subsidiaries.

Among the parent type variables, which reflect various 'initial conditions' and the cultural distances that affect the joint venture stability/termination, joint ventures with conventional local firms are less likely to convert, as the foreign partner finds it harder to sever its relationship with state-owned enterprises or collectives than when local partners are private firms or incorporated firms. On the other hand, the type of foreign parents—HMT firms or nonethnic-Chinese firms—does not seem to have much influence on the conversion decision. The foreign share variable is significant and positive, while its squared term is significant and negative, suggesting that, as predicted, the relationship between the level of foreign ownership and the likelihood of conversion is an inverted U shape. This result may be due to the fact that the likelihood of converting increases when foreign investors have higher shares but decreases after a certain level since the additional benefit of converting may be smaller for joint ventures in which foreign investors already have relatively large shares.

Table 3a shows the value of ROA for both the converted and the remaining joint ventures over time, with the matching performed within the three-digit SIC industry code and within the same year. This procedure generates matching for 799 out of 840 converted wholly owned subsidiaries with the same number of continuing joint ventures from the full sample of 19,557 minority joint ventures that remained in our database for at least five years. The median matching distance is 0.0025. Table 3a shows the results from the difference-in-differences estimation, which denotes the differences in the performance measure estimates for the 799 converted wholly owned subsidiaries relative to the performance for their counterparts in the control group. The ATT measures the difference in cumulative changes in ROA since the year of conversion (at time t) between the two groups. The results demonstrate that, for each of the first three years after conversion, converted wholly owned subsidiaries, on average, have 1.12, 1.21, and 1.55 percentage points greater increase in ROA than firms that remained joint ventures with similar observed characteristics. These estimates are significant at the five percent level. Such superior performance of converted wholly owned subsidiaries over continuing joint ventures seems jointly conditioned by improved performance of the former and declining performance of the latter. While converted wholly owned subsidiaries might have improved or maintained their profitability faced with intensifying competition in China during our study time period, continuing joint ventures might not have been able to do so.

Table 3a also displays the performance differences between the converted wholly owned subsidiaries and continuing joint ventures in subsamples of high/low R&D- and advertising-intensive industries in an analogous way to De Loecker (2007), Girma and Görg (2007), and MacGarvie (2006), who presented separate results between two subgroups. The difference in ROA increase of the converted wholly owned subsidiaries compared to continuing joint ventures in high R&D-intensive industries is 1.49 percentage points in the first year after conversion, 1.60 percentage points in the second year, and 1.76 percentage points in the third. These differences are statistically significant at the five percent level. In contrast, there are no significant differences in ROA between these two groups for firms in low R&D-intensive industries. ROA for converted wholly owned subsidiaries relative to continuing joint ventures in high advertising-intensive industries is 2.36 percentage points greater in the first year after conversion, which is significant at the one percent level. In the second year, this difference is 1.84 percentage points, and it is 2.08 percentage points in the third year. These estimates

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Table 3. Financial performance of joint ventures turned wholly owned subsidiaries vs. continuing joint ventures

a) ROA (%) over time

Whole sample					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	4.20	4.86	5.73	5.49	5.31
JV	4.24	4.92	4.67	4.34	3.82
ATT			1.12**	1.21**	1.55**
S.E.			0.51	0.61	0.68
# Matches	799	799	799	799	799

High R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	3.96	4.43	5.65	5.63	4.92
JV	4.44	4.68	4.40	4.27	3.41
ATT			1.49**	1.60**	1.76**
S.E.			0.75	0.77	0.89
# Matches	388	388	388	388	388

Low R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	4.43	5.21	5.68	5.28	5.55
JV	4.91	5.05	5.08	4.32	4.00
ATT			0.44	0.80	1.39
S.E.			0.75	0.96	0.97
# Matches	410	410	410	410	410

High advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	3.44	4.08	5.63	5.37	5.11
JV	3.41	4.60	3.79	4.05	3.54
ATT			2.36***	1.84**	2.08**
S.E.			0.71	0.85	0.93
# Matches	414	414	414	414	414

