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Business Ownership and Economic Growth: An Empirical Investigation

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Abstract

In the present paper we address the relationship between the extent of business ownership, or as we use interchangeably self-employment, and economic growth. Specifically, we will focus upon three issues. First, how is the equilibrium rate of self-employment (business ownership) related to the stage of economic development? Second, what is the speed of convergence towards the equilibrium rate when the rate of self-employment is out-of-equilibrium? Third, to what extent does deviating from the equilibrium rate of business ownership lead to less economic growth? Hypotheses concerning all three issues are used setting up a new two-equation model, while also variables like the unemployment rate, labor income quote and gross domestic product play a role. We find confirmation for the hypothesized effects using a data panel of 23 OECD countries. An important policy implication of our exercises is that free entry and exit of self-employed/businesses is a necessary condition for the equilibrium seeking mechanisms that are vital for sound economic development.

1 Introduction

In the present paper we address the relationship between the extent of business ownership (or interchangeably self-employment) and economic growth. Equilibrium rates of self-employment can be derived by making assumptions about (1) the aggregate production function combining the efforts of business owners and wage-employed individuals and (2) their rational occupational choice between self- and wage-employment. Differences in the assumptions about the critical factors to choose self-employment lead to different equilibrium models. Two early contributions are Lucas (1978) and Kihlstrom and Laffont (1979). Lucas assumes individuals to have different managerial abilities while Kihlstrom and Laffont assume individuals to differ with respect to their risk attitudes. Calvo and Wellisz (1980) extend Lucas' model by introducing a learning process through which managers acquire the necessary knowledge. More recent contributions include Schmitz (1989), Holmes and Schmitz (1990), De Wit and Van Winden (1991) and Gifford (1993). The equilibrium rate of business ownership depends upon the stage of economic development. This may be due to changes in the aggregate production function (e.g. scale economies) or the criteria of the occupational choice (e.g. degree of risk aversion). Recently, Iyigun and Owen (1998) developed a model explicitly relating the equilibrium rate of self-employment and the stage of economic development. The variables self-employment and business ownership are used synonymously in the current research. We use a unified international dataset in which business owners (self-employed) are defined as individuals owning a business that is not legally incorporated or owning an incorporated business from which they gain profits as well as a salary.¹

There are various links between the rate of business ownership and economic performance. First, we suspect the existence of a long-term relation between the rate of business ownership and the stage of economic development. Deviations from this 'equilibrium' should be interpreted as misallocation and may lead to adaptations in the number of business owners as well as to lower growth levels. Second, low growth levels may lead to high unemployment levels making self-employment more attractive providing an alternative at low opportunity costs. Low employment may induce people who have a hard time finding work or whose careers are threatened within existing companies to become self-employed. This leads to the reverse effect

¹ For more details on these definitions, see Appendix I.

that economic growth affects the rate of business owners per labor force.

In short, we will focus upon three issues. First, how is the equilibrium rate of business ownership related to the stage of economic development? Second, what is the speed of convergence towards the equilibrium rate when the rate of business ownership is out-of-equilibrium? Third, to what extent does deviating from the equilibrium rate of business ownership lead to less economic performance (growth)? All these hypotheses are used setting up a new two-equation model while also other variables like the unemployment rate, labor income quote and gross domestic product play a role. We find confirmation for each of these effects using a data panel of 23 OECD countries.

Self-employment has received quite some attention from policy makers in European countries. Despite a recent drop from about 11 to 10 percent in the period 1996 through 1998, the persistently high unemployment level is the main economic problem in the European Union. The high unemployment rate coupled with limited economic growth in Europe has triggered a plea by policy makers for rethinking the policy approach that ushered in European prosperity during the post-war era. The twin forces of globalization have reduced the ability of the European countries to generate economic growth and create jobs. On the one hand has come the advent of new competition from low-cost countries in Central and Eastern Europe as well as Asia. On the other hand, the telecommunications and computer revolutions have drastically reduced the cost of shifting not only capital but also information out of the high-cost locations of Europe and into lower-cost locations around the globe. Taken together, these twin forces of globalization mean that economic activity in a high-cost location is no longer compatible with routinized large-scale operations.

Hence, in their efforts to create jobs, politicians turned to promoting labor-intensive and small-scaled organizations. This is why both politicians and scientists have become interested in small businesses recently: labor-intensive economic growth can be achieved by stimulating the small business sector because generally small businesses are labor-intensive. Furthermore, entrepreneurship, in the form of new firms, and intrapreneurship, in the form of new ideas and responsibilities implemented in existing organizations, are essential to creating new economic activity. In modern economies a great variety of organizations is involved in making innovative products. This

is the case particularly in niche markets like in the ICT sector. The more organizations are active in such markets, the greater the chance that an innovation takes place. Variety and selection play a dominant role in this mechanism.

It is deeply embedded in the current European policy approach that creativity, autonomy and independence embedded in self-employment contribute to higher levels of economic activity. Therefore, major funds of governmental institutions and independent donor organizations are being channelled towards young and small firms. The present paper aims at judging whether such policies are justified in all phases of economic development.

The present paper is set up as follows: in section two a survey is given of the empirical and theoretical literature on the relationship between business ownership and growth. Also some definitional and data questions are covered. Our two-equation model is specified in section three while section four deals with data and estimation technique. In section five some extensions (the role of Italy) and alternative specifications (the penalty structure of an economy in 'disequilibrium' and the shape of the long-term equilibrium relation between the number of business owners and the stage of economic development) of the basic model are discussed. Conclusions are drawn in section six.

2 Theory

Definitions

Our study focuses on the number of business owners (self-employed), although occasionally we will refer to entrepreneurs despite the fact that these concepts are not synonymous. *First*, business owners serve many roles and functions. Many researchers distinguish between Schumpeterian (or real) entrepreneurs and managerial business owners (Wennekers and Thurik 1999).¹ Entrepreneurs are a small fraction of the business owners. They own and direct independent firms that are innovative and ‘creatively destroy’ existing market structures. After realizing their goals Schumpeterian entrepreneurs often develop into managerial business owners, but some may again start new ventures or new firms. Managerial business owners are to be found in the large majority of small firms. They include many franchisees, shopkeepers and people in professional occupations. They belong to what Kirchoff (1996) calls ‘the economic core’. Occasionally entrepreneurial ventures grow out of them. In an empirical context it is difficult to discriminate between managerial business owners and entrepreneurs. For that one would need profiles of individual business owners. Moreover, the discrimination is a theoretical one since most business owners are neither pure ‘Schumpeterians’ nor pure ‘shopkeepers’ but share the attitudes associated with these extremes in a varying degree.

Second, entrepreneurial energy is not limited to self-employed individuals. Large companies promote ‘intrapreneurship’ within business units to achieve more flexibility and innovativeness (Stopford and Baden-Fuller 1994). This broader interpretation of entrepreneurship implies measurement difficulties. It is inconceivable however that a society in which entrepreneurship by self-employment thrives would not generate modern decentralized larger companies. In that sense the rate of self-employment may be a fair indicator of a general level of entrepreneurship in a society, at least in modern economies.

¹ In a similar fashion Audretsch and Thurik (1998) distinguish between two types of self-employed: the ‘refugee’ or ‘shopkeeper’ type and the ‘Schumpeterian’ type. In their analysis of how and why entrepreneurship has made important contributions to economic and social life in modern industrialized countries they assume that these two types have different economic roles in their relation with unemployment. The number of ‘shopkeepers’ is likely to go up if the level of unemployed rises and that same level is expected to go down if the number of ‘Schumpeterians’ increases.

Entrepreneurship remains a very broad concept (Wennekers and Thurik 1999), a challenging concept (Amit et al. 1993) and of considerable importance for a country's competitive edge (Porter 1990) and for the functioning and restructuring of markets. That is why sometimes we will refer to entrepreneurship when discussing the determinants of growth.

In this study we use data material of 23 OECD countries including the fifteen countries of the EU-15, Iceland, Norway, Switzerland, Canada, Australia, New Zealand, Japan and the U.S. for the period 1974 through 1994. We define the number of self-employed or business owners as including owner-managers of legally incorporated businesses for the whole economy excluding the agricultural sector. See appendix I to this paper for more details.

The impact of economic progress on business ownership

The proportion of the labor force that is self-employed has decreased in most Western countries until the mid-1970s. Since then the self-employment rate has started to rise again in several of these economies. Blau (1987) observes that the proportions of both male and female self-employed in the nonagricultural U.S. labor force declined during most of this century. He also observes that this decline bottomed out in the early 1970s and started to rise until at least 1982. The data used in this report show that the self-employment rate in the U.S. has continued to rise gradually since then. More recently business ownership increased in several other countries like Canada, the U.K., Spain, the Netherlands and Australia. In this section we present some empirical evidence and discuss the main reasons for a structural or long-term relationship between the self-employment rate and economic development.

Negative relationship

A negative relationship between the self-employment rate and economic development was already reported by Kuznets (1971) describing the shift in locus of production from family to firm. A negative correlation of -0.85 between real per capita GDP and the self-employment share is found in Yamada (1996). Schultz reports that 'a 1% annual rate of growth in real income per adult is associated with about the same increase in the share of wage earners for men and women, 0.15% and 0.16%, respectively.' (Schultz 1990, p. 475). These studies use a large cross-section of countries with a wide variety in the stage of economic development. Bregger (1996) reports a decline of the U.S. self-employment for all industries from 18.5% in 1948 until 8.7% in 1975. The decline is less vehement when agri-

culture is excluded: from 12.0% in 1948 to 6.9% in 1975. This reduction in the rate of self-employment is representative for that in many Western countries during the most part of this century.

There are many reasons for the decline of self-employment, and of small business presence in general. Lucas (1978) shows how rising real wages may raise the opportunity cost of self-employment relative to the return. Given an underlying distribution of persons by 'managerial' talent this induces marginal entrepreneurs (in this context Lucas refers to managers) to become employees. This pushes up the average size of firms. Chandler (1990) stresses the importance of investment in production, distribution, and management needed to exploit economies of scale and scope during the period after the second industrial revolution of the second half of the 19th century. It was a period of relatively well-defined technological trajectories, of a stable demand and of seemingly clear advantages of diversification. Audretsch and Thurik (1997) characterize this period as one where stability, continuity and homogeneity were the cornerstones and label it the managed economy. Schaffner (1993) takes a somewhat different and more theoretical approach. She points out that 'over the course of economic development the advantages firm owners derive from being less risk averse (better diversified) than self-employed producers are likely to rise relative to the disadvantages caused by the costliness of circumventing asymmetric information problems.' (p. 435). Iyigun and Owen (1998) develop a model implying that economic development is associated with a decline in the number of entrepreneurs relative to the total number of employees. They argue that fewer individuals are willing to risk becoming an entrepreneur as the 'safe' professional earnings rise with economic development. See also Kihlstrom and Laffont (1979), Blanchflower and Meyer (1994) and Blanchflower and Oswald (1998). Other explanations are from Galbraith (1956) who considered the increase in market concentration to be a consequence of 'countervailing power' and Cohen and Klepper (1996) who see important scale advantages in R&D.

