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# The More Business Owners the Merrier? The Role of Tertiary Education

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**The More Business Owners the Merrier?  
The Role of Tertiary Education**

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**Abstract**

Policy in developed countries is often based on the assumption that higher business ownership rates induce economic value. Recent microeconomic empirical evidence casts doubts on the validity of this assumption or, at least, leads to a more nuanced view: Especially the top performing business owners are responsible for the value creation of business owners. Other labor market participants would contribute more to economic value creation as an employee than a business owner. The implied existence of an ‘optimal’ business ownership rate would thus replace the dictum of ‘the more business owners, the merrier’. We attempt to establish whether there is such an optimal level, while investigating the role of tertiary education. Two findings stand out. First, by estimating extended versions of traditional Cobb Douglas production functions on a sample of 19 OECD countries over the period 1981-2006, we find indeed robust evidence of an optimal business ownership rate (at around 12.5%, on average). Second, the relation between business ownership and macroeconomic productivity is steeper for countries with higher participation rates in tertiary education. Thus, the optimal business ownership rate tends to decrease with tertiary education levels. This is consistent with microeconomic theory and evidence showing that entrepreneurs with superior levels of human capital run larger firms.

**JEL classification:** E23, J24, L26, O40, O57

**Keywords:** entrepreneurship, business ownership, human capital, (returns to) education, cross-country comparison, production function

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## 1. Introduction

*Policy makers believe a dangerous myth. They think that start-up companies are a magic bullet that will transform depressed economic regions, generate innovation, create jobs, and conduct all sorts of other economic wizardry.*

(Shane, 2009, p. 142)

Developed countries have installed many policy measures over the past decades based on the assumption that higher business ownership rates induce economic value creation (European Commission, 2009, Chapter 3). Indeed, evidence has been collected of a positive relationship between entrepreneurship and economic value creation, albeit the evidence may be ambiguous (Parker, 2009; Van Praag and Versloot, 2007).<sup>1</sup>

Recent microeconomic empirical evidence casts doubts on the validity of this assumption (Parker, 2009) or, at least, leads to a more nuanced view (e.g., Henrekson and Johansson, 2010): Especially the top performing end of the population of business owners is responsible for the largest part of the value creation of the whole population of business owners (Shane, 2009). Other labor market participants would contribute more to economic value creation as an employee (in the firms of these top business owners) than as a business owner (e.g., Hartog et al., 2010). Thus the common and rather popular assumption ‘the more business owners, the merrier’ would not hold and there should then be an ‘optimal’ business ownership rate. Scott Shane even concludes that ‘encouraging more people to become entrepreneurs is bad public policy’ (2009).

These recent insights are obtained in three strands (or corners) of microeconomic studies. The first consists of a few studies showing that a small percentage of (mostly relatively young) high growth or ‘high impact’ firms measured in terms of sales or employment growth, is responsible for the largest part of the total growth of net employment and sales (see a meta-analysis by Henrekson and Johansson, 2010; and an extensive study on US firms by Acs et al., 2008 or many examples in Shane, 2009). The second strand leads to this insight in a more indirect manner: There is ample evidence that only a fraction of the labor force actually receives a higher income as an entrepreneur than an employee (e.g., Hamilton, 2000; Parker, 2009). This evidence is (indirectly) in line with the presence of an optimal business ownership rate because individual incomes of entrepreneurs and their firm’s contribution to economic value creation are correlated strongly (see Parker, 2009). Third, there is a strand of theoretical equilibrium models of occupational choice that lead to an equilibrium business ownership rate given the optimal division of the labor force across the occupations ‘entrepreneur’ and ‘wage employee’. Early and influential examples of such models are Lucas (1978), Kanbur (1979), and Kihlstrom and Laffont

<sup>1</sup> Value creation is mostly measured in terms of a firm’s contribution to economic growth, labor demand or innovation (Van Praag and Versloot, 2007).

(1979). The recent insights are thus supportive of equilibria obtained in these occupational choice models (Shane, 2009).

Our main contribution to the literature is that we perform a cross-country *test* of the empirical validity of the phenomenon of an optimal business ownership rate and, if valid, what the estimated optimal rate is. The test is performed by estimating an extended version of traditional Cobb Douglas production functions based on a panel of 19 OECD countries over the period 1981-2006. Indeed, we find evidence consistent with the presence of an optimal business ownership rate and inconsistent with ‘the more the merrier’. We estimate the ‘optimal’ business ownership rate (BOR) to lie around 12.5%, on average. We show that the actual business ownership rate is somewhat lower than optimal in most OECD countries. Based on this we try to feed the discussion of ‘Are there too many or too few entrepreneurs?’, which may bear policy implications if one believes that public policy has a role in this (Parker, 2005; Shane, 2009; Parker and Van Praag, 2010).

The second part of the paper focuses on the heterogeneity of this ‘optimal’ business ownership rate across countries and over time. Microeconomic evidence supports the view that top business owners, i.e., the ones with high levels of performance [in terms of income and growth] that are in particular responsible for value creation, have superior levels of human capital. In other words, human capital, in particular education, is one of the most important individual drivers of the performance of business owners and the ensuing firm size. This has already been expressed by seminal economists, such as Marshall (1890), Kaldor (1934), and Coase (1937) and these claims have obtained broad empirical support (Parker, 2009; Parker and Van Praag, 2006).

Even stronger, recent evidence convincingly shows that especially those labor force participants with high levels of education and ability are the ones that earn a premium income as entrepreneurs, whereas others, with lower levels of human capital are better off as employees. This is a combination of the fact that the returns to ability and education are higher in entrepreneurial positions than in wage employment and that average incomes –conditional on observed characteristics- are higher for employees than entrepreneurs (Hamilton, 2000; Hartog et al., 2010; Van Praag et al., 2009). This implies, at the macro level, that higher levels of education lead to more productive entrepreneurs and thus to a steeper relationship between the business ownership rate and economic value creation (the macroeconomic equivalent of higher returns to human capital). And since more productive entrepreneurs run larger firms, they require, on average, more employees leading to a lower optimal business ownership rate. We consider the indicative evidence of these relationships obtained in our study its second contribution: we show that higher participation rates in tertiary education are associated with a steeper relationship between production outcomes and the business ownership rate and with lower levels of the ‘optimal’ business ownership rate.

Our results are obtained using a methodology connecting two small strands of empirical literature that deal with the relationship between entrepreneurship and macro-economic performance, while

introducing the interplay between tertiary education and business ownership as a new element in the determination of macro-economic production. In a first strand of literature the relation between economic growth and shares of small and medium-sized enterprises (SMEs) or business ownership rates is analyzed for a group of developed countries (Audretsch et al., 2002a; Carree et al., 2002, 2007, Erken et al., 2008). Most closely related are Carree et al. who model an ‘equilibrium’ rate of business ownership, and find a negative relationship between deviations of the actual business ownership rate from the ‘equilibrium’ and subsequent macroeconomic growth. We try to corroborate the existence of an optimal business ownership rate, as implied by Carree et al. (2002, 2007), by enriching the model in the following respects: We allow for a non-linear relationship between the business ownership rate and productivity –such that the presence of an optimum can actually be *tested*- in a formal production function framework, where the role of various input factors in the production process is explicitly acknowledged.<sup>2</sup>

By estimating macro-economic production functions, we follow the tradition of a second strand of literature which models output as a function of the traditional input factors physical capital, labor, and knowledge capital, and, in addition, of an input factor labeled entrepreneurship capital (see for instance Audretsch and Keilbach, 2004a, 2004b; Audretsch et al., 2006; Mueller, 2007). We contribute to this strand of literature in two ways. First, instead of a regional comparison within one country – Germany in all studies mentioned above–, we perform an international comparison, using data for 19 OECD countries. Second, we focus on the relationship between economic outcomes and the business ownership rate, while the earlier studies operationalized entrepreneurship as the number of new-firm start-ups. Our indicator of entrepreneurship measures which proportion of the workforce is an entrepreneur and which proportion an employee and may be more consistent with the occupational choice framework employed in microeconomic theory.

The remainder of the paper is organized as follows. The next section develops propositions to be tested. In Sections 3 and 4, we discuss the empirical methodology and the data. Section 5 is devoted to the estimation results while Section 6 concludes.