Low advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	5.16	5.54	5.78	5.45	5.54
JV	5.39	5.77	5.15	4.56	4.94
ATT			0.86	1.12	0.83
S.E.			0.66	0.78	0.88
# Matches	386	386	386	386	386

b) Operating ROA (%) over time

Whole sample					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	4.38	4.82	5.57	5.57	5.56
JV	3.99	4.74	4.49	4.07	4.05
ATT			1.00*	1.41**	1.43*
S.E.			0.54	0.63	0.73
# Matches	799	799	799	799	799

High R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	4.05	4.49	5.54	5.55	5.16
JV	4.17	4.46	4.10	3.79	3.82
ATT			1.40*	1.73**	1.31
S.E.			0.78	0.80	0.94
# Matches	388	388	388	388	388

Low R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	4.71	5.08	5.47	5.47	5.82
JV	4.61	5.35	5.15	4.48	4.43
ATT			0.59	1.26	1.65
S.E.			0.86	1.06	1.15
# Matches	410	410	410	410	410

High advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	3.69	4.16	5.57	5.31	5.59
JV	3.36	4.19	3.79	3.68	3.48
ATT			1.80**	1.66*	2.13**
S.E.			0.84	0.87	0.97
# Matches	414	414	414	414	414

Low advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	5.30	5.37	5.50	5.76	5.68
JV	5.12	5.47	5.07	4.39	5.44
ATT			0.52	1.46*	0.33
S.E.			0.66	0.84	0.96
# Matches	386	386	386	386	386

[Note] *,**,*** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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are significant at the five percent level. In low advertising-intensive industries, however, the differences in ROA are insignificant. These results confirm Hypotheses 1 and 2, which predict that the performance-enhancing effects of wholly owned subsidiaries are stronger in industries characterized by higher R&D and advertising intensity; they are also consistent with transaction cost theory. As illustrated by Table 3a, we do not find any significant results in industries with low R&D and advertising intensity.

In Table 3b, we use Operating ROA as an alternative performance measure. For each of the first three years after conversion, converted wholly owned subsidiaries, have, on average, 1.00, 1.41, and 1.43 percentage points greater increase in Operating ROA than firms that remained joint ventures with similar observed characteristics. These estimates are significant at the 10 percent, five percent, and 10 percent level, respectively. Similar to difference in ROA, the difference in Operating ROA increase between converted wholly owned subsidiaries relative to continuing joint ventures is more pronounced in high R&D- or advertising-intensive industries. These results confirm that our findings are robust over different choices of financial performance variables.

Potential sources of performance improvement

In order to identify potential sources for performance improvement, Tables 4a–4c show the changes of key strategic indicators for continuing joint ventures and converted wholly owned subsidiaries. We trace sales, intangible assets, and fixed assets that are salient in explaining the performance differences between converted wholly owned subsidiaries and continuing joint ventures over time. We use the natural logarithm of sales, intangible assets, and fixed assets since the differences in the natural logarithm of these variables can be interpreted as percentage changes over time.[7] The results suggest that the converted wholly owned subsidiaries show substantial increases in sales and intangible assets, when compared to continuing joint ventures.

Table 4a displays the results for the natural logarithm of sales over time. In the first and second year after conversion, there is a five percentage point and a six percentage point difference in sales growth rate, which is significant at the 10 percent level. These differences are greater in high R&D-intensive industries than in low R&D-intensive industries. These differences are also greater in high advertising-intensive industries than in low advertising-intensive industries, but the estimates in high advertising-intensive industries are not statistically significant.

We expected that foreign parents would bring more sophisticated technology or brands to their converted wholly owned subsidiaries. If a technology transfer or new brand introduction is associated with conversion, there should be an increase in subsidiary-level intangible assets in the balance sheet. Table 4b examines the natural logarithm of intangible assets over time, which captures new transfers of technology or brand from foreign parents to local subsidiaries. By the second year after conversion, there is a 38 percentage point difference in intangible asset growth rate, which is significant at the five percent level. This difference grows to 52 percentage points in the third year after conversion, which is significant at the one percent level. The different growth rates for these two groups is more pronounced in high advertising-intensive industries than in low advertising-intensive industries, and also in high R&D-intensive industries compared to low R&D-intensive industries. The fact that the increase of intangible assets is more pronounced in high R&D- and advertising-intensive industries is consistent with our expectation that conversions improve performance by allowing multinational parents to bring more intangible assets to their now wholly owned subsidiaries. In low R&D- or advertising-intensive industries, we find no significant differences between converted subsidiaries and continuing joint ventures.