Reversal of the trend

Several authors provide evidence of the reversal of the trend towards less self-employment. Acs et al. (1994) report that of 23 OECD-countries, 15 experienced an increase in the self-employment rate during the 1970s and 1980s. They show that the weighted average of the self-employment rate in OECD-countries rose slightly from 8.4% in 1978 to 8.9% in 1987. Closely related to the development of the self-employment rate is the development of small business presence in general. Carlsson (1989) provides data on the share of the Fortune

500 companies in total manufacturing. He shows that this share in total manufacturing employment dropped from 78.7% in 1975 to 72.5% in 1985. In the same period the share of these firms in total shipments dropped from 83.2% to 77.2%. Other sources showing that the growing importance of large business has come to a halt in Western countries include Loveman and Sengenberger (1991), Acs and Audretsch (1993) and Acs, Carlson and Thurik (1996).¹

There are several reasons for the more prominent place of small business and self-employment in Western economies. *First*, the last 25 years of the 20th century may be seen as a period of creative destruction, as described in Schumpeter (1950). Piore and Sabel (1984) use the term Industrial Divide, Jensen (1993) prefers the term Third Industrial Revolution, while Freeman and Perez (1988) talk about the transition from the fourth to the fifth Kondratiev wave. Audretsch and Thurik (1997 and 1998) stress the effects of globalization and the information revolution leading to the demise of the comparative advantage of Europe in many of the traditional industries, such as machine tools, metalworking, textiles and automobile production. The most obvious evidence is the emergence of new industries like the software and biotechnology industries. Small firms play an important role in these new industries. Acs and Audretsch (1987) provide empirical evidence that small firms have a relative innovative advantage over their larger counterparts in such highly innovative industries. Evidence for the comparative advantage of small firms in inventing radically new products is also given in Prusa and Schmitz (1991), and Rothwell (1983, 1984).

Second, new technologies have reduced the importance of scale economies in many sectors and small technology-based firms started to challenge large companies that still had every confidence in mass production techniques (Carlsson 1989). Meredith (1987) argues that small firms are just as well, or better, equipped to implement technological advances and predicts the factory of the future to be a small factory. Jensen argues that 'It is far less valuable for people to be in the same geographical location to work together effectively, and this is encouraging smaller, more efficient, entrepreneurial organizing units that cooperate through technology' (Jensen 1993, p. 842). This is supported by Jovanovic saying that: 'recent advances in information technology have made market-based coordination cheaper relative to internal coordination and have partially caused the recent decline in firm size and diversification' (Jovanovic 1993, p. 221).

¹ See also the various editions of *The European Observatory for SMEs* which provide an account of the state of small business in Europe, for instance EIM (1997).

Others, like Rothwell (1983, 1984), stress that large and small firms complement and succeed each other in the innovation and diffusion process. His theory is one of 'dynamic complementarity'. See also Nooteboom (1994).

Third, the increasing incomes and wealth have enabled individuals to consider 'higher' needs. As a result the demand for variety increases (Jackson 1984). Cross-cultural influences have also enlarged the demand for variety. Small firms are often the most obvious suppliers of new and specialized products. The decrease in diversification as reported by Jovanovic (1993) suggests that large firms have not been capable of entering into such market niches.

Fourth, deregulation movements have swept the world. Phillips (1985) reports that small firms have dominated in both the creation of new businesses and new jobs in deregulated industry sectors in the U.S. in the early 1980s. This confirms some preliminary empirical evidence as provided by Shepherd (1982). Governments have also begun to acknowledge and promote the vital role by small (start-up) firms in achieving economic growth and development. See Storey and Tether (1998), OECD (1998) and EIM (1994 and 1996).

Fifth, there has been a tendency of large firms to concentrate on 'core competences' (Carlsson 1989). Jovanovic (1993) reports that the 1980s were characterized by corporate spin-offs and divestment. Aiginger and Tichy (1991) blame much of the 'back-to-basics' and downsizing (or rightsizing) tendencies on the opportunistic conglomerate merger wave of the late 1960s.¹

Sixth, self-employment is more highly valued as an occupational choice than before. Roughly one out of four young U.S. workers pursue self-employment according to Schiller and Crewson (1997). Kirchhoff (1996) argues that self-employment is not anymore characterized as under-employment or being mom-and-pop establishments, but as a way to achieve a variety of personal goals. Baumol (1990) stressed the importance of entrepreneurship being led into productive channels. Also, as hypothesized in social psychology there is a Maslowian hierarchy of human motivations, with physical needs at the bottom and self-realization at the top (Maslow 1970). A higher level of prosperity will induce a higher need for self-realization and thereby may stimulate entrepreneurship.

¹ See also *The Economist*, Jan. 9th 1999, How to make mergers work (pp. 13-14) and How to merge: after the deal (pp. 19-21).

Finally, the employment share of the services sector has been well documented (Inman, 1985) to increase with per capita income. Given the relatively small average firm size of most services (barring airlines, shipping and some business services) this creates more possibilities for self-employment (EIM 1997).

Obviously, some of these factors may have had a temporary effect only. For example, it is not unlikely for the 'back to core business', outsourcing and deregulation waves to dry up.¹ On the other hand, there are more permanent effects like that of new technologies. We refer again to Freeman and Perez (1988). They claim that in the new techno-economic paradigm (fifth Kondratiev wave) the organization of firms will be 'networks' of large and small firms. See also Oughton and Whittam (1997) who emphasize the role of external economies of scale when explaining the viability of small firms. Small firms will profit from the new model of flexible specialization (Piore and Sabel 1984 and Fiegenbaum and Karnani 1991). Moreover, the introduction of new technologies is also positively related to the stage of economic development through necessary skills and other investments. Finally, the increasing variety of demand for specialized goods and services, the increased valuation of self-realization and the rise of the services sector are also dependent on per capita income.

An equilibrium rate of business ownership

As the extent to which there is a reversal of the trend towards less self-employment is still not quite clear we hypothesize a relationship between the rate of business ownership and per capita income that is either L-shaped or U-shaped². In case of an L-shape it is assumed that the equilibrium business ownership rate continues to decline with the stage of economic development while in case of a U-shaped curve it is assumed that this trend is reversed at higher levels of development. The U-shaped pattern has the advantage that it allows the establishment of a level of economic development with a 'minimum' business ownership rate.

The secular trend is best viewed as a long-term equilibrium rate of business ownership resulting from technological conditions, the demand for goods and services and the supply of potential entrepreneurs. The theoretical viability of an equilibrium rate of self-employment is corroborated by De Wit and Van Winden (1991) using an m-sector, n-group general equilibrium model of self-employment. In this model several of the above determinants are used to determine

1 See *The Economist*, June 24th 1995, Big is back (survey).

2 Schultz (1990) reports having found statistical evidence for a quadratic relationship between the share of wage earners and the stage of economic development.

the equilibrium rate of self-employment. Schmitz (1989) derives the equilibrium fraction of the self-employed in an endogenous growth model. Gifford (1992, 1993 and 1998) develops a model of entrepreneurial attention between maintaining current activities and starting new ones. She derives the proportion of agents choosing a career as innovative entrepreneur, managerial entrepreneur and salaried employee. See also Holmes and Schmitz (1990).

However, many forces may cause the actual number of self-employed (business owners) to differ from the long-term equilibrium rate. Such a 'disequilibrium' (i.e. deviation from the long-term equilibrium) may stem from cultural forces, institutional settings (regulation of entry, incentive structures, functioning of the capital market) and economic forces (unemployment, profitability of private enterprise). See Kirzner (1997), Davis and Henrekson (1999) and Henrekson and Johansson (1999).

In a market economy there will be underlying endogenous movements to restore equilibrium. Some examples may illustrate this point. A structurally low number of enterprises such as many Western economies experienced in the late 1970s and early 1980s, has undoubtedly contributed to structural unemployment. A positive influence of unemployment on self-employment has already been demonstrated by several authors such as Storey (1991), Evans and Leighton (1989) and Audretsch and Thurik (1998). Alba-Ramirez (1994) shows that for both Spain and the U.S. the duration of unemployment increases the probability of becoming self-employed. His analysis suggests that the effect of unemployment duration on the probability of becoming self-employed is not very different for the two countries, albeit stronger for the U.S. The results are interesting especially since the Spanish economy has a higher degree of unemployment and self-employment when compared to the American. The results suggest that the influence of unemployment on business ownership is a common feature across economies.¹ Gradually high unemployment also results in wage moderation helping to restore profitability of private enterprise. The effect of profitability on self-employment was shown by Wildeman et al. (1998). Finally, we assume that a shortage of business ownership induces many policies fostering entrepreneurship, ranging from a lower replacement ratio to better access to financing and competition policies. See OECD

¹ Alba-Ramirez (1994) also notes that legislation aimed to help the jobless start up their own business has been implemented across developed countries and gives the example of the Spanish 1985 law providing lump-sum unemployment insurance to workers willing to become self-employed.

(1998). These processes are hard to observe and may therefore be modelled best using an error correction mechanism. Likewise a number of business owners which structurally exceeds the equilibrium rate may be expected to diminish profitability, resulting in higher exit (failure rates) and lower entry, and to induce policies and practices restricting entry.

The effect of business ownership on economic progress

There is some evidence on the relation between size class distributions and economic performance. For instance, see Nickell (1996), Nickell et al. (1997) and Lever and Nieuwenhuijsen (1999) who present evidence that competition, as measured by increased number of competitors, has a positive effect on the rate of total factor productivity growth.¹ Carree and Thurik (1998, 1999) show that the share of small firms in manufacturing industries in European countries has a positive effect on the industry output growth. Thurik (1996) reports that the excess growth of small firms² has had a positive influence on percentage change in gross national product for a sample of 16 European countries in the period 1988 through 1993. Audretsch and Thurik (1999) show that self-employment brings down unemployment for a sample of 23 OECD countries.³

A theoretical endogenous growth model was developed by Schmitz (1989). His model predicts that an increase of the proportion of entrepreneurs in the working force leads to an increase in long-run economic growth. See also Holmes and Schmitz (1990) who develop a model of entrepreneurship in the spirit of T.W. Schultz. They show how specialization in managerial tasks and entrepreneurship – responding to opportunities for creating new products and production processes – may affect economic development. Finally, some evidence of a well-established historical (long-term) relationship between fluctuations in entrepreneurship and the rise and fall of nations has been assembled by Wennekers and Thurik (1999). In this respect also the work of Eliasson (1995) on economic growth through competitive selection is of relevance.