## 2. Propositions

Considerable research effort has been put into quantifying the relationship between economic value creation and entrepreneurship. Are more entrepreneurs associated with better economic performance? Based on a meta-analysis of studies (Van Praag and Versloot, 2007) it is concluded that the answer to this question is positive, but does certainly require more nuance:

Entrepreneur(ial firm)s create relatively more employment than a control group of non-entrepreneurial firms, where in each of the studies that form the basis of the meta-analysis a compari-

<sup>2</sup> Carree et al. (2002, 2007) model per capita income growth by only including one control variable: initial per capita income.

son is made between (i) young versus older firms, or (ii) new versus incumbent firms, or (iii) small versus large firms. However, the jobs created in entrepreneurial firms are less secure and, on average, pay worse. At the macro level new firms have, in addition, an indirect effect on employment. This effect is negative shortly after they have entered the market due to the fact that some of the incumbent firms can't cope with the competition caused by the new entrants and shrink or get out of the market altogether. In addition, many of the new firms do not survive the first years after the start. The indirect effect on employment turns positive after five to eight years because new firms have a disciplinary effect on (surviving) incumbents. Depending on the quality of the new firms, the positive effect on the longer term is larger than the short term negative effect such that the net indirect effect of start-ups on employment is positive (Fritsch and Mueller, 2004; Van Stel and Suddle, 2008). Moreover, entrepreneurs are associated with higher levels of labor/factor productivity, with (the commercialization of) innovation, and with knowledge diffusion (Braunerhjelm et al., 2010).

The studies discussed above show that, if anything, the association between entrepreneurship and economic outcomes is positive. However, these studies do not address the highly relevant question: "Is more entrepreneurship better in general or can we have, instead, too many entrepreneurs?" In other words, can it be that there is some sort of optimal rate of business ownership (a common empirical equivalent of entrepreneurship)?

Carree et al. (2002) summarize arguments stemming from macroeconomic studies as to why the level of entrepreneurship (business ownership) may be too low or too high, as follows: "A shortage of business owners is likely to diminish competition with detrimental effects for static efficiency and competitiveness of the national economy. 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. It will result in large numbers of marginal entrepreneurs, absorbing capital and human energy that could have been allocated more productively elsewhere." (p. 276).

Occupational choice theory provides a micro foundation for the phenomenon of an optimal business ownership rate. Early and influential occupational choice models are Lucas (1978); Kanbur (1979); and Kihlstrom and Laffont (1979) who describe the division of a given workforce over the two classes of entrepreneurs and wage-earners, or employers and employees. This division depends on the distribution of individual characteristics. For Lucas (1978) this is entrepreneurial aptitude, in addition to capital; for Kanbur (1979) and Kihlstrom and Laffont (1979) the emphasis is on risk with respect to entrepreneurial aptitude which is unknown until it has been proven. In all of these models, a certain equilibrium rate of entrepreneurship results.<sup>3</sup>

<sup>3</sup> Many more recent applications of these models follow Lucas' idea that (entrepreneurial) ability is the main driver of occupational choice (e.g., Blanchflower and Oswald, 1998; Calvo and Wellisz, 1980; Evans and Jovanovic, 1989; Jovanovic, 1994; Lazear, 2005; Parker and Van Praag, 2010; Van Praag and Cramer, 2001).

*Proposition 1* There is an optimal business ownership rate

Based on the assumption of the existence of an optimal business ownership rate, various theoretical models and ideas have been developed to further our understanding of why the actual business ownership rate may be higher or lower than optimal. This may be due to market imperfections in credit markets (Stiglitz and Weiss, 1981; De Meza and Webb, 1987) or labor markets (Parker and Van Praag, 2010), positive external effects of entrepreneurship (Parker, 2009), distorted incentives due to tax systems (e.g., Schuetze, 2000), large (perceived) non-pecuniary gains from entrepreneurship (e.g., Benz and Frey, 2008; Blanchflower and Oswald, 1998) or cognitive biases arising from, for instance, overoptimism (Lowe and Ziedonis, 2006; Dushnitsky, 2009) or overconfidence (Hayward et al., 2006). Many of these underlying mechanisms leading to a possible under or oversupply of business owners have been supported empirically and thus underscore the relevance of obtaining more insight in the level of the optimal business ownership rate. Only then, an assessment can be made whether policy measures are appropriate that fight against a lack of entrepreneurship or its abundance.

*Proposition 2* The actual business ownership may be higher or lower than optimal

The *quality* of business owners, in terms of their contribution to economic growth, may well have implications for the link between business ownership and productivity at the country level. Lucas' influential model of occupational choice (1978) forms a strong basis for this argument. In his model, individuals are selected into entrepreneurial positions based on their (entrepreneurial) ability. An individual's higher entrepreneurial ability translates into lower (marginal) production costs. In equilibrium, only people with an ability level above a certain threshold run firms, whereas the others obtain higher utility levels as wage workers (with a uniform wage rate). People with the highest levels of ability run the largest firms, i.e., employ more personnel.<sup>4</sup>

At the macro level, a higher participation rate in tertiary education translates into relatively more individuals with high ability, i.e. in a fatter right hand side tail of the ability distribution. Hence, there are more individuals willing and able to run large firms. This means the demand for workers (employees) increases, which leads to higher wages. The higher wages, in turn, increase the level of ability of the *marginal* business owner (the business owner with the lowest entrepreneurial ability) so that in the end the equilibrium business ownership rate decreases as a result of higher participation levels in tertiary education. The business owners for whom it is still profitable to be an entrepreneur, on average, run larger firms. As a consequence, the business ownership rate will be lower. Lucas' model is strongly

<sup>4</sup> This is a direct consequence of the assumption that marginal production costs decrease with entrepreneurial ability.



related to earlier seminal contributions to the entrepreneurship literature that all lead to the conclusion that the quality of business owners may affect the relationship between economic value and the business ownership rate.

Marshall claimed already in 1890 that “There is a far more close correspondence between the ability of business men and the size of the businesses they own than at first sight would appear probable.” (Marshall, 1890 [1930]: p. 312). Or, as Kaldor expressed this in 1934 in his seminal article “The Equilibrium of the Firm”, the production factor which is most determining for the size of any (mature) firm is the coordinating ability of the entrepreneur leading the firm. There can be at most one coordinator, coordinating all transactions in which the firm is involved, thereby restricting the size of the firm. The amount of all other factors of production employed is limited by the fixed supply of coordinating ability by the unique entrepreneur. In another seminal contribution, Coase (1937) argued similarly: there are “diminishing returns to management” in the sense of decreasing returns to scale at a given level of entrepreneurial ability.

Based on Lucas’ model and these seminal arguments, we are interested in the determinants of the quality and thus optimal firm size of business owners insofar these determinants can be aggregated to the country level and serve as a possible determinant of the heterogeneity of the optimal business ownership rate across countries and over time. The most widely recognized determinant of labor market performance in general and of business owners in particular is human capital (Mincer, 1958; Becker, 1964). Citing Parker’s handbook:

*Overall, the literature suggests that human capital is the major determinant of entrepreneurs’ earnings (van Praag, 2005, p. 9). Few other explanatory variables, including ethnicity, family background, social capital, business strategy, or organisational structure of the venture, possess much explanatory power, Parker (2009), p. 582*

Human capital refers to the stock of skills and knowledge relevant to produce economic value and is gained through education and experience. It was first defined as such by Adam Smith (1776 [1904]). Investments in human capital does not only increase the productivity of business owners but can also be used as a signal of their quality toward suppliers of capital (Parker and van Praag, 2006) or (prospective) customers and qualified employees (Backes-Gellner and Werner, 2007).

Microeconomic evidence supports the view that top business owners, i.e., the ones with high levels of performance [in terms of income and growth] that are in particular responsible for value crea-

tion, have superior levels of human capital in terms of ability and education. These are the most important individual drivers of the performance of business owners and the ensuing firm size.<sup>5</sup>

This implies, at the macro level, that higher levels of education lead to more productive entrepreneurs and thus to a steeper relationship between the business ownership rate and economic value creation (the macroeconomic equivalent of higher returns to human capital). And since more productive entrepreneurs run larger firms, they require, on average, more employees leading to a lower optimal business ownership rate.

Measures of human capital or education have often been included in empirical macroeconomic growth models. For instance, in his seminal work, Barro (1991) estimates a strong positive association between school enrollment rates at the primary and secondary levels and the growth rate of real per capita GDP on a cross section of countries, including both developed and developing countries. This positive association turns, however, insignificant when estimated on a sample of developed countries only, see the overview by Krueger and Lindahl (2001). Vandenbussche et al. (2006) explain this counter-intuitive result, both theoretically and empirically, by emphasizing the crucial role of *skilled* human capital for economic growth in developed economies. They associate skilled human capital with innovation, whereas the measures of education used in the studies reviewed by Krueger and Lindahl are indicators of total human capital which is associated with imitation rather than innovation. Vandenbussche et al. conclude that “skilled human capital has a stronger growth-enhancing effect in economies which are closer to the technological frontier” (p. 122). Accordingly, they also conclude that it is crucial to distinguish between primary/secondary versus tertiary educational attainment. We follow this argument by employing participation rates in *tertiary* education, the measure of (skilled) education that is more crucial than participation in lower levels of education or average educational attainment (Hanushek and Woessmann, 2008) for endorsing economic growth in developed economies.

*Proposition 3* The relationship between economic productivity and the business ownership rate is steeper if the participation rate in tertiary education is higher

*Proposition 4* The optimal business ownership rate is lower if the participation rate in tertiary education is higher.

