

Berthold, Norbert; Gründler, Klaus

Working Paper

Entrepreneurship and economic growth in a panel of countries

Wirtschaftswissenschaftliche Beiträge des Lehrstuhls für Volkswirtschaftslehre,
Wirtschaftsordnung und Sozialpolitik, Universität Würzburg, No. 118

Provided in Cooperation with:

Chair of Economic Order and Social Policy, Julius Maximilian University
of Würzburg

Suggested Citation: Berthold, Norbert; Gründler, Klaus (2012) : Entrepreneurship and economic growth in a panel of countries, Wirtschaftswissenschaftliche Beiträge des Lehrstuhls für Volkswirtschaftslehre, Wirtschaftsordnung und Sozialpolitik, Universität Würzburg, No. 118, Univ., Lehrstuhl für Volkswirtschaftslehre, insbes. Wirtschaftsordnung und Sozialpolitik, Würzburg

This Version is available at:

<http://hdl.handle.net/10419/67487>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Bayerische Julius-Maximilians-Universität Würzburg

Wirtschaftswissenschaftliche Fakultät

**Entrepreneurship and Economic Growth
in a Panel of Countries**

Norbert Berthold

Klaus Gründler

Wirtschaftswissenschaftliche Beiträge
des Lehrstuhls für Volkswirtschaftslehre,
insbes. Wirtschaftsordnung und Sozialpolitik
Prof. Dr. Norbert Berthold

Nr. 118

2012

Sanderring 2 • D-97070 Würzburg

Entrepreneurship and Economic Growth in a Panel of Countries

Norbert Berthold

Klaus Gründler

Bayerische Julius-Maximilians-Universität Würzburg

Lehrstuhl für Volkswirtschaftslehre, insbes. Wirtschaftsordnung und Sozialpolitik

Sanderring 2

D-97070 Würzburg

Tel.: 0931-31-84588

Fax: 0931-3182774

Email:

norbert.berthold@uni-wuerzburg.de

klaus.gruendler@uni-wuerzburg.de

Entrepreneurship and Economic Growth in a Panel of Countries

Norbert Berthold and Klaus Gründler

December 2012

Abstract

We study the effect of entrepreneurship on economic growth. First, we illustrate that entrepreneurship affects the investment decision in horizontal and vertical innovations within endogenous growth models. As a direct consequence, the level of entrepreneurship exerts significant growth stimuli. We then evaluate this prediction empirically applying 3SLS estimations based on the approach proposed by BARRO (1991, 2000, 2003). Using data of 188 countries between 1980-2010, we show that entrepreneurship has a significantly positive effect on growth, even when controlling for a wide range of commonly used political and state variables suggested by the standard growth model. Our sensitivity analysis that takes into account different proxies of entrepreneurship supports our results. It turns out that the level of uncertainty avoidance - perhaps the purest proxy of entrepreneurship - exerts negative effects on economic growth. The extent of entrepreneurship can thus be considered an adequate additional determinant in growth models to explain differences in per capita income.

Keywords: Entrepreneurship, Economic Growth

JEL No.: L26, O31, O47

Address: Lehrstuhl für Volkswirtschaftslehre
Insbesondere Wirtschaftsordnung und Sozialpolitik
Julius-Maximilians-Universität Würzburg
97070 Würzburg
Tel: (49) 931 31 84588
e-Mail: klaus.gruendler@uni-wuerzburg.de

1 Introduction

This paper studies the effects of entrepreneurship on economic growth. While contemporary growth theory mainly focuses on human capital and technological change, entrepreneurship ekes out a living as an academic orphan. Yet, SOLOW (2007) argues that one of the most valuable contributions of endogenous growth theory is the body of work on Schumpeterian models. These models, in particular the work of AGHION and HOWITT (1992, 1998), emphasize the importance of 'creative destruction' which leads to an improvement of existing specialized intermediate goods. Vertical innovations thus trigger growth in this type of theory. However, as the approaches illustrate the monetary incentives of innovations, they do not take into account the individuals behind such decisions: the entrepreneurs. If there are relevant non-monetary factors that determine the investment in innovations, then these factors must be expected to influence growth. And if these factors turn out to differ systematically between countries, then they must be able to explain differences in wealth. BARRO and MCCLEARY (2003) already drew the conclusion that successful explanations of economic growth patterns have to go beyond narrow economic measures to encompass cultural forces. The entrepreneurial activity is one of these cultural forces, as risk-averseness is a part of the collective mental programming passed from one generation to the next. Risk-averseness, however, is without a doubt an important factor in each investment decision. The tangential role of entrepreneurship in economic literature may therefore be unjustifiable, since it can be one crucial factor to explain the origin of innovations and therefore exerts a meaningful influence on wealth increases.