1 Acis et al. (1999) point at differences in competition and entrepreneurship when comparing the more successful U.S. economy to that of Europe and Japan.

2 The excess growth of small firms is defined as the percentage change in the value-of-shippments accounted for by small firms minus the percentage change in the value-of-shippments accounted for by large firms.

3 A subset of small firms which are assumed to improve economic performance are the so-called New Technology-Based Firms (NTBFs). Many of the businesses can be found on Science Parks of which the number in many countries has increased strongly during the 1980s and 1990s. Storey and Tether (1998) show that most of the NTBFs are, in fact, small firms. They report the average number of employees to be around 20 both in France and the U.K. The two countries were the first in Europe (in 1969) to establish science parks (Cambridge Science Park in the U.K. and Sophia Antipolis in France). They claim that Italy serves as an example of lagging behind in the establishment of 'advanced' science parks and relate this to the relatively low proportion of university research that is financed by the Italian private sector.

Another source of evidence on the relation between self-employment and progress is the economic history of the formerly centralized planned economies. A characteristic of these economies was the almost complete absence of small firms (and private ownership of the means of production), and this extreme monopolization constituted one of the major factors leading to the collapse of state socialism (Acs 1996). The development of small enterprises is considered a vital part of the current transition process in Eastern Europe.¹

Finally, we assume that deviations between the actual and the equilibrium rate of business ownership will diminish the growth potential of an economy in the short and medium term.² A shortage of business owners will diminish competition with detrimental effects for static efficiency and competitiveness of the national economy. Worse still, it will also diminish variety, learning and selection and thereby harm dynamic efficiency (innovation). On the other hand, a glut of self-employment will cause the average scale of operations to remain below optimum. Moreover, it will result in large numbers of marginal entrepreneurs, absorbing capital and human energy that could have been allocated more productively elsewhere.

1 See for example Russia's Shatalin Plan, which 'is built on the assumption that society needs small enterprises to orient production to the needs of every person, to fight the dictatorship of monopolies in consumer and production markets, and to create a favourable environment for quick introduction of new scientific and technological ideas' (Nolan (1995), p. 82).

2 Iyigun and Owen (1998) show in a dynamic model with two types of human capital (professional and entrepreneurial) that a misallocation of the existing human capital stock between professional and entrepreneurial activities may occur. The nature of the inefficiency, however, is not clear-cut. There may be too much entrepreneurship or too little, depending on how entrepreneurial and professional skills contribute to the level of technology. They find that 'a more efficient ratio of professional and entrepreneurial skills will raise the steady state of technology, the wages paid to human capital providers, and therefore, the economy's human capital stock (p. 457). Therefore, their model supports our notion that deviations from the level of optimal relative entrepreneurial activity come at a cost of lower economic performance.

3 Model

3.1 Two equations

Our main research object is to find evidence for the impact of business ownership on economic growth at the macro level. Investigating this influence cannot be carried out in the framework of a single-equation regression explaining economic growth. There are important feedback relations of economic growth influencing business ownership. A single-equation regression might then result in biased estimations. Therefore, we introduce a model that consists of two equations. The first equation deals with the *causes* of business ownership whereas the second deals with its *consequences*.

3.2 Description of the model

The model reads as follows:¹

$$(1a) \quad E_{i,t} - E_{i,t-4} = b_0 (E_{i,t-4}^* - E_{i,t-4}) + b_1 (U_{i,t-6} - \bar{U}) + b_2 (\overline{LIQ}_{i,t-4} - \overline{LIQ}) + \varepsilon_{1,i,t},$$

$$(1b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 (E_{i,t-4}^* - E_{i,t-4})^2 + c_1 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + c_2 \left(\frac{Y}{CAP} \right)_{i,t-4} + \alpha_1 + \varepsilon_{2,i,t},$$

$$(1c) \quad E_{i,t}^* = \alpha + \beta \left(\frac{Y}{CAP} \right)_{i,t} + \gamma \left(\frac{Y}{CAP} \right)_{i,t}^2,$$

- where
- E: number of business owners per labor force,
 - E*: equilibrium number of business owners per labor force,
 - Y: gross domestic product in purchasing power parities per U.S. \$ in 1990 prices,
 - Y/CAP: per capita gross domestic product in thousands purchasing power parities per U.S. \$ in 1990 prices,
 - U: unemployment rate,
 - \bar{U} : sample average of unemployment rate,
 - \overline{LIQ} : labor income quote,
 - \overline{LIQ} : sample average of labor income quote,

1 Next to the levels of unemployment U and the labor income quote LIQ, we have also considered the *relative mutations* of these variables as possible explanatory variables in (1a). However, estimations point out that the corresponding parameters are not significantly different from zero and therefore we do not consider these relative mutation variables in the present report.

- $\varepsilon_1, \varepsilon_2$: disturbances of (1a) and (1b), respectively (possibly correlated),
i, t indices for country and time (in years), respectively.

Business ownership equation

In equation 1a, the variable to be explained is the growth in the number of business owners per labor force in a period of four years. As a first explanatory variable we use lagged unemployment acting as a push factor for business ownership. The expected sign of the parameter b_1 is positive. We choose a lag for this variable because practical procedures and legal requirements are involved in starting a new enterprise. Furthermore, setting up a business may require a considerable period of mental preparation, particularly if (the threat of) unemployment is the main motive.

As a second explanatory variable we apply the labor income quote. This variable is a pragmatic proxy for the earning differentials between expected profits of business owners and wage earnings. We assume that a relatively high business profitability (as compared to wage earnings) acts as a pull factor for business ownership. The labor income quote is defined as the share of labor income (including the 'calculated' compensation of the self-employed for their labor contribution) in the net national income. The expected sign of the parameter b_2 is negative. As with the unemployment variable, a lag has been included.

Error correction mechanism

The third explanatory variable in equation 1a, which has the parameter b_0 assigned to it, is an error correction variable describing the difference between the equilibrium and the actual rate of business ownership. The parameter b_0 is expected to have a positive sign. In the basic version of our model the equilibrium function is U-shaped with respect to per capita income (equation 1c has a quadratic form). Below we will also consider an L-shaped functional shape. Because the parabola should first drop and then rise (instead of the other way around) we expect the parameter γ to be positive and the parameter β to be negative. Furthermore, since the relative number of business owners cannot be negative, the parameter α should be positive. Also, the relative number of business owners cannot be in excess of one. Thus, we expect the value of the parameter a to lie between zero and one.

Economic growth equation

In equation 1b, the variable to be explained is economic growth in a four-year period, measured as the relative change in gross domestic product (implemented as a log-difference). The first determinant of growth is the squared deviation of the actual number of self-employed (business owners) from the equilibrium rate of business ownership. As explained in a previous section, the deviation variable is expected to have a negative impact on growth. Below we will consider an alternative penalty function based on the absolute instead of the squared deviation.

Next to this deviation variable, which is the most important variable concerning the impact of business ownership on growth, control variables such as lagged growth and the level of per capita income are taken into account. Using this last variable we capture the convergence hypothesis of countries: countries which are lagging behind in economic development can grow more easily than other countries because they can profit from modern technologies developed in other countries. The expected sign of the parameter c_2 is negative.

4 Data and estimation technique

We use data material of 23 OECD countries including the fifteen countries of the EU-15, Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland and the U.S. and for the period 1974 through 1994. Data are available for the even years only. The main data sources are the OECD Labor Force Statistics and the OECD National Accounts. A detailed description of the variable definitions can be found in appendix I to this paper. In table 1 the values are given of four variables in the middle year of our sample, 1984, for all countries.

Table 1 1984 values of some variables

Country	Self-employment*	GDP per capita**	Unemployment*	Labor income quote
Austria	0.053	14,351	0.045	0.84
Belgium	0.102	14,109	0.121	0.85
Denmark	0.073	14,882	0.102	0.89
Finland	0.056	13,550	0.052	0.86
France	0.096	15,006	0.097	0.88
Germany (West)	0.067	15,761	0.071	0.83
Greece	0.177	6,747	0.042	1.03
Ireland	0.098	8,713	0.155	0.89
Italy	0.165	13,599	0.094	0.83
Luxembourg	0.081	18,425	0.018	0.87
The Netherlands	0.083	13,802	0.118	0.76
Portugal	0.120	7,009	0.084	0.76
Spain	0.150	9,359	0.197	0.84
Sweden	0.066	15,304	0.031	0.85
United Kingdom	0.087	13,249	0.117	0.85
Iceland	0.068	15,196	0.012	0.81
Norway	0.091	15,801	0.031	0.67
Switzerland	0.099	18,437	0.011	0.85
United States	0.102	19,662	0.074	0.83
Japan	0.115	14,037	0.027	0.89
Canada	0.086	16,439	0.112	0.78
Australia	0.136	14,684	0.089	0.83
New Zealand	0.131	13,339	0.050	0.76
Mean	0.100	13,977	0.076	0.84

* Relative variable: per labor force.

** Unity: purchasing power parities per U.S. \$ at 1990 prices.

From table 1 we see that Greece, Italy and Spain have the highest levels of self-employment (business ownership): more than 15% of the labor force. The unweighed sample average level of self-employment in 1984 is 10%. The countries with the lowest levels of self-employment in 1984 are Austria, Finland, Germany, Sweden and Iceland: less than seven percent of the labor force. Looking at the GDP per

capita in 1984, we see that the United States, Switzerland and Luxembourg are the most affluent countries while Greece, Ireland, Portugal and Spain are the least affluent countries in the sample. The unemployment rates in 1984 are highest in Ireland and Spain: more than 15% of the labor force. Low unemployment rates are found in Japan, Norway, Sweden, Switzerland, Iceland and Luxembourg: 3.1% or lower. The average unemployment rate in 1984 is 7.6%. High values of the labor income quote are found in Denmark, Ireland and Japan. In these countries business profitability is relatively low in comparison to average wage earnings of an employee. Countries with a low labor income quote in 1984 are the Netherlands, Portugal, Norway, Canada and New Zealand: LIQ is below 0.80 (sample average in 1984 is 0.84). A country that attracts attention is Greece with a labor income quote of 1.03. This has to do with the way the LIQ is calculated: self-employed persons obtain an imputed compensation for their labor contribution set equal to the average wage earnings per employee. This is done in order to distinguish business profits from labor compensation for self-employed persons. When the number of self-employed persons is high, the calculation becomes less accurate since the imputed part of 'wage earnings' by the self-employed is higher. Since Greece has the highest self-employment rate, this problem occurs for Greece in particular. However, we can conclude that business profits are low in Greece: according to the LIQ being in excess of one, the average self-employed person has a lower income than the average employee.