### 3. Methodology

#### *Developing estimation equations*

<sup>5</sup> Recent studies have shown that the returns to ability (Hartog et al., 2010), education (Van Praag et al., 2009) and being a generalist rather than a specialist (Lazear, 2005) are even larger for entrepreneurs than employees. In these studies the performance measure in terms of which these returns are measured is, necessarily, income since this is the only performance measure that is available for both employees and business owners.

As mentioned, we will estimate Cobb Douglas production functions explaining output. In the Neoclassical production function, the key inputs of production are (physical) capital and labor (Solow, 1956). In endogenous growth theory, knowledge is added as an important factor of production (Romer, 1986, 1990, 1994). A typical production function model, written in log-linear form, then looks as follows:

$$(1) \quad \log Y = \alpha + \beta_K \log K + \beta_R \log R + \beta_L \log L$$

where  $Y$  is output,  $K$  is physical capital,  $L$  is labor (total employment) and  $R$  is knowledge capital (often operationalized as research and development).

Audretsch and Keilbach (2004a) add a fourth input factor to the production function: entrepreneurship capital, operationalized as the number of new-firm start-ups, i.e., a *dynamic* measure capturing the notion that entrepreneurship is about newness. We extend Equation (1) by including a *static* measure of entrepreneurship capital, to be specific, the number of (new and incumbent) business owners relative to the labor force (business ownership rate – *BOR*). As mentioned before, this measure is more closely related to the occupational choice framework underlying our empirical model. *BOR* is operationalized as the number of owner-managers of unincorporated and incorporated businesses as a share of the labor force (see Section 4).

$$(2) \quad \log Y = \alpha' + \beta_K \log K + \beta_R \log R + \beta_L \log L + \gamma_1 BOR$$

Next, we also include a (second order) polynomial of *BOR* to enable testing the hypothesis of decreasing marginal returns to business ownership. The third equation that we will estimate results:<sup>6</sup>

$$(3) \quad \log Y = \alpha' + \beta_K \log K + \beta_R \log R + \beta_L \log L + \gamma_1 BOR + \gamma_2 BOR^2$$

In this model the  $\beta$  coefficients are output elasticities.<sup>7</sup> Next, we extend Equation (3) by including education, in particular, as we motivated based on Vandenbussche et al. (2006), the participation rate in tertiary education, such that the fourth equation results as:

$$(4) \quad \log Y = \alpha' + \beta_K \log K + \beta_R \log R + \beta_L \log L + \gamma_1 BOR + \gamma_2 BOR^2 + \gamma_3 EDUC$$

<sup>6</sup> We also estimated this and the following equations upon the inclusion of a third order polynomial, i.e., by including *BOR* to the third power. However, this did not significantly improve the model fit and it is further left out.

<sup>7</sup> For instance, the output elasticity with respect to labor is  $e_{Y,L} \equiv \frac{\partial Y}{\partial L} \cdot \frac{L}{Y} \equiv \frac{\partial \log Y}{\partial \log L} = \beta_L$

where *EDUC* is education (in terms of participation in tertiary education). In addition to including this measure of education in a linear way, we also allow for the possibility that education mediates the relationship between the business ownership rate and macro-economic production, in order to enable testing the validity of propositions 3 and 4. Equation 5 results:

$$(5) \quad \log Y = \alpha' + \beta_K \log K + \beta_R \log R + \beta_L \log L + \gamma_1 BOR + \gamma_2 BOR^2 + \gamma_3 EDUC + \gamma_4 BOR \times EDUC + \gamma_5 BOR^2 \times EDUC$$

We will estimate Equations (1) to (5). We compute the optimal business ownership rates in equations (3) and (5) as  $\frac{-\gamma_1}{2\gamma_2}$  and  $\frac{-(\gamma_1 + \gamma_4 EDUC)}{2(\gamma_2 + \gamma_5 EDUC)}$ , respectively.

Two more remarks are in order. First, we estimate the equations in levels rather than in growth rates. While differences in growth rates across countries may be mostly transitory, levels capture the differences in long-run economic performance which are more directly relevant to welfare (Hall and Jones, 1999, p. 85). As business ownership rates change only slowly over time, we follow this argument and estimate the equations in levels. Second, we add time dummies to the model so that we focus on explaining cross-country variations, thereby following the usual approach in the empirical growth literature (e.g. Barro, 1991, 1997; Barro and Sala-i-Martin, 1992; Beck et al., 2005; Bleaney and Nishiyama, 2002; Hall and Jones, 1999; Mankiw et al., 1992).

#### 4. Data and sample

We estimate the model expressed in equations 1-5 using data for 19 OECD countries over the period 1981-2006. The 19 countries are chosen on the basis of data availability for our model variables.<sup>8</sup> For reasons explained below, the available data for Greece and Italy have been excluded from the sample that consisted originally of 21 countries. Our measure for knowledge capital is available only from 1981 onwards, defining our sample period as running from 1981 onwards. As a result, the equations are estimated using 494 observations, corresponding to a panel of 19 countries and 26 years. We provide the definitions and data sources for our model variables below.

##### Output (*Y*)

We measure *Y* as gross domestic product (GDP) in constant prices of 1990. Purchasing power parities of 1990 are used to make the monetary units comparable across countries. Data are obtained from *OECD National Accounts*.

<sup>8</sup> The 19 countries are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Netherlands, Portugal, Spain, Sweden, United Kingdom, Norway, Switzerland, United States, Japan, Canada, Australia and New Zealand.

### Physical capital ( $K$ )

Our measure of  $K$  is obtained from Kamps' (2004) internationally comparable net capital stock estimates for 22 OECD countries over the period 1960-2001, based on OECD series of real gross fixed capital formation. Capital stock estimates are constructed applying the perpetual inventory method, assuming that depreciation (i.e. consumption of fixed capital) follows a geometric pattern. In particular, we use the variable 'real total net capital stock as a percentage of real GDP' (see Kamps, 2004, for more details). For the period 2002-2006 these percentages are extrapolated based on average annual changes over the five-year period 1997-2001. We multiply the resulting capital share series with the real GDP variable (as defined above). Thus, we obtain physical capital stock estimates expressed in purchasing power parities per U.S. dollar in 1990 prices.

### Research and development (knowledge capital) ( $R$ )

The indicator of research and development (knowledge capital) we use is the variable gross domestic expenditure on R&D (GERD) as a share of GDP, as provided by OECD (Science, Technology and R&D data base). These data are available from 1981 onwards. We multiply the R&D share series with our real GDP variable (as defined above), so that we obtain knowledge capital stock estimates expressed in purchasing power parities per U.S. dollar in 1990 prices.

### Labor ( $L$ )

Total employment is defined as the number of persons in the total labor force minus the number of unemployed. Data on total labor force are taken from *OECD Labour Force Statistics* while the number of unemployed is calculated using the standardized unemployment rate published in *OECD Main Economic Indicators*. Some missing values in the unemployment series are estimated using data from OECD Labour Force Statistics. Total employment measures the labor contribution to the macro-economic production process of both employees and business owners.

### Business ownership rate ( $BOR$ )

Business ownership is defined as the total number of unincorporated and incorporated self-employed outside the agriculture, hunting, forestry and fishing industries, who carry out self-employment as their primary employment activity, see Van Stel (2005, p. 108). Unpaid family workers are excluded. These data are taken from EIM's COMPENDIA data base (version 2006.1).<sup>9</sup> In this data base, self-employment numbers as published in OECD Labour Force Statistics are corrected for measurement differences across countries and over time and thus harmonized. Finally, to arrive at a business owner-

<sup>9</sup> COMPENDIA is an acronym for COMParative ENTrepreneurship Data for International Analysis. See <http://www.ondernemerschap.nl> for the data and Van Stel (2005) for a justification of the harmonization methods. This database has been used and acknowledged widely (see, among other studies, Armour and Cumming, 2008, Carree et al., 2002, 2007, Davis, 2008 (p. 54), Koellinger and Thurik, 2009, and Nyström, 2008).

ship *rate*, the number of business owners is divided by the total labor force. Obviously, given the purpose to estimate an optimal business ownership rate, the harmonized character of these rates is of vital importance.<sup>10</sup>

### Education (*EDUC*)

As we discussed, and based on Vandenbussche et al. (2006), the measure of education that is most likely to be associated with productivity is participation in tertiary education, as a rough proxy of ‘skilled’ human capital in a country, rather than primary or secondary enrollment rates as used by Barro (1991). The empirical measure of tertiary education that we use is the gross enrollment rate for tertiary education, published by the World Bank in their EdStats data base. It is defined as the number of pupils enrolled in tertiary education, regardless of age, expressed as a percentage of the population of the five-year age group following on from the secondary school leaving age. Where necessary, interpolations have been applied.