The aim of this paper is to illustrate that entrepreneurship indeed affects economic growth. The paper proceeds as follows: Section 2 provides an overview of recent studies concerning entrepreneurship, economic growth and the combination of the two. In section 3, we sketch how entrepreneurship can be incorporated into endogenous growth theories. We will mainly focus on the work of ROMER (1987, 1990), AGHION and HOWITT (1992, 1998), GROSSMAN and HELPMAN (1991) and most of all BARRO and SALA-I-MARTIN (2004). Our simple outline will show that endogenous growth models indicate a positive influence of entrepreneurship on growth. In section 4, we evaluate this prediction empirically. The econometrical model is based on the approach proposed by BARRO (1991, 1997, 2000, 2003) applying 3SLS on 5-year cross section averages for 188 countries between 1980 and 2010. In section 5, we discuss the

results in detail and carry out some sensitivity analysis, using different measures of entrepreneurship. As we will demonstrate, the positive influence of entrepreneurship found in the basic regression system turns out to be stable. We conclude in section 6.

2 Recent Literatur

Theory on entrepreneurship

Without any doubt, SCHUMPETER (1911, 1939) has been the pioneer establishing the role of entrepreneurs within economic theory. The core of Schumpeters considerations is an entrepreneur who is willing to take risks and thus takes advantage of new opportunities. He invests in new products as existing markets are saturated. This entrepreneur can be considered an innovator. Yet, one can only be innovative if there is a willingness to take risks. The property of an entrepreneur to be a risk-taking innovator is undoubtedly the main characterization found in historical and recent economic publications. However, HÉBERT and LINK (1989) indentify at least thirteen distinct roles that classify entrepreneurs within professional literature. Each of these roles delineates the nature of the entrepreneur in a very specific way and emphasizes different aspects. Whilst some classifications simply describe the entrepreneur as a person who realizes a start-up of a new business or - more generally - is the owner of an enterprise, others stress the importance of concrete activities in the economy such as the allocation of resources among alternative uses and the employment of production factors. Further characterizations consider the entrepreneur a supplier of capital or an arbitrageur. To bring order into the variety of description patterns, THURIK and WENNEKERS (1999) condense the taxonomy of entrepreneurial theories into three major intellectual traditions. Each of these paradigms has its origin in the work of CANTILLON (1755) who was the first to describe the nature of entrepreneurs, distinguishing their economic relevance from landowners and employees. The first of these traditions is the German school which was mainly established by VON THÜNEN (1826) and SCHUMPETER (1911, 1939). This paradigm accents the role of an innovative entrepreneur who is willing to take risks and who uses new combinations of existing production factors to develop new goods and products. In this role, the entrepreneur causes instability as he destructs existing equilibria. Schumpeter calls this process 'creative destruction'. Quite the contrary, the (neo-)classical tradition of, inter alia,

MARSHALL (1891), KNIGHT (1921) and - with some restrictions - COASE (1937) postulates that the entrepreneur leads the market to its equilibrium due to his economic activity. The third tradition is the Austrian school of MENGER (1871), VON MISES (1940) and later KIRZNER (1973) which focuses on the ability of entrepreneurs to perceive profit opportunities by fulfilling currently unsatisfied needs or by improving market inefficiencies. NOOTEBOOM (1993) states that the main differences between the German and the Austrian school may be seen in the creation (German school) and the realization (Austrian school) of potential gains.