Estimation technique

Since we estimate a model with two equations, we have to choose a technique that deals with parameter restrictions across both equations. For this purpose Full Information Maximum Likelihood (FIML) is a suitable estimation technique. Model (1) is not an *intrinsically* simultaneous model in the sense that both variables to be explained (in equations 1a and 1b) appear as an explanatory variable in the other equation. However, since there are parameter restrictions, we estimate the model simultaneously (instead of estimating both equations separately) to obtain efficient parameter estimates. To avoid confusion, we shall characterize the model as a system of two equations and not as a simultaneous model.

When estimating the model, we weigh the observations with the number of self-employed. We think that bigger countries such as the U.S. and Japan are more important in establishing the relationship between business ownership and economic growth than small coun-

tries. When the data of, for example, Luxembourg or Iceland would call for a different relation, we would not want this to have a big impact on the model. A technical description of the weighing of observations can be found in appendix II to this paper.

5 Extended model and estimation results

The model presented in section 3 (equations 1a and 1b) should be viewed as the basic specification of the model. Before presenting estimations, we will discuss the special position of Italy. After that we will present the definitive specification as well as the estimation results.

Italy

The main problem with estimating the basic model is that there may be (big) countries with specific economic circumstances not covered by our model which could influence the estimates towards implausible results. The country we suspect may deviate most from the other countries is Italy. Looking at table 1, we see that Italy combines a high level of self-employment with a normal (near average) level of per capita income. This is unusual: the countries with many self-employed (business owners) are generally in a less advanced stage of economic development (for example Greece and Spain). Roughly, Italy can be divided in two quite different types of economies: a well-developed economy (Northern Italy) and a less developed economy (Southern Italy or the Mezzogiorno). Italy might not fit well in our model because it basically consists of two different economies. A closer inspection of the data for Northern and Southern Italy¹ shows that Northern Italy in particular deviates from the expected pattern, i.e., the U-shaped or L-shaped trend of the relative number of business owners set out against per capita income. Here, a high self-employment rate is combined with a relatively high value of the GDP per capita. Small and medium-sized firms play a bigger role in (Northern) Italian manufacturing than in other industrialized countries. A notable feature of the organization of Italian small and medium-sized firm production is its high geographical concentration in small areas or industrial districts (Piore and Sabel 1984). The geographical distribution also shows that the majority of small and medium-sized manufacturing firms is located in Northern and Central Italy (Acs en Audretsch, 1993). It often has a strong family component.

The specific Italian model of extensive small and medium-sized firm production when compared to other countries in similar stages of development may have positive and/or negative effects on econom-

¹ Separate data for North- and South-Italy are obtained from the Eurostat Regions Statistical Yearbook.

ic growth. Many of the Italian firms are highly specialized and are organized on a flexible basis, so as to meet specific customer needs, and produce well designed and fashionable goods, aimed at the richest segments of the market. Another characteristic of the Italian model, however, is that Italian R&D expenditures as a percentage of GNP are by far the lowest among the largest OECD-countries. They amount to only half of that in Germany, the U.S. and Japan over a long period (Klomp and Pronk 1998, p. 167). Hence, the number of business owners in Northern Italy is higher than one would expect on the basis of the advanced stage of economic development. The data for Southern Italy seem to be in conformity with the general pattern: there is also a high level of self-employment but combined with a low value of the GDP per capita.

Further suspicions are illustrated in table 2 where the development of GDP per capita and the number of business owners per labor force for the period 1974 through 1994 is reported for the major industrialized (G7) countries U.S., Japan, Canada, Germany (Western part), U.K., France and Italy. Notice that, along with Spain, these countries weigh the most heavily in the estimations such that deviations in the pattern relative number of business owners versus GDP per capita for these countries will influence the parameter estimates considerably.

Table 2 Per capita income* and self-employment** in G7 countries, 1974-1994

Country	Y/CAP 1974	Y/CAP 1994	self-empl. 1974	self-empl. 1994
U.S.	16,938	23,123	0.092	0.103
Japan	10,589	18,655	0.119	0.092
Canada	13,481	18,453	0.072	0.109
Germany (Western part)	12,917	18,999	0.067	0.080
U.K.	11,457	16,176	0.067	0.110
France	12,781	17,577	0.106	0.080
Italy	10,951	16,618	0.144	0.181

* Unity: purchasing power parities per U.S. \$ at 1990 prices.

** Relative variable: per labor force.

As can be seen from table 2, the level of self-employment is much higher in Italy than in the other G7 countries while the per capita income does not deviate considerably. For example, the U.K. has a lower value of the GDP per capita in 1994. The higher level of self-employment in Italy can be explained in part by specific Italian policy stimulating the small business sector. Our conclusion is that the Italian economy has some specific characteristics that are not embedded in our basic model.

Final model

We introduce a dummy variable D_{ITA} that is 1 for the Italian observations and 0 elsewhere. There are several ways to use the dummy in equation 1a. Specifically, it could be placed inside or outside the parabola describing the equilibrium rate of business ownership (or both inside *and* outside the parabola). Clearly, the interpretations differ. When the dummy is placed inside the parabola (parameter α_{ITA} in model (2) below), it is assumed that the Italian economy has a different equilibrium relation between business ownership and the stage of economic development than economies of other countries. In other words, Italy is assumed to have a higher (the dummy parameter α_{ITA} is expected to have a positive value) level of business ownership. In that case self-employment is generally considered a more natural option to be active in the labor market than in other countries. When the dummy is placed outside the parabola (parameter $d_{0,ITA}$ in model (2) below), it is assumed that an autonomous rise in the *actual number of business owners* has taken place in Italy. This might be the case because of the specific government policies promoting start-ups. When such an autonomous rise in self-employment takes place, it can have positive and negative effects on economic growth depending on whether or not the initial number of business owners is higher or lower than the equilibrium rate. A final possibility is a combination of the two former ones, i.e., an Italy-dummy is placed inside as well as outside the parabola. In that case we allow for a possibly different equilibrium relation as well as an autonomous rise in the number of business owners. The model then looks as follows (note that the equilibrium function is now put directly into the business ownership equation and the growth equation):

$$(2a) \quad \bar{E}_{i,t} - \bar{E}_{i,t-4} = b_0 \left(\alpha + \alpha_{ITA} D_{ITA} + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - \bar{E}_{i,t-4} \right) + b_1 (U_{i,t-4} - \bar{U}) + b_2 (LQ_{i,t-4} - \bar{LQ}) + d_{0,ITA} D_{ITA} + \varepsilon_{i,t}$$

$$(2b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 \left(\alpha + \alpha_{ITA} D_{ITA} + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - \bar{E}_{i,t-4} \right)^2 + c_1 (\ln(Y_{i,t-4}) - \ln(\bar{Y}_{i,t-4})) + c_2 \left(\frac{Y}{CAP} \right)_{i,t-4} + d_1 + \varepsilon_{2,i,t}$$

Straightforward Likelihood Ratio tests (LR tests) can be applied to validate the specific role of Italy.¹ The assumption of a structurally different economy corresponds with the restriction $d_{0,ITA} = 0$, where-

1 We also tested for possible impacts on economic growth of the deviating form of the entrepreneurship equation for Italy by also implementing an Italy-dummy in the growth equation. However, the null hypothesis of the corresponding parameter being equal to zero could not be rejected for any of the variants of the entrepreneurship equation.

as the assumption of an autonomous rise in self-employment corresponds with the restriction $\alpha_{ITA} = 0$. First we test model (2) against the alternative model that follows when we impose the restriction $d_{0,ITA} = 0$. The restriction is rejected: the value of the test statistic is 7.4 whereas the critical value at the 5% significance level is 3.84 (χ^2 distribution with 1 degree of freedom). The second choice is between model (2) and the model that remains when imposing $\alpha_{ITA} = 0$. This restriction is not rejected at the 5% level: the test statistic is 3.0 whereas the critical value is again 3.84. We conclude that Italy does not have a different equilibrium relation between self-employment and the stage of economic development, but that Italy has developed an autonomous (additional) rise in the number of business owners when compared to other countries.

5.1 Results

Proceeding with equation (2) with $\alpha_{ITA} = 0$ we obtain

$$(3a) \quad E_{i,t} - E_{i,t-4} = b_0 \left(\alpha + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - E_{i,t-4} \right) + b_1 (U_{i,t-4} - \bar{U}) + b_2 (LQ_{i,t-4} - \bar{LQ}) + d_{0,ITA} D_{ITA} + \varepsilon_{i,t}.$$

$$(3b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 \left(\alpha + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - E_{i,t-4} \right)^2 + c_1 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + c_2 \left(\frac{Y}{CAP} \right)_{i,t-4} + d_1 + \varepsilon_{2,i,t}.$$

The model is estimated using FIML. The sample consists of 184 observations: 23 countries times 8 years (1980 through 1994, only the even years).¹ Weighing with the number of business owners (in the year t-4) implies that all variables (including constants and dummies) are multiplied with the square root of the number of business owners before the FIML procedure is run. In this way, bigger countries are given a bigger influence in determining the parameter estimates than smaller countries. The weighing procedure will be explained in detail in appendix II.

The estimation results of model (3) are in table 3.² Next to the parameter estimates we report some characteristics of the parabola describing the equilibrium rate of business owners by reporting some statistics for different values of the GDP per capita.³

1 Notice that for the Y variable (gross domestic product), which has a lag of eight years in the second equation 3b, we also dispose of data for the year 1972.
 2 We also estimated the model without the Italy-dummy in (3a). This changes the results considerably, especially the parameters of the parabola α , β and γ , the error-correction parameter b_0 (which becomes 0.04) and the 'punishment' parameter c_0 , which becomes insignificant. The loglikelihood value is -378.6 such that the null hypothesis of $d_{0,ITA}$ being equal to zero is rejected convincingly (loglikelihood of (3) is -364.7, see table 3) in an LR-test between the models with and without the Italy-dummy in the entrepreneurship equation.
 3 For these calculations, the exact parameter estimates (6 decimals) have been used.

Table 3 Estimation results model (3)*

Parameter	Estimate	Parameter	Estimate
$d_{0,PA}$	.011 (6.2)	b_2	-.035 (-3.0)
b_0	.13 (6.3)	d_1	.18 (11.1)
α	.46 (8.9)	c_0	-3.67 (-2.51)
β	-.039 (-6.2)	c_1	-.20 (-3.6)
γ	.0010 (5.4)	c_2	-.0031 (-3.8)
b_1	.078 (7.0)		
Statistics			
minimum of parabola	.088	R^2 (3a)	.41
Y/CAP (min.)	19041	R^2 (3b)	.70
equilibrium self-empl. at Y/CAP=10(000)	.17 10000	# observations	184
		log-likelihood	-364.7

* t-values are between parentheses.