### *Descriptive statistics*

In Table 1 we provide summary statistics for our main variables of interest, the business ownership rate and the gross tertiary enrollment rate. We observe great country variations in business ownership rates. In 2006 (non-agricultural) business ownership amounts to 6.6 percent of the total labor force in Switzerland and 15.2 percent in Australia. These country differences are related to differences in institutions and cultural attitudes towards entrepreneurship (Freytag and Thurik, 2007). Furthermore, in most but not all OECD countries, business ownership has increased between 1981 and 2006. Notable exceptions are France and Japan. We also observe considerable variations in tertiary enrollment rates, both across countries and over time. As expected, the enrollment rate in tertiary education has increased considerably over the period studied.

INSERT TABLE 1 ABOUT HERE

## **5. Results**

This section presents the estimation results of the models specified above, i.e., equations (1) to (5). In Table 2, we present the main results. The first two columns of Table 2 provide results of equation (1), including (physical) capital ( $K$ ), knowledge capital ( $R$ ) and labor ( $L$ ) as production factors in the production function. All three factors contribute significantly to production, and the estimated production

<sup>10</sup> Data taken directly from the OECD Labour Force Statistics suffer from a lack of comparability across countries and over time. In particular, owner-managers of incorporated businesses (OMIBs) are counted as self-employed in some countries, and as employees in other countries. Also, the raw OECD data suffer from many trend breaks relating to changes in self-employment definitions (Van Stel, 2005).

function exhibits constant returns to scale: The sum of the estimated elasticities, i.e.  $\beta_K + \beta_R + \beta_L$ , does not differ significantly from unity. The difference between equation (1) and equation (1') is the inclusion of year dummies in the latter. Based on a comparison of the loglikelihood values, we conclude that including year dummies significantly contributes to the model explanation. Equation (1') is used as the benchmark.

INSERT TABLE 2 ABOUT HERE

### 5.1 *Optimal Business Ownership Rate*

The business ownership rate (*BOR*) is added in equation (2). The positive and highly significant coefficient  $\gamma_1$  for *BOR* indicates that higher business ownership rates are associated with higher production levels, holding constant the actual levels of the production factors *K*, *R*, and *L*. Assuming that an optimal business ownership actually exists, i.e.,  $\gamma_2 < 0$ , this finding implies that during the period 1981-2006, most countries in our sample had a business ownership rate below the optimum.

Next, equation (3) includes a squared *BOR* term and tests whether an optimal level of business ownership can actually be found for our estimation sample, i.e.,  $\gamma_2 < 0$ . Indeed, there seems to be such an optimal level, consistent with the highly significant and negative coefficient for *BOR*<sup>2</sup> in equation (3). The likelihood ratio test, between equations (2) and (3), supports that the inclusion of *BOR*<sup>2</sup> in the model increases its explanatory power significantly. Moreover, including third or higher orders of the business ownership rate turned out not to add any more explanatory power to the model. According to these model estimates, the relationship between production and the business ownership rate is inversely U-shaped. In equation (3) the optimal business ownership rate is equal to 12.7% of the labor force. Thus, we find empirical support for the first proposition that there is, indeed, an optimal business ownership rate.

The positive coefficient pertaining to the business ownership rate in equation (2) –where *BOR* is exclusively entered in its linear form and  $\gamma_2 \equiv 0$  is assumed, already implied that most countries in our sample period of 1981-2006 have lower than optimal levels of *BOR*, given the presence of an optimal *BOR*. Indeed, Table 3 shows that this is the case. The table shows a comparison between the actual and the optimal *BOR* for each country for a selection of years, i.e., 1981, 1994 and 2006. Although we find obvious support for the second proposition, i.e., that the actual business ownership may be

higher or lower than optimal, Table 3 shows evidence that most countries in fact have lower than optimal business ownership rates.<sup>11</sup>

INSERT TABLE 3 ABOUT HERE

Column (3') in Table 2 shows estimates of the same specification as in equation (3), however, this time excluding nine observations for Germany in the period 1981-1989, for which there are no observations available for tertiary education. Since this variable is added to the model in equation (4) and further, column (3') is used as a benchmark so that the added value of the specifications including indicators of enrollment rates in tertiary education can be assessed. The results from estimating equation (3') are similar to equation (3). We now turn to discussing the results from including the gross tertiary enrollment rate (*EDUC*) into the equations.

## 5.2 *Education and the Optimal Business Ownership Rate*

In equation (4) we include the enrollment rate in tertiary education (*EDUC*) in the equation. As expected, the coefficient  $\gamma_3$  is significantly positive. Equation (5) is used to test whether there is an interaction between business ownership and education in determining macro-economic production. Using this equation, one can assess if and to what extent propositions 3 and 4 are empirically valid. Is the relationship between the business ownership rate and production steeper for higher levels of higher education? And, as a consequence, is the optimal business ownership rate lower for higher enrollment rates in tertiary education? The estimated values of  $\gamma_4$  and  $\gamma_5$  are significantly positive and negative, respectively. We thus find support in our data for the hypothesis that higher enrollment rates of tertiary education make business ownership more valuable for production. Moreover, the optimal business ownership rate decreases when *EDUC* increases.

The loglikelihood tests reveal that the model fit only improves marginally from including interaction terms of *BOR* and *EDUC*. This is due to the fact that the significance of the parameter estimates shifts from *BOR* and  $BOR^2$  (without interaction) to  $BOR * EDUC$  and  $BOR^2 * EDUC$ . In terms of Equation (4) and (5) in the previous section, the significance shifts from parameters  $\gamma_1$  and  $\gamma_2$  (in equation (4)) to parameters  $\gamma_4$  and  $\gamma_5$  (in equation (5)). The results indicate that the inversely U-shaped relationship between the business ownership rate and macro-economic outcomes depends on the participation rate in tertiary education in a way that is consistent with propositions (3) and (4).

<sup>11</sup> Table 3 uses optimal BOR levels derived from Equation (5), where the optimal BOR is allowed to vary across countries. When using Equation (3), the actual BOR levels reported in Table 3 should be compared to the (static) optimal BOR level of 12.7% (see Table 2). Again, most countries are below the optimum.



Figure 1 illustrates the relation between education, business ownership, and macro-economic output, where we fix the levels of the production factors capital, R&D, and employment at the levels of their respective sample averages. The relation between the business ownership rate ( $BOR$ ) and output is depicted for three levels of the enrollment rate in tertiary education, i.e. the 25%-, 50%-, and 75%-quartile values in our sample. The figure illuminates that the relationship between the business ownership rate and production is steeper and that the optimal business ownership rate is lower with higher enrollment rates in tertiary education.

INSERT FIGURE 1 ABOUT HERE

Table 4 shows the numbers underlying Figure 1, i.e., it tabulates the derivative of  $\log(GDP)$  with respect to  $BOR$ , i.e., the marginal effect on output of increases in  $BOR$ . For instance, the table shows that, for the 75%-quartile value of  $EDUC$  (0.61), an increase in  $BOR$  from 0.05 to 0.06 increases  $\log(GDP)$  with 0.064, i.e. a 6.4%-point increase in output. The same increase in  $BOR$  at a level of 0.10 increases output with 1.6%. Hence it is clear that the marginal returns to business ownership are decreasing in the level of business ownership. The table also illustrates, in line with proposition 4, that the level of  $BOR$  at which the marginal returns become negative (i.e. the optimal business ownership rate), decreases with education.

INSERT TABLE 4 ABOUT HERE

This is in fact consistent with the formula derived at the end of the previous section, which, in terms of Equation (5), expressed the optimal  $BOR$  as a function of  $EDUC$ , as follows:  $\frac{-(\gamma_1 + \gamma_4 EDUC)}{2(\gamma_2 + \gamma_5 EDUC)}$ . Using the parameter estimates obtained from estimating Equation (5), the function is depicted in Figure 2. The optimal business ownership rate is decreasing in the participation rate of the population in higher education.

INSERT FIGURE 2 ABOUT HERE

### 5.3 Robustness tests

We perform four robustness tests. The first test relates to the question ‘Are the results that we observe driven by a particular subperiod of the long time period we study, i.e., 1981-2006?’ In other words, is the structure of the macro-economic production process constant over time? Is an optimal business ownership rate present in both the earlier and the later period? And if so, is it at approximately the same level in both subperiods? And is its relationship with the enrollment rate in tertiary education sub-

ject to changes over time? To answer this set of questions, we split the sample in two (equally long) time spans. Table 5 presents the results of estimating equations 4 and 5 on these two subsamples.

INSERT TABLE 5 ABOUT HERE

The estimates of equation (4), represented in the left hand side panel of the table, show for each subperiod highly significant coefficients for both the linear and the squared *BOR* term, consistent with an optimal *BOR* in each period. However, the optimal business ownership rate is lower in the period 1994-2006 compared to the earlier period. Considering that education levels are increasing over time (see Tables 1 and 5), this finding is consistent with the negative relation between tertiary education and the optimal business ownership rate, depicted in Figure 2. Please also note that, while the optimal *BOR* decreased between the two periods, the sample average of the actual *BOR* increased. As the latter is lower than the optimal *BOR*, this implies that, on average for the countries in our sample, the gap between the actual and the optimal *BOR* has become smaller.<sup>12</sup> See also Table 3.