Summarizing the paradigms discussed above in a more formal description, an entrepreneur can simply be considered an individual i who owns a certain set of properties P . The most relevant and unambiguous properties are low risk-averseness θ and the willing to take advantage of new opportunities v , so P equals at least $P = (\theta, v)$. Let S be the set of properties of each individual, the entrepreneurial activity A of a country therefore is the cardinality of the subset of entrepreneurs $E = \{i \in C | P \subset S\}$ relative to the cardinality of the superset of all citizens C , so $A = \frac{E \subset C}{C}$.

The linkage between entrepreneurship and growth theory

The neoclassical growth theory, especially the models of SOLOW (1956) and SWAN (1956), contributes a coherent and empirically well-founded explanation on global growth patterns, at least during some periods.¹ Thus, the neoclassical explanation can be considered the first growth theory that provides convincing empirical evidences. Yet, the main trigger of economic growth in this class of theory - that is technological progress - cannot be explained by the models themselves as it represents an externally given parameter whose accumulation follows a random walk. In such an environment, entrepreneurship as a key driver of innovations cannot be incorporated properly. This incapability is amplified by the fact that neoclassical theory makes very little effort to break down economic growth on firm levels. Aggregate production functions, the assumptions of rational individuals and a perfect distribution of information left no room for an active entrepreneur. It is therefore not surprising that the literature accounting for the influence of entrepreneurship on economic growth must be considered quite sparse until the end of the 1980s. Yet, as endogenous growth

¹See, amongst others, SOLOW (1957), MANKIW et al. (1992) and BAROSS-FILHO et al. (2005).

theory gained more and more popularity, the role of the entrepreneur experienced a renaissance. Even though only few studies devote themselves to the strict econometric analysis of the entrepreneur's role in the development of per capita income, there is a rich amount of essays considering various theoretical interdependencies.

The survey of THURIK and WENNEKERS (1999) synthesizes disparate strands of literature to link economic growth and entrepreneurship. The authors investigate a variety of theoretical links between the two concepts, emphasizing the role of the entrepreneur as a creator of new products. AUDRETSCH and KEILBACH (2003, 2004, 2008) and AUDRETSCH (2007) focus on the meaning of entrepreneurship capital. This kind of capital is shaped by a broad spectrum of factors (policies, institutions, traditions, law and finance) and reflects social acceptance and valuation of entrepreneurial behaviour, along with attitudes towards risks. Thus, entrepreneurship capital can be expected to be strongly influenced by culture. AUDRETSCH and KEILBACH (2004, 2008) and AUDRETSCH et al. (2008) investigate the importance of entrepreneurship capital empirically using regional data and discover a positive influence that turns out to be significant in most cases.

ACS et al. (2004) and ACS et al. (2005) describe the influence of entrepreneurship in a different way using knowledge diffusion as transformation mechanism. As they point out, knowledge created by a specific firm is only partially excludable and all firms benefit from spillovers originated in knowledge investments. Following ARROW (1962), they further argue that the conversion of knowledge into growth must be assumed a general externality in recent literature. Yet, they identify entrepreneurship as one factor that is able to endogenize this transformation. For the empirical evaluation of their theoretical considerations, ACS et al. (2005) carry out 2SLS estimations using five year moving averages for growth in GDP per capita where the extent of entrepreneurship is approximated by the self-employment rate. Including some control variables, they find a significantly positive influence on growth in each of the estimated models. Applying OLS, a similar estimation has been carried out by VAN STEL et al. (2005) who use the Total Entrepreneurial Activity Index (TEA) of GEM (2004) as a proxy of entrepreneurship. The results turned out to be heterogeneous, although TEA in most instances reveals positive coefficients. Likewise, WONG et al. (2005) find a generally positive influence of TEA on growth rates, albeit with some restrictions.

Another class of studies is concerned with the role of firm establishments.

Using data of firm births and deaths in the United States, REYNOLDS (1999) reports a positive influence on economic growth as approximated by job creation. Similarly, PICOT et al. (1998) found that new firms enhance employment levels by creating new jobs. By contrast, a variety of studies, such as EVANS and LEIGHTON (1989, 1990) and REYNOLDS et al. (1994) ascertain that unemployment forces individuals to seek self-employment and thus stimulates the entrepreneurial activity. According to VAN STEL and STOREY (2004), this 'refugee' effect can assure jobs for the particular business owners but it contributes very little to economic growth, as this kind of entrepreneurs do not tend to exhibit the Schumpeterian properties of low risk-averseness and the willing to be innovative.