As can be seen from table 3, all parameter estimates are significant. Notably, the hypothesized equilibrium rate of business ownership indeed appears to exist. Parameters α , β , and γ are significantly differing from zero. Also, β , and γ have the predicted signs and α lies between zero and one, as expected. Further investigation of the parabola shows that the minimum value is reached for a level of per capita income of 19041 purchasing power parities per U.S. \$ at 1990 prices (abbreviated as PPPs from now on). The minimum level of equilibrium business ownership is 8.8% of the labor force. Notice that in the equilibrium relation per capita income is expressed in *thousands* of PPPs. For lower values of GDP per capita (which corresponds to less well-developed economies), the equilibrium rate of business ownership is considerably higher: 17% at 10000 PPPs and 28% at 5477 PPPs (the lowest value of GDP per capita in our sample is Greece in 1974). For the highest value of GDP per capita in our sample (23731 PPPs in Luxembourg 1994), equilibrium business ownership is 11%.

For the interpretation of this parabola describing the equilibrium rate of business ownership given a certain stage of economic development, it should be noted that the relation is based upon a limited range of values of GDP per capita. For values of per capita income far outside our sample range, for example 50000 PPPs, the equilibrium rate of business ownership is not properly described by the quadrat-

ic function. This implies that the relation cannot be used for long-term predictions of the rate of business ownership, since the rate would go beyond 1 eventually. However, since the U.S. data play an important role in estimating the parabola and since the U.S. have high values of GDP per capita throughout the years relative to most other countries, predictions of the (equilibrium) rate of business ownership can be made for most countries up to about 20 years ahead using the estimated parameters. This can be done because most countries have not yet reached the stage of economic development of the U.S. For the U.S., predictions can not be made that far ahead, because the U.S. are at the edge of the range of per capita income values in the sample.

Furthermore, we see that also the hypothesized error-correction process of the number of business owners towards the equilibrium rate is supported: parameter b_0 is significantly positive. The speed of adjustment is not high: the deviation from equilibrium at a certain point in time decreases with 13 percent point in a period of four years. This corresponds to a 50 percent point decrease in a period of twenty years and a 75 percent point decrease in a period of 40 years, *ceteris paribus*. The low value of the speed of adjustment is not surprising: the process of the relative number of business owners converging to the equilibrium number is intrinsically slow because it involves both changes in policies and structural changes of the supply side (setting up enterprises, investments in physical and human capital, divestments, etc.).

The parameter b_1 points to a positive impact of unemployment on self-employment: every percent point rise in the unemployment rate leads to a rise of 0.078 percent point in the self-employment rate in the succeeding six years. This is in accordance with earlier studies: unemployment is a push factor for self-employment (Evans and Leighton 1989 and Storey 1991). The other variable explaining the change in self-employment, the labor income quote, also shows a significant parameter with the expected sign: the parameter b_2 is negative. This means that higher business profitability indeed acts as a pull factor for business ownership. The remaining variable in the business ownership equation, the Italy-dummy, shows a significant positive parameter ($d_{0,ITA}$): in Italy the rate of business ownership rises faster than in other countries.

Another important characteristic of the estimation results is the deviation of the actual number of business owners from the equilibrium rate having a negative impact on economic growth: the parameter c_0

is significantly negative. This implies that economies with relatively few business owners can grow by stimulating business ownership. In section 5.3 the magnitude of the impact will be analyzed for different values of the deviation.

In the growth equation, lagged growth has a negative parameter value ($c_1 = -0.20$) representing cyclical fluctuations: a period of high economic growth is followed by a period with lower growth and vice versa. The per capita income parameter is significantly negative. This might reflect the convergence of countries hypothesis. However, a within-between analysis reveals that this parameter value is mainly a within effect: the negative impact on growth of a higher GDP per capita exists *within* the countries over the years but not between the countries.¹ Therefore, the negative parameter c_2 can best be interpreted as a regression-to-the-mean effect: a higher value of GDP per capita in a certain year leads to a smaller economic growth in the subsequent period. Finally, the constant term d_1 is positive.

Convergence to equilibrium rate of business ownership

An interesting question is how the actual number of business owners (relative to the labor force) has developed over time in comparison to the equilibrium rate of business owners as implied by the model outcomes. From table 3 we see that the equilibrium rate of business ownership can be expressed as $E^*_{it} = .46 - .039 Y/CAP_{it} + .0010 (Y/CAP)_{it}$.² Note that Y/CAP is expressed in thousands of PPPs (U.S. 1990 dollars) in this formula. In table 4 we report the difference between the actual number of business owners and the equilibrium rate of business ownership, $E - E^*$, for all 23 OECD-countries in our dataset for the years 1974, 1984 and 1994 (first, middle and last year of our sample).²

1 Further results of this within-between analysis are the following: the positive impact of unemployment on self-employment growth is a within effect (by and large, this reflects the fact that mainly the new unemployed persons become self-employed) and the negative impact of the labor income quote on business ownership is a between effect. The parameters describing the equilibrium rate of business ownership α , β and γ can be characterized as a mixture of a within effect and a between effect.

2 For these calculations, the exact parameter estimates of the equilibrium rate have been used: $\alpha = .458385$, $\beta = -.038862$ and $\gamma = .00102049$.

Table 4 E-E*, 1974-1994*

Country	1974	1984	1994
Austria	-7.8	-5.8	-3.2
Belgium	-3.7	-1.1	2.2
Denmark	-4.5	-3.3	-2.5
Finland	-11.5	-6.3	-3.5
France	-2.2	-0.9	-1.1
Germany (West)	-6.0	-3.2	-0.8
Greece	-10.2	-6.6	-2.4
Ireland	-15.2	-10.0	-0.3
Italy	-1.1	4.6	8.7
Luxembourg	0.3	-0.8	-5.5
Netherlands	-3.7	-3.4	0.3
Portugal	-17.4	-11.6	0.0
Spain	-4.2	-3.4	3.0
Sweden	-5.4	-3.7	-1.7
U.K.	-8.0	-3.6	1.3
Iceland	-7.4	-3.6	2.5
Norway	-5.5	-0.8	-0.7
Switzerland	1.0	1.0	0.8
U.S.	-0.1	1.3	-0.3
Japan	-4.3	0.1	0.4
Canada	-4.8	-0.9	2.0
Australia	-1.6	2.8	5.6
New Zealand	-1.3	1.0	5.8

* Unity: percent points.

In 1974, almost all countries have too few self-employed relative to the equilibrium value. For most countries, the actual equilibrium rate converges to the equilibrium in the subsequent twenty years. Striking examples of this phenomenon are Ireland and Portugal. These countries show a deviation of more than 15 percent point in 1974 and a deviation of zero in 1994. Other countries with clear convergence are Finland, Germany, Greece, the Netherlands, Sweden, the U.K., Norway and Japan. Convergence takes place in twenty years: for a number of countries the deviation of 1974 disappeared almost completely in 1994. In our discussion of the estimation results of model 3 it is brought forward that the error-correction parameter b_0 , which has value 0.13, leads to a reduction of 50% of the initial deviation in a period of twenty years. Hence, actual convergence to equilibrium takes place faster than implied by the error-correction parameter. However, the calculation based on the parameter b_0 was made under the ceteris paribus condition of all other variables than E remaining constant. Obviously this is not the case in reality. From equation 3a we see that changes in unemployment and the labor income quote have an impact on the growth rate of business ownership, which in turn can accelerate the convergence process. However, the explana-

tion of the convergence should not only be searched for in a rapid change of the actual self-employment rate, but also in a change of the equilibrium rate over time. Because equilibrium self-employment is a function of per capita income, which in general rises considerably in twenty years (see table 2 for the G7 countries), the equilibrium rate goes down because for most countries the rise of per capita income in the period 1974 through 1994 takes place in the downward part of the parabola. In general, the reduction of the deviation between actual and equilibrium self-employment is due to a decreasing equilibrium rate of self-employment and, to a smaller extent, to an increasing rate of (actual) self-employment.

From table 4 it can be seen that the U.S. deviation is always small: below 1.5 percent point. Only for Switzerland the deviation is also this small during the whole period. This is a reflection of the weight the U.S. represents in determining the equilibrium relation. Therefore, the low deviations for the U.S. should be interpreted with caution. Furthermore, we see a considerable increase in the value of $(E-E^*)$ for Ireland, Portugal and Spain in the period 1984 through 1994. This may have to do with the integration of these countries in the European Union and the use of funds channelled to these countries promoting small and young firms. Another phenomenon that attracts attention is that in 1994, certain countries have *too many* self-employed relative to the stage of economic development. The countries with the highest *positive* deviation from the equilibrium are New Zealand, Australia and Italy. In New Zealand this may be a result of the economic reforms in this country, through which business ownership experienced a big boost in the early eighties. See Evans et al. (1996). The positive deviation is highest for Italy: 8.7 percent point. This indicates that the high level of self-employment in Italy is not efficient: it has a relatively large negative impact on economic growth.¹

5.2 Alternative model specifications

In this section we investigate two alternative model specifications. The first has to do with using the deviation-variable in the growth equation. The second one deals with an alternative formulation of the equilibrium rate of business ownership.

¹ In Italy, research and development expenditures are by far the lowest among the largest OECD countries as a percentage of gross national product. This is in line with the idea that when there are too many business owners, the scale advantages in research and development are not utilized. See Cohen and Klepper (1996).

Absolute deviation impact in growth equation

So far, we have paid little attention to how the deviation of the actual rate of self-employment from the equilibrium rate is specified in the growth equation. We have chosen the square of the deviation as a convenient variable because the sign of the deviation (positive or negative) is of no concern. However, we then implicitly assume that the (negative) impact on growth increases more than proportionally with the magnitude of the deviation. This seems a reasonable assumption. However, one can also imagine that the impact increases proportionally with the magnitude of the deviation. To investigate whether or not this specification is more appropriate than the quadratic deviation impact, we estimate the following model where the absolute value of the deviation is taken as explanatory variable in the growth equation.¹

$$(4a) \quad E_{i,t} - E_{i,t-4} = b_0 \left(\alpha + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - E_{i,t-4} \right) + b_1 (U_{i,t-4} - \bar{U}) + b_2 (LQ_{i,t-4} - \bar{LQ}) + d_{i,MS} D_{MS} + \varepsilon_{i,t}$$

$$(4b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 \left| \alpha + \beta \left(\frac{Y}{CAP} \right)_{i,t-4} + \gamma \left(\frac{Y}{CAP} \right)_{i,t-4}^2 - E_{i,t-4} \right| + c_1 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + c_2 \left(\frac{Y}{CAP} \right)_{i,t-4} + d_1 + \varepsilon_{i,t}$$

The estimation results are in table 5.