Table 4c examines the natural logarithm of fixed assets, which captures new investment in physical capital, for example, the transfer of technology that is embedded in sophisticated machinery or equipment, especially in technology-intensive industries. By the third year after conversion, there is a 10 percentage point difference, which is significant at the five percent level. The net increase in fixed assets is more pronounced in high R&D-intensive industries than in low R&D-intensive industries, in line with our expectation. However, we also find that the asset growth is slightly more pronounced in

[7] Let r_t be the rate of change in x_t over time, then: $\ln x_t - \ln x_{t-1} = \ln\left(\frac{x_t}{x_{t-1}}\right) = \ln(1 + r_t) \approx r_t$, when r_t is small (typically, less than 0.2) as in most of our cases.

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Table 4. Changes in key strategic indicators

a) Log sales over time

Whole sample						High R&D intensity industries						Low R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	10.13	10.24	10.37	10.48	10.52	JV-to-WOS	10.12	10.27	10.38	10.52	10.59	JV-to-WOS	10.11	10.22	10.34	10.41	10.44
JV	10.12	10.21	10.29	10.38	10.42	JV	10.14	10.25	10.33	10.41	10.47	JV	9.98	10.06	10.14	10.20	10.23
ATT			0.05*	0.06*	0.06	ATT			0.03	0.10**	0.10*	ATT			0.04	0.06	0.05
S.E.			0.03	0.03	0.05	S.E.			0.03	0.05	0.06	S.E.			0.04	0.06	0.08
# Matches	799	799	799	799	799	# Matches	388	388	388	388	388	# Matches	410	410	410	410	410

High advertising intensity industries						Low advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	10.06	10.18	10.29	10.40	10.45	JV-to-WOS	10.22	10.33	10.44	10.55	10.59
JV	10.05	10.14	10.23	10.30	10.33	JV	10.14	10.26	10.36	10.44	10.52
ATT			0.03	0.06	0.08	ATT			0.02	0.05	0.01
S.E.			0.04	0.05	0.07	S.E.			0.03	0.05	0.06
# Matches	414	414	414	414	414	# Matches	386	386	386	386	386

b) Log intangible assets over time

Whole sample						High R&D intensity industries						Low R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	2.57	2.55	2.90	3.09	3.10	JV-to-WOS	2.78	2.75	3.12	3.19	3.31	JV-to-WOS	1.99	2.08	2.09	2.10	2.10
JV	2.78	3.01	3.15	3.16	3.04	JV	2.57	2.64	2.64	2.90	2.84	JV	1.66	2.25	2.26	2.27	2.28
ATT			0.20	0.38**	0.52***	ATT			0.38**	0.18	0.37	ATT			−0.01	0.00	−0.01
S.E.			0.14	0.16	0.19	S.E.			0.19	0.23	0.25	S.E.			0.01	0.01	0.01
# Matches	799	799	799	799	799	# Matches	388	388	388	388	388	# Matches	410	410	410	410	410

High advertising intensity industries						Low advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	2.38	2.34	2.77	2.96	2.97	JV-to-WOS	2.86	2.87	3.04	3.28	3.28
JV	2.44	2.72	2.78	2.93	2.86	JV	3.11	3.21	3.34	3.38	3.34
ATT			0.36**	0.41*	0.49**	ATT			0.05	0.24	0.28
S.E.			0.18	0.22	0.24	S.E.			0.19	0.21	0.25
# Matches	414	414	414	414	414	# Matches	386	386	386	386	386

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Table 4. (*Continued*)
c) Log fixed assets over time

Whole sample						High R&D intensity industries						Low R&D intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	8.60	8.70	8.67	8.73	8.76	JV-to-WOS	8.71	8.85	8.92	9.01	9.00	JV-to-WOS	8.49	8.57	8.61	8.66	8.73
JV	8.66	8.71	8.70	8.72	8.72	JV	8.76	8.84	8.85	8.86	8.83	JV	8.40	8.46	8.49	8.50	8.50
ATT			0.02	0.07*	0.10**	ATT			0.07	0.14***	0.17**	ATT			0.02	0.06	0.12*
S.E.			0.03	0.04	0.05	S.E.			0.05	0.05	0.07	S.E.			0.05	0.06	0.07
# Matches	781	781	781	781	781	# Matches	378	378	378	378	378	# Matches	402	402	402	402	402