The columns at the right hand side of Table 5 show the estimates of equation (5) for both subperiods. For the earlier period the interaction terms between education and the business ownership rate are highly significant and in accordance with the results obtained from the whole period sample. However, for the later period the interaction terms are not significant. Given the shape of Figure 2, where the relation between the optimal *BOR* and education is much steeper for lower levels of education, this result is not surprising (as education levels are lower in the earlier period).

The second robustness test pertains to the definition of business ownership. In particular, we vary the denominator of the business ownership rate that may influence the results. The default denominator is the total labor force, i.e., the sum of private sector employment, government employment and unemployment, consistent with the definition used in COMPENDIA data base (Van Stel, 2005). However, our microeconomic theoretical underpinning assumes that the labor force is split into a group of entrepreneurs and a group of employees, where the first group employs the second, as in Lucas (1978), such that the business ownership rate is (inversely) related to the average firm size. The COMPENDIA definition of the business ownership rate thus deviates from the definition that would best fit the theoretical notion of the business ownership rate, i.e., excluding the unemployed and public sector workers from the labor force. This may bias our results due to cross country variation in rates of unemployment or the employment share of the government. For instance, Anglo-Saxon countries in general have small governments while Scandinavian countries have larger governments. In Table 6, we estimate equations

<sup>12</sup> The table also shows that the importance of knowledge and labor in the production process has increased at the cost of the marginal value of physical capital, indicating the increased role of knowledge capital as a vital source of competitiveness (e.g., Audretsch and Thurik, 2001).

(4) and (5) using three different BOR denominators: total labor force, total employment (i.e., excluding unemployment), and private sector employment (i.e., excluding unemployment and government employment). The results are qualitatively the same and seem to be independent from the definition of *BOR*. Importantly, a U-shaped pattern between *BOR* and  $\log(GDP)$  is found in all three columns representing estimates of equation (4), suggesting that the existence of an optimal business ownership rate does not depend on the definition of *BOR*. The estimates based on equation (5) in the right hand side panel of the table show that the association of education with the optimal business ownership rate remains qualitatively the same upon variations in the definition of the business ownership rate. Naturally, in both equations, since the values of the alternative business ownership rates are higher (as denominators are smaller), the estimated optimal rates are also higher for the alternative measures (i.e. *BOR2* and *BOR3* in Table 6).

INSERT TABLE 6 ABOUT HERE

The third robustness test addresses the issue of endogeneity. The estimated relationship between the business ownership rate and economic performance is not necessarily a causal impact. In particular, the possibility that the coefficients reflect, to some extent, the influence of macro-economic performance on the business ownership rate, i.e., reversed causality, or, alternatively, that there is some underlying unobserved factor covarying with both economic outcomes and the business ownership rate, i.e., unobserved heterogeneity, cannot be ruled out.<sup>13</sup> We thus tested whether instrumental variable (IV) estimation where the business ownership rate (and its squared term) are treated as endogenous explanatory variables leads to similar results. Three instrumental variables are used that are known to influence business ownership rates (but not the level of GDP), see Audretsch et al. (2002b).<sup>14</sup> The first is the growth rate of per capita income, the second the share of the population living in rural areas, and the third the age composition of the population (operationalized as the share of the population aged 25-39 years within the population aged 25-64).<sup>15</sup> Table 7 presents the results of our IV estimations for equations (2) and (3).

INSERT TABLE 7 ABOUT HERE

<sup>13</sup> Theoretically, though, reversed causality is unlikely due to the definition of the dependent variable in the production function in terms of the *level* of GDP rather than the *growth* of GDP. Hence, the usual reversed causality argument of fast-growing economies attracting more entrepreneurs, does not apply.

<sup>14</sup> Thus, we only address the issue of endogeneity of the business ownership rate leaving education out of the equation. We acknowledge that education may as well be an endogenous variable in this equation but we do not further pursue this issue.

<sup>15</sup> The sources of data are OECD National Accounts, the World Bank EdStats data base, and the U.S. Census Bureau International Database, respectively.

Results of the first stage (not shown), i.e., the regression of the business ownership rate (BOR) on our identifying instrumental variables in combination with all the exogenous regressors included in the second stage, reveal that our instruments are sound. The estimated effects of our set of identifying instruments on BOR are highly significant and in line with expectations: countries with higher economic growth rates and with higher shares of 25-39 year old individuals (the age class with a higher share of entrepreneurs) have more entrepreneurs, whereas countries with many people living in rural areas have less entrepreneurs (for most economic activities cities are more attractive locations for entrepreneurs). The usual F-test establishes that the set of identifying instruments consisting of these three variables is of sufficient quality (i.e., generating F-statistics of 12.7, 47.0 and 66.9, i.e.  $> 10$ ), see Bound et al. (1995).

To facilitate comparison, in the first two columns of Table 7 the OLS results from Table 2 are repeated. The third and fourth column show the results from instrumental variable estimation. In these IV estimations, BOR and BOR squared are considered endogenous regressors, so that the number of identifying instrumental variables (three) exceeds the number of endogenous regressors (one in equation 2 and two in equation 3). Hence the model may be overidentified, and an F-test on the overidentification of restrictions is necessary. In the IV estimation of equation (2) in Table 7 we see that the positive linear impact of BOR found in Table 2 is confirmed. The IV estimate is even higher compared to OLS estimation (the coefficient is 4.83 versus 1.43 for OLS). However, the F-test on valid instruments is not passed. In the next column, the squared BOR term is added, and this time the instruments do pass the test. Compared to the OLS estimates, the IV coefficients of BOR and BOR squared are higher in magnitude, implying a steeper relation between business ownership and production. Reassuringly, the optimal business ownership rate is similar to the one obtained using OLS (11.5% versus 12.7%). We conclude that IV results are qualitatively similar to OLS results, and hence that it is likely that the impact of business ownership on production in our model is in fact causal.

The results from the fourth and final robustness check indicate why we have excluded two countries from the sample i.e., Greece and Italy. Table 8 presents results when these two countries are included in the sample, i.e. when the number of observations is 546 instead of 494. The first column presents results for equation (2) which are similar for BOR compared to Table 2 excluding the two countries. However, when we allow coefficients for BOR to be different for the group of 19 original sample countries on the one hand, and Greece and Italy on the other (second column), we see that the coefficient for these two countries is significantly smaller compared to the other countries (1.26 versus 1.92). A likelihood ratio (LR) test between equations (2) and (2'') indeed reveals that the model fit significantly increases when allowing the coefficient for BOR to be different for Greece and Italy. Interestingly, the coefficient for the total sample in the first column (1.27) is almost the same as that of Greece and Italy in the second column (1.26). This suggests that the impact of the two countries on the total sample es-

timate is disproportionately large, providing support for our decision to exclude these two countries from our sample.

The last two columns present results when the squared business ownership variable is included as well. The optimal business ownership rate is now estimated to be 15.9% (versus an estimated optimum of 12.7% when excluding Greece and Italy, see Table 2). Hence, similar to equation (2) the impact of these two countries on the overall estimate of equation (3) is quite large. When allowing the estimates for BOR and BOR squared to be different for the two groups of countries, the LR test again reveals that this significantly improves the model fit.<sup>16</sup> Moreover, the separate estimation for the two groups of countries shows an estimated optimal BOR for the original sample countries of 13.4%, which is rather close to the original estimates in Table 2.

These exercises show that the statistical relation between business ownership and production is indeed different for the outliers Greece and Italy.<sup>17</sup> We argue that Greece and Italy are outliers due to certain extraordinary characteristics. Most importantly, both countries have extremely high business ownership rates. In 2006 the (non-agricultural) business ownership rates in Greece and Italy were at least one third higher than any other country in the sample, i.e., 19.7% and 21.0%, respectively (Australia has a BOR of 15.2%, see Table 1).<sup>18</sup>

## 6. Conclusions

Many policy measures in developed countries are based on the assumption that higher business ownership rates induce economic value creation. This has led to the commonly accepted paradigm of ‘the more business owners, the better’. The positive relation between entrepreneurship and macroeconomic performance found in many empirical studies may indicate that in a majority of (developed) countries entrepreneurship rates have been (too) low in recent periods, so that countries with higher levels of entrepreneurship indeed perform better. However, the possibility that countries may also have too many entrepreneurs is seldom considered, even though microeconomic theories on occupational choice predict that only a fraction of the population is more productive as an entrepreneur than as an employee. Indeed, Shane (2009) has recently argued, based on anecdotal evidence, that ‘the more busi-

<sup>16</sup> The LR test statistic is  $2 \times (514.7 - 500.2) = 29.0$ , which is greater than 9.21, the 1% critical value for the chi-squared distribution with two degrees of freedom.

<sup>17</sup> From exercises not presented here we find that the role of education in the relation is also different for Greece and Italy.