1 Next to the difference between a linear and a quadratic impact on growth we have also tried to test for another implicit assumption of the (quadratic) form of the deviation-variable, viz., the symmetry in the impact of positive and negative deviations. We used a two-step method in which both model equations are estimated separately: first the business ownership equation and after that the growth equation. Based on the outcomes of the business ownership equation (i.e. the equilibrium rate parameters α , β and γ), we constructed different deviation-variables for the growth equation for positive and negative deviations. However, we could not distinguish between impacts of both types of deviations because we had too few observations with a positive deviation. The two-step method is described in detail in appendix III.

Table 5 Estimation results of model (4)*

Parameter	Estimate	Parameter	Estimate
$d_{0,ITA}$	.011 (6.6)	b_2	-.036 (-3.1)
b_0	.13 (6.8)	d_1	.21 (10.2)
α	.47 (10.3)	c_0	-.65 (-3.9)
β	-.041 (-7.3)	c_1	-.23 (-4.1)
γ	.0011 (6.3)	c_2	-.0045 (-4.3)
b_1	.077 (6.8)		
Statistics			
minimum of parabola	.089	R^2 (4a)	.41
Y/CAP (min.)	18866	R^2 (4b)	.71
equilibrium self-empl. at Y/CAP=10(000)	.17 10000	# observations	184
		log-likelihood	-360.5

* t-values are between parentheses.

We see that, except for c_0 , the parameter estimates hardly differ from those of model (3) in table 3. The parameter of the deviation variable c_0 is different. This is not surprising, since the measurement units are different. Analyzing whether the different specifications imply different impacts of deviations from the equilibrium rate we see that in the original model with the quadratic impact $c_0 = -3.67$. In the alternative model with the linear impact $c_0 = -.65$. We can calculate the impact on economic growth of a deviation of one percent point from equilibrium. For model (3) the negative impact is $3.67 * 0.01^2 = .000367$ (.0367 percent point), whereas for model (4) the impact is $.65 * .01 = .0065$ (.65 percent point). Hence, for a 1% deviation the impact on cumulative growth in the subsequent four years is almost 18 times greater for the linear impact specification than for the quadratic impact specification. Of course, this difference becomes smaller when the deviation increases. See table 6.

Table 6 Impact on four-year growth of linear (model (4)) and quadratic (model (3)) deviation specifications*

Deviation	Model (3): $c_0 = -3.67$	Model (4): $c_0 = -.65$	Factor (4)/(3)
1	.037	.65	18
2	.15	1.3	9
5	.92	3.3	3.6
10	3.7	6.5	1.8
18	12	12	1
20	15	13	.9

* Unity: percent points (except last column).

From table 6, we see that the impact of a deviation of the actual number of business owners from the equilibrium rate is generally greater for model (4) with the linear type of impact than for model (3) with the quadratic type of impact. Only when the deviation is in excess of 18 percent points, the impact of model (3) becomes greater. However, an (absolute) deviation of 18 percent point is outside the range of values that we find for the deviation from equilibrium, see table 4. In general we can say that the negative impact on growth of a deviation is quite large for the linear impact model (.65 percent point for every percent point deviation) while for the quadratic impact model the negative impact is small for small deviations and becomes greater for larger deviations (1% impact on growth when the deviation becomes greater than 5%). Furthermore, we see from table 5 that the loglikelihood value is higher for model (4) than for model (3): -360.5 versus -364.7. Although the models are not nested, so that a formal LR-test cannot be applied (at least not in a straightforward way), this is an indication that the linear impact model (4) is a more appropriate specification than the quadratic impact model (3). The differences, however, are small.

Declining equilibrium function (quadratic deviation impact)

Because in the basic version of our model we hypothesized the relation between the number of business owners and the stage of economic development to be U-shaped, we chose a quadratic form for the equilibrium function in that model. We have seen that the implied minimum of the estimated parabola is reached for a per capita income level of 19041 U.S. 1990 dollars. From our per capita income data we know that only 10 of the 184 observations in the estimation sample have a value of per capita income higher than 19041. Although four of these are of the U.S. having the highest weighing factor in the FIML estimations one may suspect that the rising part of the parabola is not properly described by the estimated parame-

ters α , β , and γ . It might be that the FIML procedure is actually trying to fit an ever declining equilibrium function and that this is the reason that almost all observations belong in the declining part of the estimated parabola. Therefore we investigate whether a different functional form for the equilibrium function leads to a better fit. We choose the following functional form: $E^*_{it} = a_0 + a_1/(Y/CAP_{it} + 1)$. Notice that this is a strict monotonic decreasing function with asymptote a_0 . The model then reads as follows:

$$(5a) \quad E_{i,t} - E_{i,t-4} = b_0 (E^*_{i,t-4} - E_{i,t-4}) + b_1 (U_{i,t-6} - \bar{U}) + b_2 (LQ_{i,t-6} - \bar{LQ}) + d_{0,ITA} D_{ITA} + \varepsilon_{i,t},$$

$$(5b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 (E^*_{i,t-4} - E_{i,t-4})^2 + c_1 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + c_2 \left(\frac{Y}{CAP}\right)_{i,t-4} + d_1 + \varepsilon_{2,i,t},$$

$$(5c) \quad E^*_{i,t} = a_0 + a_1 / \left(\left(\frac{Y}{CAP}\right)_{i,t} + 1 \right).$$

Again we estimate the model with the number of business owners as weighing variable. The results are in table 7.

Table 7 Estimation results model (5)

Parameter	Estimate	Parameter	Estimate
$d_{0,ITA}$	.0098 (5.4)	b_2	-.039 (-3.4)
b_0	.12 (5.9)	d_1	.17 (11.3)
a_0	-.013 (-.73)	c_0	-3.18 (-2.26)
a_1	2.02 (6.6)	c_1	-.20 (-3.6)
b_1	.078 (7.1)	c_2	-.0030 (-3.8)
Statistics			
asymptote of eq. function as $Y/CAP \rightarrow \infty$	-.013	R^2 (5a)	.40
		R^2 (5b)	.70
equilibrium self-empl. at $Y/CAP=10000$	.17	# observations	184
		log-likelihood	-367.2

* t-values are between parentheses.

Comparing the results from table 7 with those from table 3 (original model with quadratic equilibrium function), we see that the parameter estimates hardly differ (except for the equilibrium function parameters). The parameter a_1 describing the declining character of the equilibrium function is significantly positive. Using the parameter estimates of a_0 and a_1 we can write the equilibrium function of model (5) as $E^*_{it} = -.013 + 2.02/(Y/CAP_{it} + 1)$. The asymptote of this function is not significantly different from zero: the t-value is $-.73$. Note that for $Y/CAP = 0$, the implied relative number of business owners by model (5) is less realistic than for the quadratic equilibrium function: 2.0 versus $.46$. Looking at the range of values of GDP per capita in our sample we find an equilibrium rate of business ownership that varies between 30% of the labor force (Greece 1974) and 6.8% (Luxembourg 1994). Remember that the corresponding range for the quadratic equilibrium model (3), was between 28% and 11%. We observe that for high values of GDP per capita, the implied equilibrium rates start to differ between both models. This is easy to understand. At first both equilibrium functions are declining with an increasing value of per capita income. When the minimum of the parabola is reached, however, the quadratic function starts to rise while the monotonic decreasing function of model (5) continues to decline. Because many countries in our sample are still in the phase of the decreasing part of the parabola during (the largest part of) the estimation period (i.e. the equilibrium number of self-employment is still decreasing because of the occurrence of economies of scale), the FIML procedure can not distinguish between the quadratic function and the monotonic decreasing function: both models display a good fit with high t-values. Again, a nested LR-test is not possible but the loglikelihood-values show that there is not much difference between both model fits: -364.7 for model (3) versus -367.2 for model (5). Notice that model (5) has one parameter less than model (3). This indicates that we cannot distinguish between both models statistically.

Another argument that the quadratic equilibrium function is more appropriate than the declining equilibrium function is illustrated by the figures 1a and 1b. In these figures business ownership is set out against per capita income for the major industrialized countries (G7) for the sample period 1974 through 1994. In figure 1b, we have also plotted the estimated equilibrium functions. The dotted line in figure 1b represents the estimated function $E^*_{it} = -.013 + 2.02/(Y/CAP_{it} + 1)$ and the dotted line with the markers represents the estimated function $E^*_{it} = .46 - .039 Y/CAP_{it} + .0010 (Y/CAP_{it})^2$. The other lines in figure 1b are the same as in figure 1a. For ease of

presentation, we have not inserted the names of the countries in figure 1b. Notice that business ownership is again a relative variable (per labor force) and that the x-axis starts at 10000 PPPs. We see that, of the G7 countries, only Japan and France show a descending pattern of the relative number of business owners as the GDP per capita rises. In the other countries the number of business owners rises or stays constant when countries reach a higher stage of economic development. Therefore, it is unrealistic to assume that the equilibrium number of business owners would always decline. This can also be seen in figure 1b. When the level of per capita income grows, the declining function deviates increasingly from the values of per capita income/self-employment for the G7-countries, while the quadratic function is more or less in line with the values in the sample. The U.S. are the best example of this phenomenon, since it is the only G7-country with values of per capita income at levels where the equilibrium values of the two functions are quite different from each other (viz., the high values of Y/CAP). For these high values of GDP per capita, the quadratic equilibrium function is the better approximation, as can be seen from figure 1b. Thus, also on the basis of a graphical analysis of the equilibrium functions, we tend to conclude that the quadratic function is a more realistic specification than the declining function.