High advertising intensity industries						Low advertising intensity industries					
Year	t−1	t	t+1	t+2	t+3	Year	t−1	t	t+1	t+2	t+3
JV-to-WOS	8.59	8.68	8.73	8.78	8.82	JV-to-WOS	8.64	8.75	8.83	8.90	8.92
JV	8.58	8.68	8.76	8.76	8.72	JV	8.67	8.71	8.77	8.78	8.76
ATT			−0.04	0.01	0.10	ATT			0.03	0.08	0.12*
S.E.			0.04	0.05	0.07	S.E.			0.05	0.05	0.07
# Matches	403	403	403	403	403	# Matches	379	379	379	379	379

[Note] *,**,*** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

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low advertising-intensive industries than in high adverting-intensive industries. This suggests that converted wholly owned subsidiaries may bring in more brands in the form of intangible asset investments but not necessarily by increasing fixed asset investments like building factories or purchasing machinery. This contrast between intangible and fixed assets reconfirms that technology is often embodied by more sophisticated machinery and equipment in high R&D- intensive industries, but brand is not necessarily embodied in physical assets.

In addition, we also trace export ratio and financial leverage for each time period in order to see whether the improved performance of converted wholly owned subsidiaries might be attributable to an increase in multinational parents' export sales after the conversion or to financial restructuring. We find no difference between these two groups. These results are available upon request.

While these additional analyses do not necessarily confirm the causal relationships between these key strategic indicators and performance, they provide circumstantial evidence that such increases in intangible assets may contribute to higher sales growth and profitability for converted wholly owned subsidiaries over continuing joint ventures. This notion finds support in the resource-based theory (Wernerfelt, 1984).

Robustness check

We perform additional robustness tests to ensure the validity of our results. First, we check whether our results are sensitive to how we define a joint venture, which is currently set as a 25–50 percent foreign share. We relax the lower bound of our definition of minority joint venture by including firms with 20–25 percent shares. We also lower the upper bound to 45 percent without losing too many observations, and then raise the upper bound to 55 percent without adding too many more majority joint ventures. Results are consistent with those reported in this study. Second, we estimate results without dropping extreme outliers whose ROA values are greater than 100 percent or below −50 percent, which also generates consistent results.[8] Third, we employ different cutoff points for high and low R&D or advertising intensity, for example, rounding the median values for R&D and advertising intensity to one percent and two percent, respectively. Our findings are also robust to different cutoff points for high/low R&D and advertising intensities. All additional robustness test results are available upon request.

DISCUSSION AND CONCLUSION

This paper evaluates the differences in performance between joint ventures and wholly owned subsidiaries. To circumvent the endogeneity problem inherent to research in this vein, we adopt a propensity score matching technique combined with the difference-in-differences approach, which together allow us to focus on the comparison between joint ventures that were converted to wholly owned subsidiaries and continuing joint ventures. We compare these two groups' performance for three years following this conversion, after controlling for endogeneity in operating mode choice. We detect a steady improvement in the performance of converted wholly owned subsidiaries, as measured by ROA and Operating ROA, which far exceeds that of continuing joint ventures. We also find this improvement to be more pronounced in industries characterized by high R&D and advertising intensity. Lastly, our results suggest that enhanced performance from ownership conversion is associated with increased sales and increased intangible and fixed assets.

This study offers several contributions to the literature on international operating mode choice. First, it supports transaction cost theory's prediction that wholly owned subsidiaries perform better than joint ventures in industries characterized by high levels of intangible resources, after controlling for the local knowledge or resources that joint venture partners can contribute. In contrast to most prior work, which focuses on the *ex ante* mode choice, we find that the operation mode dictated by transaction cost theory significantly and positively affects a firm's *ex post* performance. While some previous studies, for example, Reuer (2001),

[8] If we do not drop firms whose ROAs are greater than 100 percent or below −50 percent, we are left with 801 instead of 799 matched samples of converted wholly owned subsidiaries and continuing joint ventures. While results are consistent with those presented in the paper, these two additional matches of extreme outliers tend to depress the performance of converted joint ventures in low R&D-intensive industries. As a consequence, converted wholly owned subsidiaries outperform continuing joint ventures, even in low R&D-intensive industries.