3 Theoretical Framework

Some preliminary considerations

DIXIT and STIGLITZ (1977) have been the first to capture preferences for varieties within an utility function. The intuition is that an increase in available final consumption goods leads to an increase of the utility of the consumers. ETHIER (1982) reinterprets this mechanism and suggests that the output of final consumption goods is a function of the total number of available intermediate goods used by final goods producers. ROMER (1987) transforms this approach into the context of technological progress and economic growth. Considering a continuum of intermediates, the production function of firm i can be denoted as

$$y_i = \Psi L^{1-\alpha} \int_{\mathbb{R}^+} x_{ij}^\alpha \quad (1)$$

where Ψ denotes factor productivity, L describes labor and x_{ij} denominates the amount x of the specialized intermediate good $j \in \mathfrak{P}$ as used by the i th firm, $i = 1, \dots, I$. As a matter of course, each j owns diminishing marginal returns, so $\alpha \in (0, 1)$. This condition also leads to constant returns to scale in (1). BARRO and SALA-I-MARTIN (2004) formulate (1) using a discrete and finite number of available specialized intermediate goods (SIG).

$$y_i = \Psi L_i^{1-\alpha} \sum_{j=1}^N x_{ij}^\alpha \quad (2)$$

This formulation provides both an intuitive economic interpretation and a direct explanation of the growth effect if the cardinal number of the set of available SIG, N , increases. Assuming that all j can be measured in consistent physical units and under the condition $x_{ij} = x_i$ (which equals the equilibrium condition in the model), (2) can be rearranged as follows

$$y_i = \Psi * L_i^{1-\alpha} N X_i^\alpha. \quad (3)$$

It is immediately apparent that an increase of N leads to an increase in the firm output and ceteris paribus to an increase in GDP (Y), since $Y = \sum_{i=1}^I y_i$. ROMER (1987, 1990) discusses interesting properties of the production functions above and derives equilibrium quantities and growth rates for M and x_{ij} .

The role of entrepreneurship

What is the role of entrepreneurship in the above considerations? As (3) proves, the cardinal number of \mathfrak{P} limits the output of the i th firm. The main growth effect in the production function above emerges due to an increase in N , the supremum of \mathfrak{P} . The central question arising in this context is: How can an increase in N be achieved? To increase the number of SIG, firms must innovate in order to gain blueprints of new intermediate goods j^* . BARRO and SALAI-MARTIN (2004) formulate the capital value $V(j)_t$ of existing j at t building upon the approach of ROMER (1990) as

$$V(j)_t = \int_t^\infty (P_j - 1)x_j \exp\{-\bar{r}(v,t)(v-t)\} dv \quad (4)$$

where $\bar{r}(v,t)$ denominates the average interest rate between t and v and $\pi_j(v) = (P_j - 1)x_j$ displays the cashflow stream at time v . In order to cover the invention costs η , the price of j has to cover the marginal costs of the production of j at least for some periods after t . It is easy to show that under some conditions, x_j equals $L\Psi^{1/(1-\alpha)}\alpha^{2/(1-\alpha)}$ and the monopolistic price resulting

from the maximization of the term $(P_j - 1)x_j$ is $1/\alpha$.² As a matter of course, i will be the monopolist of an invention j^* at least for a very short period. In order to set incentives for the creation of j^* , most countries do have patent protection laws, so the assumption of a monopoly for j^* is reasonable. Using the above values for P_j and x_j in (4) and bringing the constants in front of the integral gives the following condition for inventions of j^*

$$\eta < L\Psi^{1/(1-\alpha)} \frac{1-\alpha}{\alpha} \alpha^{2/(1-\alpha)} \int_t^\infty \exp\{-\bar{r}(v,t)(v-t)\} dv \quad (5)$$