Figure 1a Business ownership versus per capita income for G7-countries, 1974-1994

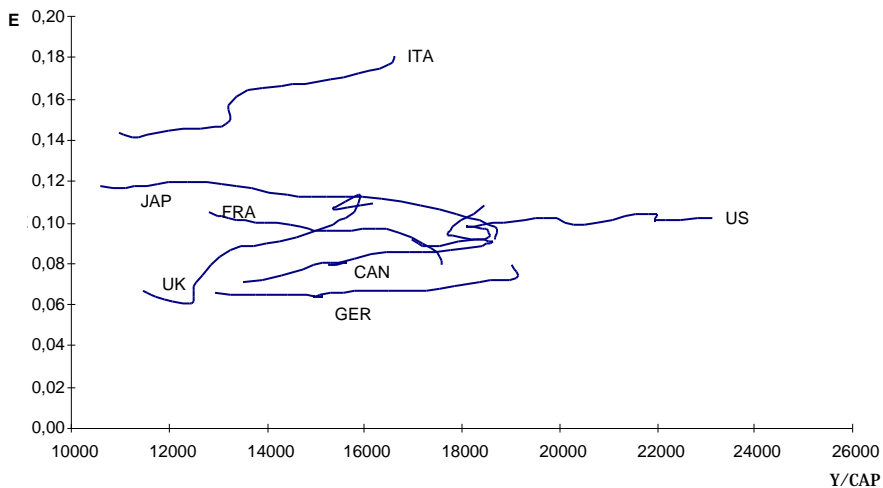
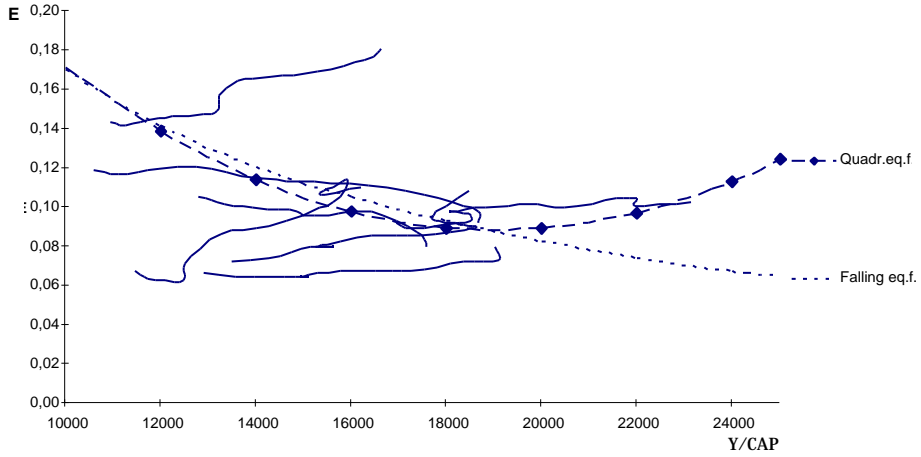


Figure 1b Business ownership versus per capita income for G7-countries, 1974-1994, with eq. functions



Declining equilibrium function (absolute deviation impact)

We observed that for the quadratic equilibrium function, the model with the impact of the deviation of the actual number of business owners from the equilibrium rate on growth specified as an absolute deviation (model (4)) had a slightly better model fit than the quadratic deviation impact model (3). It is interesting to see whether this is also the case for the declining equilibrium function model. Therefore we present the following model (the equilibrium function is put directly into the business ownership equation and the growth equation):

$$(6a) \quad E_{i,t} - E_{i,t-4} = b_0 \left(a_0 + a_1 / \left(\left(\frac{Y}{CAP} \right)_{i,t-4} + 1 \right) - E_{i,t-4} \right) + b_1 (U_{i,t-4} - \bar{U}) + b_2 (LQ_{i,t-4} - \bar{LQ}) + d_{0,72} D_{72} + \varepsilon_{i,t}$$

$$(6b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) = c_0 \left| a_0 + a_1 / \left(\left(\frac{Y}{CAP} \right)_{i,t-4} + 1 \right) - E_{i,t-4} \right| + c_1 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + c_2 \left(\frac{Y}{CAP} \right)_{i,t-4} + d_1 + \varepsilon_{2,i,t}$$

Again we estimate the model with the number of business owners as weighing variable. The results are in table 8.

Table 8 Estimation results model (6)*

Parameter	Estimate	Parameter	Estimate
$d_{0,ITA}$	.0100 (6.0)	b_1	-.038 (-3.4)
b_0	.12 (6.4)	d_1	.20 (11.0)
a_0	-.0084 (-.61)	c_0	-.62 (-4.3)
a_1	1.94 (8.4)	c_1	-.23 (-3.9)
b_1	.079 (7.0)	c_2	-.0036 (-3.8)
Statistics			
asymptote of eq. function as $Y/CAP \rightarrow \infty$	-.0084	R^2 (6a)	.40
		R^2 (6b)	.71
equilibrium self-empl. at $Y/CAP=10000$	.17	# observations	184
		log-likelihood	-363.0

* t-values are between parentheses.

Comparing the results in table 8 with those in table 7 (declining equilibrium model with quadratic deviation impact), we draw the same conclusions as with the comparison between the models (3) and (4) being the models with the quadratic equilibrium function. For the range of plausible deviation values the negative impact on growth of the linear impact model is greater than that of the quadratic impact model. Furthermore, the linear impact model (6) has a higher log-likelihood value than the quadratic impact model (5): -363.0 versus -367.2. As mentioned above, this is an indication that the linear impact model is slightly better specified than the quadratic impact model.

6 Conclusions

There are many links between entrepreneurship and the macroeconomy. See Acs, Carlsson and Karlsson (1999) for a recent and Brock and Evans (1986) for an early survey. The present paper zooms in on one specific linkage: that between the number of business owners and economic growth. Three aspects of this linkage are investigated. *First*, whether there is a long-term equilibrium relation between the number of business owners and the stage of economic development. This suspicion arises from scrutinizing empirical and theoretical work in this area. The relation is hypothesized to be a decreasing function of economic development in that the self-employment rate is high in low-developed economies whereas there is a later phase where mass production and scale economies thrive. A vast literature points at a still later phase of economic development where the business ownership rate is increasing again. This phase is characterized by 'the reversal of the trend' towards increasing economies of scale and scope. However, it is still unclear to which extent this reversal will be structural. Therefore both a U-shaped as well as an L-shaped equilibrium relation are tested in the present paper. *Second*, whether there exists a correction mechanism when the rate of business ownership is out of equilibrium and what the speed of convergence is. Out of equilibrium situations can occur due to exogenous shocks and institutional divergences, for instance, because 'government regulation of market activity is likely to obstruct and frustrate the spontaneous, corrective forces of entrepreneurial adjustments' (Kirzner 1997, p. 81). *Third*, whether deviating from the equilibrium rate of business ownership leads to lower economic growth. The three aspects are tested using a two-equation model. The first equation explains the growth of the number of business owners using the deviation of the equilibrium rate of business ownership, unemployment as a push factor and labor income quote as a measure of business profitability. The second equation explains economic growth using the deviation of the equilibrium rate of business ownership, lagged economic growth and the per capita income level. The model is tested using a data panel of 23 OECD countries. Attention is paid to the specific role of Italy's dual economy, the penalty structure of an economy in 'disequilibrium' and the shape of the long-term equilibrium relation between the number of business owners and the stage of economic development.

Our investigations show that both the U-shaped and the L-shaped relation between the number of business owners and the stage of

economic development produce satisfactory results, that a statistical discrimination cannot be made since 'the reversal of the trend' is of a recent date only and that the minimum of the U-shaped equilibrium relation is within the range observations of economic development. This minimum is calculated to be approximately a business ownership rate of 8.8 % of the labor force at a per capita income of 19.000 PPPs (per US \$ at 1990 prices). The assumption of a U-shaped curve would imply that modern economies are now in a phase where the rate of business ownership is likely to increase structurally. The rate of business ownership is shown to influence economic growth through deviations from the equilibrium rate. This result supports the view that size distribution differences across countries matter when explaining economic performance (Davis and Henrekson 1999). As a consequence, economies can have both too few or too many business owners and that both situations lead to lower growth rates. By and large, a five percent point deviation generates a growth loss of between one and three percent (depending upon the particular specification of the penalty function) over a period of four years. In particular, the fact that economic development may be hampered by a number of business owners being too high considering an economy's stage of development may come as a surprise for European politicians who see self-employment as a forceful weapon when fighting unemployment and stagnating growth. Different economic stages call for different development and stimulation programs. An error correcting mechanism exists between the real rate of business ownership and the equilibrium rate. Lagged unemployment appears to be a significant push factor of business ownership whereas a high lagged labor income quote appears to decrease business ownership rates indicating the effect of low business profitability. Italy plays an exceptional role in that there appears to be an additional autonomous increase of the rate of self-employment which may frustrate economic growth. Most countries show a convergence towards the equilibrium rate of business ownership in the period 1974 through 1994. Our model allows for two mechanisms for a disequilibrium between the actual and the equilibrium rate of business ownership to diminish. The first explicit mechanism is that of the actual rate of business ownership to converge to the equilibrium one given the level of economic development. The second implicit one is that of economic development causing the equilibrium level to shift towards its actual rate. Evidence is established for both mechanisms but the second appears to dominate the first. The speed of the first explicit error correction mechanism amounts to a half time of two decades irrespective of the choice of the equilibrium relation and the penalty function.

An important policy implication of our exercises is that not only that 'To induce dynamic entrepreneurial competition we require the fulfillment of only one condition: guaranteeing free entrepreneurial entry into any market where profit opportunities may be perceived to exist' (Kirzner 1997, p.74) but also that exit free of stigma and financial burdens is safeguarded. See also Acs, Carlsson and Karlsson (1999). Free entry and exit of entrepreneurs is a necessary condition for the equilibrium seeking mechanisms which are vital in our model of the relation between business ownership and economic growth.

Future research should investigate whether different countries have different equilibrium relations depending upon institutional, industrial and other dimensions and how and to what extent policy measures are able to influence this equilibrium. Furthermore, while the present research is fully based upon country-wide composites, sectoral diversity between countries probably plays a role when explaining differences in equilibrium situation and differences in the equilibrium restoring mechanism. For that many data problems have to be resolved.

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Appendix I: Data

The following countries are in the estimation sample (1974-1994):

Austria	Greece	Spain	U.S.
Belgium	Ireland	Sweden	Japan
Denmark	Italy	U.K.	Canada
Finland	Luxembourg	Iceland	Australia
France	Netherlands	Norway	New Zealand
Germany (West)	Portugal	Switzerland	

The variable definitions and main sources are listed below.

1. **E** : self-employment or business ownership. This variable is defined as the number of self-employed (business owners) per labor force, who in this report are defined to include owners of enterprises that are not legally incorporated as well as owner/managers of incorporated businesses. We use the terms self-employed and business owners interchangeably. For more information on various measures of self-employment, see *The state of small business; a report of the president 1986*, Washington: US Government Printing Office, chapter 4. Data on the number of self-employed (business owners) are from the OECD Labor Force Statistics 1974-1994. Some data were missing however. EIM completed the data by using ratios derived from other variables, which sometimes came from other sources. Furthermore, EIM made a unified dataset of self-employed persons, which was necessary as in the OECD statistics the definitions of self-employed were not fully compatible between countries. In some countries self-employed are strictly defined as individuals owning a business that is not legally incorporated. In other countries, owner/managers of an incorporated business who gain profits as well as a salary, are also considered self-employed. Australia, Canada, Denmark, France, Ireland, the Netherlands, New Zealand, Norway, Portugal, Spain and U.S. use the narrow definition, while the other countries apply the broader characterization. For the countries not following the broader definition, EIM made an estimation of the number of owner/managers by using information derived from statistical bureaux in these countries. Another difference in definition is that in some countries unpaid family workers are included in the data of self-employed as well. This is the case in Austria, Canada, Finland, France, Greece, Italy and the Netherlands. The unpaid family workers

were eliminated from the data by using ratios derived from other variables. Data on the labor force are also from the OECD Labor Force Statistics 1974-1994. Again, some missing data have been filled up from other sources.