<sup>18</sup> Greece has also a relatively high share of agriculture in economic activity. More than 10% of civilian employment is in agriculture in 2006 (source: OECD Labour Force Statistics), where the structure of production is different. Moreover, Greece is an outlier with regards to education: According to World Bank’s EdStats data base, Greece has the highest-but-three gross enrollment rate of *all* countries for which data are available (90.8%; as an illustration, United States has 81.7%). We find this counterintuitive. Also, in 2000 the gross enrollment rate in Greece was only 51% implying a huge increase in education during the first decade of the 21<sup>st</sup> century. Such extreme fluctuations do not occur for the other countries in our data base. Thus, the inclusion of Greece may well distort the estimation results regarding education. For further documentation of why Italy is an outlier as regards business ownership, we refer to Carree et al. (2002, 2007).

ness owners, the merrier' assumption would not always hold, leading to the phenomenon of an 'optimal' business ownership rate.

This paper has explored empirically whether there is indeed evidence of such an optimal business ownership rate and, if so, to what extent it varies with variations in education levels across countries and over time. The motivation for our study to focus on the heterogeneity caused by variations in education is as follows. The vast collection of research into the drivers of entrepreneurship performance to date has rather convincingly shown that human capital is a main driver of performance (and education a primary source of human capital). This implies, at the macro level, that higher levels of education lead to more productive entrepreneurs and thus to a steeper relationship between the business ownership rate and value creation. And since more productive entrepreneurs run larger firms, they require, on average, more employees leading to a lower optimal business ownership rate in equilibrium.

By estimating an extended version of traditional Cobb Douglas production functions on a sample of 19 OECD countries over the period 1981-2006, we find rather robust support for all propositions that we derive from combining macro and microeconomic framed theory and evidence. We find empirical support for the phenomenon of an 'optimal' business ownership rate of around 12.5%, on average. This rate is a quite robust finding surviving robustness checks that address the particular definition of the business ownership rate, the composition of the sample in terms of countries and years and the possible endogeneity of the business ownership rate in equations of economic growth.

In addition, we show indicative evidence of a set of two related propositions we have developed with respect to education: (i) a stronger relationship between the business ownership rate and economic value for higher levels of education leading to (ii) a negative relationship between the optimal business ownership rate and education in equilibrium. The result is significant and robust against changing the definition of the business ownership rate.

Our paper may have policy implications. In particular, we add quantified insights to the discussion of 'Are there too many or too few entrepreneurs?'. In 2006 the actual business ownership rate was lower than optimal for most, but certainly not all countries included in our sample. Moreover, most countries have been approaching the optimal business ownership rate in recent decades. Therefore, it is well imaginable that several Western countries will surpass the optimal rate in the near future or already surpassed this rate today.

Thus, countries may have too few or too many entrepreneurs and should device their policy measures accordingly. For instance, governments should be careful with implementing active stimulation programs for entrepreneurship, in particular when entrepreneurship rates are already relatively high and when the programs target all parts of the population (i.e. making no distinction by education levels). Such general stimulation policy may attract individuals who would be more productive working as an employee (Mueller et al., 2008; Shane, 2009). Rather than providing guidance with regards to the exact policy measure to be implemented, we show that entrepreneurship policies as such may depend on

the level of business ownership already present in the country. Policy measures depend also on the education level in a country. Education and business ownership policies may be considered at tandem.

We are aware of at least four limitations of our work. First, our country level analysis does not allow a distinction between sectors of industry. The industry composition of economies may impact the country level rate of entrepreneurship. Second, our business ownership measure does not allow a distinction between different types of entrepreneurs, e.g. high-tech versus low-tech entrepreneurs, or employers versus solo self-employed. Future work should focus on estimating the model at the industry level and on distinguishing between different types of entrepreneurs. However, to date the required cross-country data are not available. Third, our results may suffer from the use of Cobb-Douglas functions, which are restrictive in several respects.<sup>19</sup> A fourth drawback of our study is that we are not able in this framework and based on the current sample to endogenize the education variable at our disposal.

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<sup>19</sup> For instance, the Cobb-Douglas function forces the elasticity of substitution between capital and labour to be unity.

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Table 1: Business ownership rate and gross tertiary enrollment rate, 1981-1994-2006

	Business ownership rate (%)			Gross tertiary enrollment rate (%)		
	1981	1994	2006	1981	1994	2006
Austria	7.0	7.2	9.1	22.8	45.4	49.9
Belgium	10.5	12.3	11.1	27.2	54.8	62.8
Denmark	6.9	5.9	6.9	28.4	45.7	79.9
Finland	6.4	7.7	8.6	32.5	67.0	93.2
France	10.1	9.0	8.6	26.2	49.9	56.2
Germany	6.5	7.8	9.7	N.A.	44.3	70.8
Ireland	7.9	11.3	11.0	19.0	38.0	58.8
The Netherlands	8.0	9.4	11.5	29.8	47.4	59.8
Portugal	13.5	16.4	12.9	11.0	36.5	54.5
Spain	10.9	12.6	13.3	24.2	45.4	67.4
Sweden	7.0	8.0	8.5	30.6	43.0	79.0
United Kingdom	8.1	11.3	11.2	19.6	48.5	59.3
Norway	8.3	7.8	8.8	26.3	54.6	77.5
Switzerland	6.2	6.9	6.6	18.9	31.6	45.8
USA	9.8	10.7	10.1	56.4	81.1	81.8
Japan	13.0	10.5	8.8	30.0	40.5	57.3
Canada	8.6	12.1	11.8	59.6	89.3	63.4
Australia	16.1	16.4	15.2	25.9	69.9	72.7
New Zealand	9.6	13.1	13.1	28.2	61.3	79.7

Source: EIM, Compendia 2007.1 data base, and World Bank, EdStats data base. Note: For the education series for Canada, a trend break occurs in 1998.

Table 2: Explaining log (GDP), sample 1981-2006

	(1)	(1')	(2)	(3)	(3')	(4)	(5)
Constant	2.36 *** (0.26)	2.50 *** (0.23)	2.28 *** (0.22)	1.91 *** (0.18)	1.91 *** (0.18)	1.84 *** (0.18)	2.19 *** (0.25)
log (Capital)	0.278 *** (0.046)	0.257 *** (0.040)	0.294 *** (0.038)	0.296 *** (0.034)	0.297 *** (0.035)	0.290 *** (0.035)	0.298 *** (0.035)
log (R&D)	0.178 *** (0.018)	0.143 *** (0.014)	0.172 *** (0.015)	0.174 *** (0.014)	0.174 *** (0.014)	0.158 *** (0.015)	0.157 *** (0.015)
log (Employment)	0.547 *** (0.027)	0.607 *** (0.027)	0.531 *** (0.025)	0.518 *** (0.022)	0.517 *** (0.022)	0.540 *** (0.022)	0.532 *** (0.021)
Business ownership rate (BOR)			1.43 *** (0.16)	9.94 *** (1.08)	9.77 *** (1.15)	9.12 *** (1.22)	1.99 (2.36)
BOR <sup>2</sup>				-39.1 *** (4.7)	-38.3 *** (5.0)	-36.5 *** (5.3)	-3.66 (10.2)
EDUC						0.199 *** (0.031)	-0.626 ** (0.31)
BOR * EDUC							15.9 *** (5.5)
BOR <sup>2</sup> * EDUC							-72.5 *** (23.7)
Year dummies <sup>(a)</sup>	NO	YES	YES	YES	YES	YES	YES
Returns to scale <sup>(b)</sup>	1.0032 (0.0060)	1.0076 (0.0053)	0.9965 (0.0055)	0.9879 ## (0.0056)	0.9884 ## (0.0059)	0.9888 # (0.0059)	0.9871 ## (0.0060)
Optimal BOR <sup>(c)</sup>				0.127 *** (0.0027)	0.128 *** (0.0028)	0.125 *** (0.0027)	0.125 *** (0.0025)
N	494	494	494	494	485	485	485
Loglikelihood	356.0	431.8	454.0	479.3	466.5	484.48	487.8

Heteroskedastic-consistent standard errors between brackets. \*\*\* significantly different from 0 at 0.01 level; \*\* 0.05 level; \* 0.10 level.

(a) Constant term refers to reference year 2006.

(b) Significance levels are indicated relative to unity: #### significantly different from 1 at 0.01 level; ### 0.05 level; # 0.10 level.

(c) For equation (5), the optimal BOR is computed, while fixing EDUC at the sample average level.