The term $L\Psi^{1/(1-\alpha)} \frac{1-\alpha}{\alpha} \alpha^{2/(1-\alpha)}$ is typical for this class of models and will appear several times in the following equations. To preserve clarity, we substitute this term by Ω . The formula above illustrates the investment decision for known values of $V(j^*)_t$. However, since the capital value relies on assumptions of the particular firm and can ex ante not be anticipated correctly, the investment decision of j^* must include uncertainty or risk. KNIGHT (1921) distinguishes these two concepts, emphasizing that uncertainty is immeasurable and not possible to calculate, while risk is - at least to some degree - measurable. In this context, uncertainty can be considered the limit value of risk. Yet, if uncertainty is the limit value of risk, both concepts can be denoted with one continuous parameter. Incorporating this parameter in (5) can be achieved using

$$\eta < \mathbb{E}[V(j^*)_t]$$

where the expected value of $V(j^*)_t$ depends on the right side of inequation (5) and a firm specific time-invariant risk parameter θ_i that depends on the risk-averseness of firm i . If the probability of failure of an innovation is normally distributed between all j^* and cannot be exactly anticipated ex ante, the investment decision relies solely on the risk-averseness of i rather than on the 'true' risk of j^* . Interpreting $\mathbb{E}[V(j^*)_t]$ as $V(j^*)_t - \theta_i$, we can summarize our assumptions as

$$\eta + \theta_i < \Omega \int_t^\infty \exp\{\cdot\} dv \quad (6)$$

where risk or uncertainty acts as a special kind of investment cost. The equa-

²See BARRO and SALA-I-MARTIN (2004) for the derivation of these two identities.

tion above thus illustrates how entrepreneurship can influence growth. Building on KNIGHT (1921), the model of KIHLMSTROM and LAFFONT (1979) shows that it is an inherent characteristic of an entrepreneur to take risks. As they point out, the less risk-averse an individual is, the higher is the probability to become an entrepreneur rather than an employed worker. As already denoted above, a wide range of recent surveys, such as THURIK and WENNEKERS (1999) and HÉBERT and LINK (1989), follow the German (Schumpeterian) tradition emphasizing the adoption of the risk associated with uncertainty as one main property of an entrepreneur. As (6) illustrates, the extent of risk-averseness of i influences the investment decision of inventing j^* under uncertain returns. The probability of investing in j^* rises as θ_i approaches zero, whilst increasing θ_i makes investments in new SIG more and more unlikely. The preference for risk-avoidance of an economy as one crucial dimension in the property set of entrepreneurship P therefore influences the investment in innovations and thus economic growth.

While the above illustrations demonstrate how entrepreneurship may be embedded within horizontal innovation models, a very similar approach can be derived using production functions that concern vertical innovations. These kinds of innovations do not increase N , but lead to improvements in the quality or the productivity of each existing j . Thus, this class of models adopts the Schumpeterian idea of 'creative destruction'. The following sketch is based on AGHION and HOWITT (1992) and GROSSMAN and HELPMAN (1991), where we will mainly use the very intuitive and ostensive interpretation of BARRO and SALA-I-MARTIN (2004). Assuming that N is fixed, (2) can be written in dependence of quality as

$$y_i = \Psi L_i^{1-\alpha} \sum_{j=1}^N (\Theta^\phi x_{ij}^\alpha) \quad (7)$$

where the potential grades of each j are arranged on a quality ladder whose rungs have a proportionate distance of $\Theta > 1$. That means, each improvement ϕ of j leads to an increase of the term $(\Theta^\phi x_{ij}^\alpha)$ and therefore triggers a growth stimulus. This interpretation goes back to GROSSMAN and HELPMAN (1991). The cardinal question arising from (7) is the derivation of the incentive for improvements ϕ . Assuming that each improvement leads to higher qualities and that only the highest quality ϕ_j will be used in the production process, an entrepreneur will be monopolist over a period $T(\phi_j) := t_{\phi_{j+1}} - t_{\phi_j}$. Using $\frac{\partial y_i}{\partial x_{ij}^\alpha}$,

it is easy to derive the aggregate demand function

$$x_j = L[\Psi\alpha\phi^{\alpha\phi_j}/P_j]^{1/(1-\alpha)} \quad (8)$$

Again, the monopolistic price is $1/\alpha$. Thus, the profit-maximizing production can be calculated by using $1/\alpha$ in (8). Rearranging gives

$$x_j = L\Psi^{1/(1-\alpha)}\alpha^{2/(1-\alpha)}\Theta^{\phi_j\alpha/(1-\alpha)}.$$