2. Y/CAP : gross domestic product per capita. The underlying variables gross domestic product and total population are from OECD, National Accounts 1960-1994, Detailed Tables, and from the OECD Labor Force Statistics 1974-1994, respectively. The GDP is measured in constant prices. Furthermore, purchasing power parities are used to make the monetary units comparable between countries.
3. U : (standardized) unemployment rate. This variable measures the number of unemployed as a fraction of the total labor force. The labor force is formed by employees, self-employed persons, unpaid family workers, people who work in the army and unemployed persons. The main source for this variable is OECD Main Economic Indicators. Some missing data on the number of unemployed have been filled up with help of data from the OECD Labor Force Statistics and the Yearbook of Labor Statistics from the International Labor Office.
4. LIQ : labor income quote. The following definition is used. Total compensation of employees is multiplied by (total employment/number of employees) to correct for the imputed wage income for the self-employed persons. Next, the number obtained is divided by total income (compensation of employees plus other income). The data on the separate variables are from the OECD, National Accounts 1960-1994, Detailed Tables. Some missing data have been filled up with help of data from the OECD Labor Force Statistics.
5. Y : gross domestic product. This is the same variable as the Y part of the variable Y/CAP (see 2.).

Appendix II: Weighed regressions

Estimation results are obtained by weighing the observations with the number of self-employed. In this appendix the reasons for doing so will be explained. For simplicity we will assume that we have cross-section data (i.e., without time-dimension).

Suppose that there are N regions in L countries with $L \ll N$. In our case, L would be 23 because we have 23 countries in our data set. We assume that these N regions are all of the same size. Thus, for example, the U.S. would have many more regions than Luxembourg. If we would dispose of data per region, we would propose the following model for a linear relationship between two variables x and y :

$$(a) \quad y_{R,i} = \beta x_{R,i} + \varepsilon_{R,i}, \quad i = 1, \dots, N \text{ (regions)}.$$

The subscript R is used to denote that the data are assumed to be available at the regions-level. The OLS-estimator of b in (a) is then

$$b_{OLS(a)} = \frac{\sum_{i=1}^N x_{R,i} y_{R,i}}{\sum_{i=1}^N x_{R,i}^2}.$$

However, we have data at the aggregation level of countries and not at the level of regions. Given our assumption that the regions are equally large, we can write the model with the variables x and y at the country level (subscript c) as

$$(b) \quad y_{C,j} = \beta x_{C,j} + \varepsilon_{C,j}, \quad j = 1, \dots, L \text{ (countries), with}$$

$$y_{C,j} = \sum_{D_{i,j}=1} y_{R,i} / N_j \text{ and } x_{C,j} = \sum_{D_{i,j}=1} x_{R,i} / N_j,$$

and where we define the variable $D_{i,j}$ as follows: $D_{i,j} = 1$ if region i lies in country j and 0 otherwise. Furthermore, N_j denotes

the number of regions in country j ($\sum_{j=1}^L N_j = N$). Hence, we assume

that the variables x and y at the country-level can be written as the averages of the variables over the regions of the country. When we translate these country-level variables $y_{C,j}$ and $x_{C,j}$ from (b) back to the regions-level variables $y_{R,i}$ and $x_{R,i}$ from (a), we obtain the following observations for our original model (a) at the regions-level:

Observations for which:

$$\begin{array}{llll} D_{11} = 1: & y_{R1}^* = y_{C,1}, & x_{R1}^* = x_{C,1}, & (N_1 \text{ observations}), \\ \cdot & & & \\ \cdot & & & \\ D_{L1} = 1: & y_{R1}^* = y_{C,L}, & x_{R1}^* = x_{C,L}, & (N_L \text{ observations}). \end{array}$$

Writing the data at the regions-level in this manner, it is implicitly assumed that *within* countries, the various regions are identical. With these observations, the OLS-estimator can be written as:

$$b^*_{OLS}(a) = \frac{\sum_{j=1}^L x_{R,j}^* y_{R,j}^*}{\sum_{j=1}^L x_{R,j}^* x_{R,j}^*} = \frac{\sum_{j=1}^L N_j x_{C,j} y_{C,j}}{\sum_{j=1}^L N_j x_{C,j} x_{C,j}}.$$

Thus, here it is assumed that there are N observations where for every observation (region) within a country, the variables have identical values.

However, we have only L observations and then the OLS-estimator of b from (b) reads as

$$b_{OLS}(b) = \frac{\sum_{j=1}^L x_{C,j} y_{C,j}}{\sum_{j=1}^L x_{C,j} x_{C,j}}.$$

We see that this estimator is different from b^*_{OLS} (a), which we would like to have. The estimator b_{OLS} (b) does not take account that different countries have different numbers of regions, or stated differently, that the various countries are not equally large. Therefore, we weigh the observations by premultiplying the variables x_C and y_C from (b) with the square root of the number of regions. When we do that the (weighed) least squares estimator b_{WLS} (b) reads as

$$b_{WLS}(b) = \frac{\sum_{j=1}^L \sqrt{N_j} x_{C,j} \sqrt{N_j} y_{C,j}}{\sum_{j=1}^L \sqrt{N_j} x_{C,j} \sqrt{N_j} x_{C,j}}.$$

We see that the WLS-estimator of (b) is exactly the same as the OLS-estimator of (a), b^*_{OLS} (a). Clearly, we do not know the number of regions per country. We use the number of self-employed as a proxy for this number of regions.

Appendix III: Two-step method

In the paper Full Information Maximum Likelihood (FIML) is applied. This method generates parameter estimates by maximizing an objective function. This is done in an iterative process. The FIML procedure might stop while the global maximum of the objective function has not been reached yet. A disadvantage of the method is that it is sometimes not clear whether or not the FIML procedure found the 'real' parameter estimates, i.e., whether the global maximum was found. Therefore, we also applied an alternative method to find the parameter values of our basic model (3). Instead of estimating the model simultaneously, we estimated the model sequentially.

This second method is implemented as follows. First, we estimate equation (3a) with weighed least squares (weighing variable is the number of self-employed, as before). On the basis of the parameter values found for the equilibrium rate of self-employment we then calculate the deviation variable which is used in (3b) and using this variable we then estimate equation (3b), again with weighed least squares. Because the residuals of equations (3a) and (3b) are hardly correlated (we found a correlation coefficient of 0.025), we may expect that the parameter estimates of the single equation estimations will not differ considerably from the 'simultaneous' estimates of (3). Therefore, if the single equations estimates indeed appear to be approximately the same as the 'simultaneous' estimates, this would enhance our confidence in the reliability of the 'simultaneous' estimates. Notice that this approach would not be possible if model (3) would be intrinsically simultaneous.

We start the implementation of the two-step method by estimating equation (3a). Looking at equation (3a) however, we see that the model is not identified when we estimate this as a single equation: the parameters b_0 and α can not be estimated separately. Therefore we estimate the following equation:

$$(7a) \quad E_{t,j} = \alpha_0 + \alpha_1 E_{t,j-4} + \alpha_2 U_{t,j-5} + \alpha_3 LQ_{t,j-4} + \\ + \alpha_4 \left(\frac{Y}{CAP} \right)_{t,j-4} + \alpha_5 \left(\frac{Y}{CAP} \right)_{t,j-4}^2 + \alpha_6 D_{M4} + \varepsilon_{t,j}$$

It can be shown that the following relations hold between the parameters from (3a) and the parameters from (7a).

$$\begin{aligned}
 b_0 &= 1 - \alpha_1, & \beta &= \alpha_4 / (1 - \alpha_1), \\
 b_1 &= \alpha_2, & \gamma &= \alpha_5 / (1 - \alpha_1), \\
 b_2 &= \alpha_3, & d_{0,ITA} &= \alpha_6, \\
 \alpha &= \alpha_0 / (1 - \alpha_1) + \alpha_2 \bar{Y} / (1 - \alpha_1) + \alpha_3 \overline{LQ} / (1 - \alpha_1),
 \end{aligned}$$

where the upper bars again denote sample averages (of the six years lagged variables, see (7a)). The results of the single equation estimation of (7a) are in table 9a. In this table also the implied parameter values of (3a) are reported. To compare them with the 'simultaneous' equation estimates we also report them in the last column (see also table 3).

Table 9a Estimation results (7a)*, **

Parameters (7a)	Estimate	Parameters (3a)	Implied value (7a)	Value (3a)
α_0	.087 (6.2)	α	.49	.46
α_1	.88 (35.9)	b_0	.12	.13
α_2	.076 (5.4)	b_1	.076	.078
α_3	-.037 (-2.8)	b_2	-.037	-.036
α_4	-.0051 (-5.4)	β	-.042	-.039
α_5	.00014 (4.5)	γ	.0011	.0010
α_6	.011 (5.1)	$d_{0,ITA}$	.011	.011

* t-values are between parentheses.

** All reported estimations were run with 184 observations.

From table 9a we see that the parameters of the business ownership equation (fifth column) from the 'simultaneous' two equations model are about the same as the implied parameter values from the single equation (fourth column). Using the implied parameter values from the fourth column we calculate the deviation variable that we need in the growth equation, as follows: $E_dev_{it} = (.49 - .042 Y/CAP_{it} + .0011 (Y/CAP)_{it}^2 - E_{it})^2$. The following equation is estimated using weighed least squares:

$$\begin{aligned}
 (7b) \quad \ln(Y_{i,t}) - \ln(Y_{i,t-4}) &= \beta_0 + \beta_1 E_dev_{i,t-4} + \beta_2 (\ln(Y_{i,t-4}) - \ln(Y_{i,t-8})) + \\
 &\quad \beta_3 \left(\frac{Y}{CAP} \right)_{i,t-4} + \varepsilon_{i,t}
 \end{aligned}$$

In table 9b we report the results of the single equation estimation of (7b) as well as the 'simultaneous' model results of (3b).

Table 9b Estimation results (7b)*, **

Parameters (7b)	Estimate	Parameters (3b)	Value (3b)
β^0	.18 (8.9)	d_1	.18
β^1	-3.18 (-2.2)	c_0	-3.66
β^2	-.20 (-2.6)	c_1	-.20
β^3	-.0032 (-3.0)	c_2	-.0031

* t-values are between parentheses.

** All reported estimations were run with 184 observations.

From table 9b we see that also for the growth equation, the single equation estimation and the 'simultaneous' estimation yield almost identical results.