Table 3: Business ownership rate (BOR) and optimal BOR, 1981-1994-2006

	1981			1994			2006		
	BOR	Optimal BOR	Distance to optimum (%)	BOR	Optimal BOR	Distance to optimum (%)	BOR	Optimal BOR	Distance to optimum (%)
Austria	7.0	13.9	-49.7	7.2	12.6	-42.9	9.1	12.5	-27.0
Belgium	10.5	13.5	-22.3	12.3	12.3	-0.4	11.1	12.2	-8.9
Denmark	6.9	13.4	-48.6	5.9	12.6	-53.1	6.9	11.9	-42.2
Finland	6.4	13.2	-51.4	7.7	12.1	-36.4	8.6	11.8	-27.2
France	10.1	13.6	-25.8	9.0	12.5	-27.8	8.6	12.3	-30.2
Germany	6.5	N.A.	N.A.	7.8	12.6	-38.3	9.7	12.1	-19.5
Ireland	7.9	14.4	-45.1	11.3	12.9	-12.3	11.0	12.3	-10.3
The Netherlands	8.0	13.3	-40.0	9.4	12.5	-25.0	11.5	12.2	-6.1
Portugal	13.5	16.1	-16.1	16.4	13.0	26.6	12.9	12.4	4.4
Spain	10.9	13.8	-20.9	12.6	12.6	0.0	13.3	12.1	9.8
Sweden	7.0	13.3	-47.3	8.0	12.7	-36.9	8.5	12.0	-28.9
United Kingdom	8.1	14.3	-43.4	11.3	12.5	-9.7	11.2	12.3	-8.6
Norway	8.3	13.6	-38.9	7.8	12.4	-36.8	8.8	12.0	-26.5
Switzerland	6.2	14.4	-57.0	6.9	13.2	-47.8	6.6	12.6	-47.6
USA	9.8	12.3	-20.4	10.7	11.9	-10.3	10.1	11.9	-15.3
Japan	13.0	13.3	-2.4	10.5	12.8	-17.8	8.8	12.3	-28.4
Canada	8.6	12.2	-29.8	12.1	11.8	2.2	11.8	12.2	-3.1
Australia	16.1	13.6	18.1	16.4	12.1	35.9	15.2	12.0	26.3
New Zealand	9.6	13.4	-28.6	13.1	12.2	7.3	13.1	11.9	9.7

Note: Optimal BOR is computed on the basis of coefficients from Table 2, Equation (5).

Table 4: Marginal effect of business ownership on log (GDP)

Business ownership rate	Marginal effect on log (GDP)		
	EDUC = 0.32	EDUC = 0.475	EDUC = 0.61
0.05	0.041	0.054	0.064
0.06	0.036	0.046	0.055
0.07	0.031	0.038	0.045
0.08	0.025	0.031	0.036
0.09	0.020	0.023	0.026
0.10	0.014	0.016	0.016
0.11	0.009	0.008	0.007
0.12	0.004	0.000	-0.003
0.13	-0.002	-0.007	-0.012
0.14	-0.007	-0.015	-0.022
0.15	-0.012	-0.023	-0.031
0.16	-0.018	-0.030	-0.041
0.17	-0.023	-0.038	-0.051
0.18	-0.029	-0.045	-0.060
0.19	-0.034	-0.053	-0.070

Note: The marginal effects relate to increases in log (GDP) associated with increases of the business ownership rate of 0.01 (i.e. 1 percent point). The marginal effects are computed on the basis of Equation (5), for the 0.25, 0.50 and 0.75 centiles of the variable *EDUC*.

Table 5: Explaining log (GDP), Equations (4) and (5), by subperiod.

	Equation (4)		Equation (5)	
	1981-1993	1994-2006	1981-1993	1994-2006
Constant	1.170 *** (0.145)	2.346 *** (0.280)	1.942 *** (0.234)	1.960 *** (0.493)
log (Capital)	0.413 *** (0.027)	0.179 *** (0.057)	0.431 *** (0.027)	0.176 ** (0.069)
log (R&D)	0.103 *** (0.013)	0.204 *** (0.024)	0.090 *** (0.013)	0.203 *** (0.024)
log (Employment)	0.490 *** (0.019)	0.601 *** (0.042)	0.486 *** (0.019)	0.607 *** (0.059)
Business ownership rate (BOR)	5.792 *** (1.342)	11.169 *** (1.922)	-8.779 *** (4.318)	18.364 ** (8.642)
BOR <sup>2</sup>	-21.966 *** (5.646)	-45.677 *** (8.520)	37.104 * (20.236)	-76.223 * (39.123)
EDUC	0.235 *** (0.034)	0.152 *** (0.058)	-2.410 *** (0.739)	0.828 (0.746)
BOR * EDUC			44.645 *** (13.678)	-12.371 (14.120)
BOR <sup>2</sup> * EDUC			-181.391 *** (64.221)	52.401 (62.206)
Year dummies <sup>(a)</sup>	YES	YES	YES	YES
Returns to scale <sup>(b)</sup>	1.0060 (0.0069)	0.9846 ## (0.0073)	1.0074 (0.0066)	0.9860 ## (0.0071)
Optimal BOR <sup>(c)</sup>	0.132 *** (0.0052)	0.122 *** (0.0037)	0.129 *** (0.0051)	0.122 *** (0.0045)
Sample average BOR	0.097	0.104	0.097	0.104
Sample average EDUC	0.364	0.599	0.364	0.599
N	238	247	238	247
Loglikelihood	297.9	216.9	309.5	217.3

Heteroskedastic-consistent standard errors between brackets.

\*\*\* significantly different from 0 at 0.01 level; \*\* 0.05 level; \* 0.10 level.

(a) Constant term refers to reference year 2006 (1994-2006 period) or 1993 (1981-1993 period).

(b) Significance levels are indicated relative to unity: ### significantly different from 1 at 0.01 level; ## 0.05 level; # 0.10 level.

(c) For equation (5), the optimal BOR is computed, while fixing EDUC at the sample average level of the respective periods.



Table 6: Explaining log (GDP), Equations (4) and (5), 1981-2006, by different definitions BOR

	Equation (4)			Equation (5)		
	BOR1	BOR2	BOR3	BOR1	BOR2	BOR3
Denominator	Total labor force	Total employment	Private sector employment	Total labor force	Total employment	Private sector employment
Constant	1.84 *** (0.18)	1.902 *** (0.190)	1.701 *** (0.193)	2.19 *** (0.25)	2.164 *** (0.246)	2.631 *** (0.260)
log (Capital)	0.290 *** (0.035)	0.296 *** (0.035)	0.307 *** (0.036)	0.298 *** (0.035)	0.305 *** (0.035)	0.349 *** (0.034)
log (R&D)	0.158 *** (0.015)	0.163 *** (0.015)	0.149 *** (0.014)	0.157 *** (0.015)	0.162 *** (0.015)	0.133 *** (0.013)
log (Employment)	0.540 *** (0.022)	0.530 *** (0.021)	0.541 *** (0.023)	0.532 *** (0.021)	0.521 *** (0.021)	0.512 *** (0.022)
Business ownership rate (BOR)	9.12 *** (1.22)	6.900 *** (1.010)	7.114 *** (1.223)	1.99 (2.36)	1.179 (1.928)	-10.365 *** (2.247)
BOR <sup>2</sup>	-36.5 *** (5.3)	-24.259 *** (4.006)	-21.837 *** (4.372)	-3.66 (10.2)	2.083 (7.654)	43.653 *** (4.4)
EDUC	0.199 *** (0.031)	0.187 *** (0.032)	0.168 *** (0.031)	-0.626 ** (0.31)	-0.464 (0.283)	-2.673 *** (0.468)
BOR * EDUC				15.9 *** (5.5)	12.521 *** (4.641)	43.393 *** (6.556)
BOR <sup>2</sup> * EDUC				-72.5 *** (23.7)	-56.611 *** (18.361)	-159.231 *** (22.732)
Year dummies <sup>(a)</sup>	YES	YES	YES	YES	YES	YES
Returns to scale <sup>(b)</sup>	0.9888 # (0.0059)	0.9893 # (0.0059)	0.9966 (0.0053)	0.9871 ## (0.0060)	0.9878 ## (0.0059)	0.9941 (0.0052)
Optimal BOR <sup>(c)</sup>	0.125 *** (0.0027)	0.142 *** (0.0038)	0.163 *** (0.0057)	0.125 *** (0.0025)	0.143 *** (0.0040)	0.159 *** (0.0034)
Sample average BOR	0.101	0.109	0.133	0.101	0.109	0.133
Sample average BOR / Optimal BOR	0.81	0.77	0.82	0.81	0.77	0.82
N	485	485	485	485	485	485

Heteroskedastic-consistent standard errors between brackets; \*\*\* significantly different from 0 at 0.01 level; \*\* 0.05 level; \* 0.10 level; (a) Constant term refers to reference year 2006.

(a) Constant term refers to reference year 2006.

(b) Significance levels are indicated relative to unity: ### significantly different from 1 at 0.01 level; ## 0.05 level; # 0.10 level;

(c) For equation (5), the optimal BOR is computed, while fixing EDUC at the sample average level.