Recall that the profit is assumed to be $(P-1)x_j\phi_j$. This means, the present value of the ϕ th improvement equals

$$V(\phi_j) = \Omega \int_{t_{\phi_j}}^{t_{\phi_j+1}} \Theta^{\phi_j\alpha/(1-\alpha)} \exp\{\cdot\} dv \quad (9)$$

Note that Ω in this equation equals the substitution that we made within the horizontal innovation models. Again, (9) relies on assumptions of the particular entrepreneur and depends on his individual risk-averseness. However, the probability of failure is much lower considering improvements rather than innovations. Thus the investment decision in ϕ_j is given by

$$\eta_{\phi_j} + \tilde{\theta} < \Omega \int_{t_{\phi_j}}^{t_{\phi_j+1}} \Theta^{\phi_j\alpha/(1-\alpha)} \exp\{\cdot\} dv \quad (10)$$

with improvement costs η_{ϕ_j} . Since improvements are less risky than innovations, it applies that $\theta > \tilde{\theta}$. Furthermore, it can be assumed that $\eta_{\phi_j} \ll \eta$. The left-hand side of (10) therefore is (much) smaller than in (6). Yet, the investment decision is crucially influenced by the expected present value $\mathbb{E}[V(\phi_j)]$ given by the right-hand side of (10). The term Ω in (10) equals the undiscounted value in the case of horizontal innovations. Since $\Theta^{\phi_j\alpha/(1-\alpha)} \in \mathbb{R}^+ \setminus \{0\}$, the assessment which kind of innovation - horizontal or vertical - ceteris paribus leads to higher present values crucially depends on the time horizon $T(\phi_j)$. Due to the relatively low costs of improvements, risk-averse firms are nevertheless more likely to invest in improvements rather than in innovations. This is the place where 'non-entrepreneurial firms' (in the term of our definition) act. However, it is the innovation that must be carried out in the first place in order to enable improvers to realize ϕ_j . Since improvements are advantageous due to the low

costs, new j^* have two effects: First, they influence growth *directly* as shown in (6). Second, they influence growth *indirectly* as j^* enables improvements that also lead to an increase in y_i , enabling risk-averse (non-entrepreneurial) firms to contribute their part to economic growth. Thus, modern growth theory comes exactly to the same result as SCHUMPETER (1939) already postulated more than 70 years ago.

However, the analysis of the firm output provides another crucial interpretation of the role of entrepreneurs within an economy: As already mentioned above, the output of economy k , denominated with Y_k , can be written as $Y_k = \sum_{i=1}^I y_{i,k}$. This implies that GDP depends on the amount of firms $i \in \mathcal{J}_k$ of an economy. It is obvious that the assumption $y_i = y \forall i$ is quite unrealistic and that the dispersion of y_i is high. Yet, for each new established firm i^* that satisfies $y_{i^*} > 0$, the output rises. An increase in the cardinal number of \mathcal{J}_k will therefore lead to economic growth. As a matter of course, a reduction in the number of elements of \mathcal{J}_k will lead to a decline in the output Y_k .³ The concerning variable with respect to GDP growth will therefore be the difference of enterprise foundations and insolvencies. This circumstance illustrates the second direction of influence on growth emerging from the entrepreneurial activity of an economy.

Summarizing the findings of this section, we can assume that GDP growth will rise if the entrepreneurial tendencies within k are high. In this context, low risk-averseness turns out to be the main property of P that triggers growth stimuli.