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show that joint venture buyouts positively impact abnormal stock returns of parent firms with high R&D intensity, this study directly tests the performance change at the foreign subsidiary level after acquisition, which strongly supports transaction cost theory.

Our study also makes several important empirical contributions. First, it sheds light on post-entry performance, a previously understudied phenomenon due to methodological obstacles and data constraints. Relying on the *Annual Industrial Survey Database*, we could evaluate subsidiary-level financial performance of foreign firms in China. Second, we explore potential mechanisms whereby wholly owned subsidiaries might perform more effectively than joint ventures. Our results show, albeit indirectly, that converted wholly owned subsidiaries enable multinational firms to bring in more sophisticated technology and brands than joint ventures. The demonstration of the potential mechanism of ownership transition further supports our hypotheses. Finally, we exploit a unique empirical setting to observe the performance difference between joint ventures and wholly owned subsidiaries. This empirical strategy allows us to address the endogeneity issue by finding counterfactual samples of joint ventures for matching, using the propensity score matching technique, and then compare their performances with those of the converted wholly owned subsidiaries.

Furthermore, our empirical context of joint ventures in China from 1998 to 2006 provides an ideal setting for our research questions. As China prepared to join the WTO, the joint venture requirement was relaxed in most industries and many joint ventures converted to wholly owned subsidiaries. Even after this requirement was lifted, a substantial number of joint ventures continued as they were. This empirical setting provides enough cases for both groups to compare their respective performances. It is, however, important to stress that our findings are not driven by this joint venture requirement policy *per se*, because our propensity matching technique creates counterfactual foreign joint ventures in the same three-digit industry that are just as likely to convert to wholly owned subsidiaries as the ventures that actually converted. While joint venture requirements could have affected 'all' firms in the same three-digit industries, our study shows that only some joint ventures converted while others in the same industries did not, despite the same hazard rate. This suggests that the joint venture requirements in China were not the main driver for our results. Rather, our findings suggest that the existence of tacit and poorly protected proprietary intangible assets to be the main reason for the differences; the conversion to wholly owned subsidiaries improved performance only in industries characterized by high levels of intangible assets. If the joint venture requirement led to suboptimal investment and the conversion to wholly owned subsidiaries was the answer to this problem, firm performance should improve after conversion regardless of the degree of intangible assets. We find no evidence of such improvement in industries characterized by low levels of intangible assets. In other words, our results are not context-specific; they are applicable to other countries not characterized by constraints on foreign ownership.

It is worthwhile to note that not all joint ventures in industries with high levels of intangible assets converted. At the same time, we find that many joint ventures with low levels of intangible assets did convert, despite having no good reason to do so from a transaction cost perspective. We acknowledge that the conversion decision from joint ventures to wholly owned subsidiaries can be driven by 'unknown' rational or irrational reasons that our probit model cannot fully capture, such as bandwagon effects or stalemate in bargaining with local partners. The propensity score matching technique assumes such unknown rational or irrational reasons for conversion is common in both treatment and control groups, and treats them as the error term in the probit model. While we try our best to control for all 'known' factors of conversions based on the joint venture termination/instability literature and while we identify converted wholly owned subsidiaries and continuing joint ventures in the same three-digit industries, future research should consider additional factors for conversion.

This study suggests several other areas for future studies. First, researchers may conduct a similar experiment in countries without any precedent of joint venture requirements. This would further validate that our findings are not context-specific. Second, researchers may also consider why some joint ventures were dissolved without being acquired by a multinational or local parent. As this study focuses on the performance implication, we are unable to consider the cases of joint venture dissolution. Third, future studies might

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also consider some parent-firm specific factors, for example, product relatedness or cross-selling, that may have a longer-run implication on the conversion decision and the post-conversion performance. Finally, better performance indicators that take more explicit account of transfer pricing schemes may also build on the results presented here. This study suggests that the logic of transaction costs can help firms choose the best operating mode; multinational firms should consider this choice jointly with the technology they choose to transfer to their subsidiaries. Taken as a whole, our results confirm that wholly owned subsidiaries have superior performance vis-à-vis equivalent joint ventures in industries characterized by high intangible assets because wholly owned subsidiaries can tap into better technologies and brands owned by the parent firm. Thus, joint ventures should be used selectively when resources or skills that local partners can bring in are not otherwise available.

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