BOR1=number of non-agricultural business owners / total labor force

BOR2=number of non-agricultural business owners / total employment

BOR3=number of non-agricultural business owners / private sector employment

total labour force = total employment + unemployment

total employment = private sector employment + government employment

Table 7: Explaining log (GDP), Equations (2) and (3), instrumental variable (IV) estimations

	OLS (Eq. 2)	OLS (Eq. 3)	IV <sup>(d)</sup> (Eq. 2)	IV <sup>(d)</sup> (Eq. 3)
Constant	2.28 *** (0.22)	1.91 *** (0.18)	1.76 *** (0.23)	-0.29 (0.66)
log (Capital)	0.294 *** (0.038)	0.296 *** (0.034)	0.380 *** (0.042)	0.343 *** (0.061)
log (R&D)	0.172 *** (0.015)	0.174 *** (0.014)	0.241 *** (0.018)	0.215 *** (0.023)
log (Employment)	0.531 *** (0.025)	0.518 *** (0.022)	0.349 *** (0.040)	0.374 *** (0.075)
Business ownership rate (BOR)	1.43 *** (0.16)	9.94 *** (1.08)	4.83 *** (0.55)	56.4 *** (15.0)
BOR <sup>2</sup>		-39.1 *** (4.7)		-245.7 *** (71.6)
Year dummies <sup>(a)</sup>	YES	YES	YES	YES
Returns to scale <sup>(b)</sup>	0.9965 (0.0055)	0.9879 ## (0.0056)	0.970 ### (0.0073)	0.931 ### (0.0147)
Optimal BOR		0.127 *** (0.0027)		0.115 *** (0.0035)
F-test over-identification of restrictions [p-value] <sup>(c)</sup>	N.A.	N.A.	13.2 [0.000]	0.761 [0.383]
N	494	494	494	494
Method	OLS	OLS	IV <sup>(d)</sup>	IV <sup>(d)</sup>

Heteroskedastic-consistent standard errors between brackets. \*\*\* significantly different from 0 at 0.01 level; \*\* 0.05 level; \* 0.10 level.

(a) Constant term refers to reference year 2006.

(b) Significance levels are indicated relative to unity: ### significantly different from 1 at 0.01 level; ## 0.05 level; # 0.10 level.

(c) The null hypothesis is associated with valid instruments.

(d) The endogenous explanatory variables in the IV estimations are BOR and, where applicable, BOR<sup>2</sup>. The three instruments used are growth of per capita income, the share of population living in rural areas and the share of population aged between 25-39 years.

Table 8: Explaining log (GDP), Equations (2) and (3), sample 1981-2006, including Greece and Italy in estimation sample

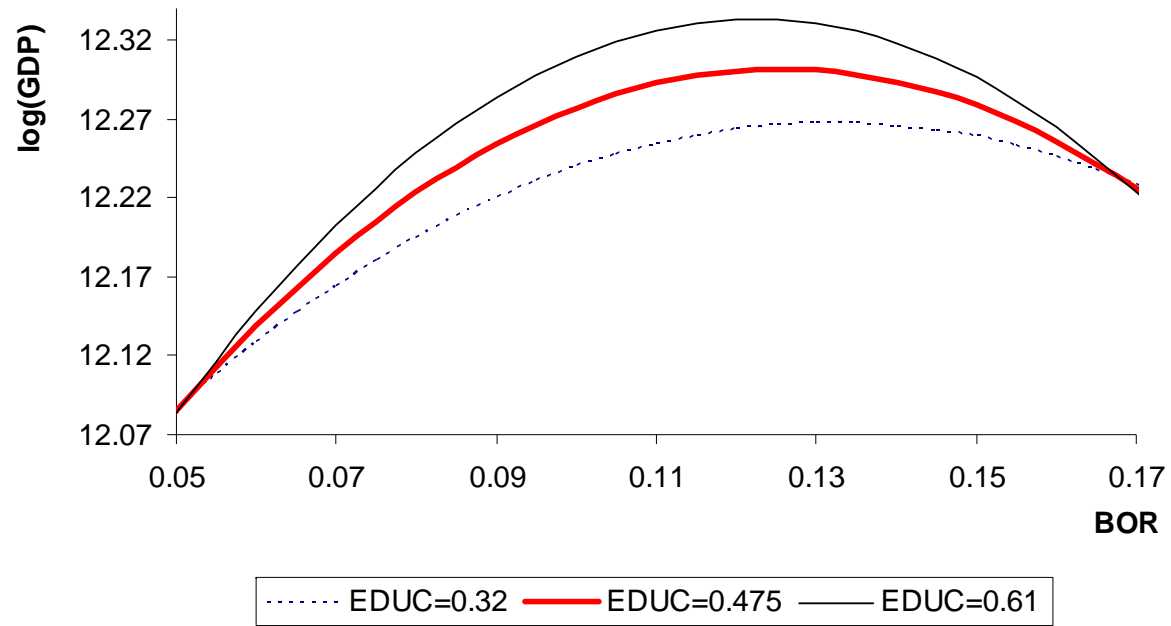
	Equation (2)	Equation (2'')	Equation (3)	Equation (3'')
Constant	2.45 *** (0.19)	2.03 *** (0.22)	1.80 *** (0.18)	1.67 *** (0.18)
log (Capital)	0.265 *** (0.032)	0.338 *** (0.037)	0.346 *** (0.031)	0.340 *** (0.034)
log (R&D)	0.214 *** (0.015)	0.193 *** (0.015)	0.197 *** (0.014)	0.191 *** (0.015)
log (Employment)	0.516 *** (0.019)	0.464 *** (0.023)	0.447 *** (0.019)	0.456 *** (0.021)
Business ownership rate (BOR) (21 countries)	1.27 *** (0.16)		6.44 *** (0.68)	
BOR <sup>2</sup> (21 countries)			-20.2 *** (2.8)	
BOR (19 countries, excl. Gre, Ita)		1.92 *** (0.17)		10.0 *** (1.1)
BOR <sup>2</sup> (19 countries, excl. Gre, Ita)				-37.3 *** (4.8)
BOR (Greece, Italy)		1.26 *** (0.17)		1.85 (1.70)
BOR <sup>2</sup> (Greece, Italy)				7.6 (7.9)
Year dummies <sup>(a)</sup>	YES	YES	YES	YES
Returns to scale <sup>(b)</sup>	0.9951 (0.0056)	0.9950 (0.0056)	0.9899 # (0.0055)	0.9873 ## (0.0057)
Optimal BOR			0.159 *** (0.0068)	
Optimal BOR (19 countries, excl. Gre, Ita)				0.134 *** (0.0031)
Optimal BOR (Greece, Italy)				N.A.
N	546	546	546	546
Loglikelihood	476.7	490.0	500.2	514.7

Heteroskedastic-consistent standard errors between brackets. \*\*\* significantly different from 0 at 0.01 level; \*\* 0.05 level; \* 0.10 level.

(a) Constant term refers to reference year 2006.

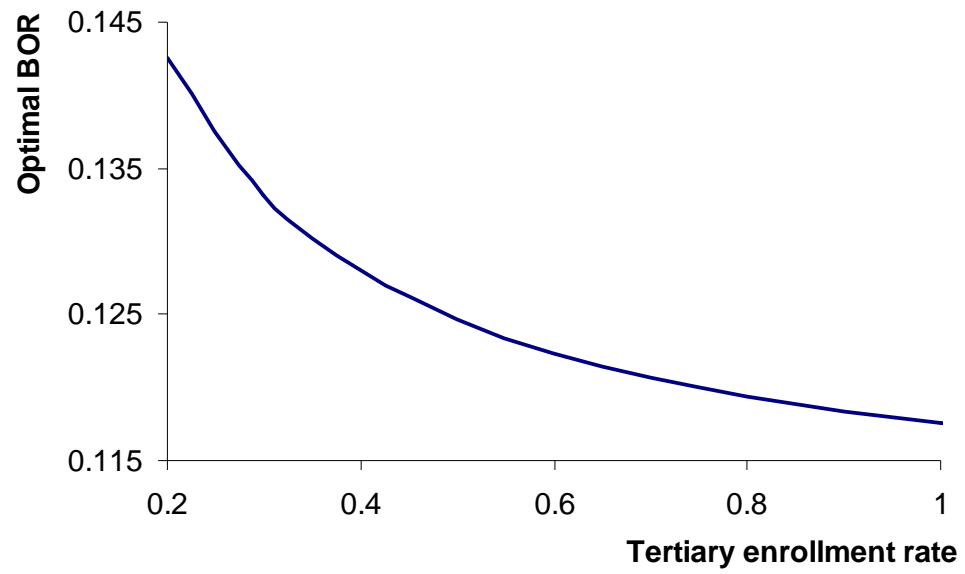
(b) Significance levels are indicated relative to unity: ### significantly different from 1 at 0.01 level; ## 0.05 level; # 0.10 level.

Figure 1: The relationship between the business ownership rate (BOR) and log (GDP)



Note: The figure is based on the estimates of Equation (5). The three curves correspond to the 0.25, 0.50 and 0.75 centiles of the variable *EDUC*.

Figure 2: Relationship between the tertiary enrollment rate and the optimal business ownership rate (BOR)



Note: The figure is based on the estimates from Equation (5)