4 Empirical Framework

The empirical system

This section attends to the investigation of the empirical influence of entrepreneurship on growth as predicted by the previous theoretical considerations. Specifying our model, we follow the basic approach proposed by BARRO (1991, 1997, 2003) interpreting the growth rate of GDP per capita as a function

³Again, this is only a ceteris paribus condition. As a matter of course, one can easily think of an economy that only consists of one (huge) firm that produces a higher output than any economy with a multitude of entrepreneurs.

$$\Delta y = F(y_{t-1}, h_{t-1}, Z) \quad (11)$$

where y_{t-1} denotes initial GDP per capita, h_{t-1} describes initial human capital per person and Z comprises an array of control and environmental variables. The latter is of great importance, since a variety of authors such as BARRO and SALA-I-MARTIN (1991), MANKIW et al. (1992) and BARRO (2003) found that the absolute convergence hypothesis of neoclassical growth theory as suggested by, amongst others, SOLOW (1956), SWAN (1956), KOOPMANS (1965) and CASS (1965) cannot be affirmed empirically. In fact, the relation between the initial level of GDP per capita and the growth rate has to be examined after holding constant some crucial variables that distinguish the countries. As our theoretical analysis of the entrepreneur's role in economic growth indicates, the level of entrepreneurship may be considered such a variable. In addition, we include several policy and state variables in order to control for environmental country-specific effects and to avoid significance of the desired entrepreneurship coefficient due to omitted variables or multi-collinearity.

Although neoclassical growth theory predicts lower growth rates for countries with higher capital endowment, this presumption cannot be evaluated properly since data on physical capital is quite unreliable as its calculation depends on arbitrary assumptions about depreciation and approximated values of both initial capital endowment and investment flows. This problem is further exacerbated if developing countries are to be included. As a consequence, we follow BARRO (2003) assuming that higher levels of y and h reflect a greater stock of physical capital. Thus, for given values of the control variables, an equiproportionate increase in initial real GDP per capita and human capital reduces growth in (11) due to diminishing returns of reproducible factors.

For a more precise specification of the model sketched in (11), we refer to the work of BARRO (1991, 1997, 2000, 2003) and BARRO and SALA-I-MARTIN (2004) which can at present be considered as the standard growth estimation approach. There is a rich empirical literature estimating more or less similar models, for instance MANKIW et al. (1992), ALESINA et al. (1992) and PEROTTI (1996) to name but a few.

The dependend variable of our model will be the average growth rate of per capita real GDP within a period of 5 years. Each of these intervals will be denoted by t . On the one hand, this long-term context is forced by the availability of data as many of the exogenous variables are at best available over

five-year intervals. On the other hand and even more important, growth theory does not aim to explain short-run fluctuations. Quite the contrary, most growth models in theory explicitly negate the existence of business cycles assuming that the capacity of utilization equals one for all production factors. Thus, applying annual data would lead to a bias of the estimation since long-term effects would be superimposed by short-run fluctuations, making the relationship between growth and its determinants more ambiguous than they are.

To account for the conditional convergence hypothesis, we include the logarithmic level of per capita real GDP in $t - 1$. We expect this coefficient to be negative as an approximation to the steady state will lead to declining growth rates for given values of the control and environmental variables. To prevent overestimations of the convergence due to temporary measurement errors in GDP, we include values of $\text{LOG}(\text{CGDP})$ in $t - 2$ in the list of instruments. In fact, measurement errors in national accounts are likely to occur, particularly when the analysis covers data of less-developed countries.

As (11) illustrates, the stock of human capital is crucial for the extent of the growth rate. We proxy this variable using school attainment (*SCHOOLY*) as well as health (*LIFEEX*). Although school attainment measured by the average years of schooling does not account for the quality of schooling, it is still the only variable existent for large samples. Data on comparable test scores that turn out to be much more proficient in explaining differences in GDP growth are available, but only for few countries. Health, on the other side, can be considered a special kind of human capital as it increases productivity. As WEIL (2005) puts it, healthier people can work longer and harder. Following BARRO (2003), health enters into the system using data on life expectancy at age one. As ARORA (2001) states, only life expectancy at birth encompasses information of all age groups. Yet, there will be some bias during the initial year, especially when infant death rates are high. Thus, life expectancy at age one may be regarded as a satisfactory compromise.

Another crucial prediction of the neoclassical growth model is the negative influence of population growth. We account for this assumption including the logarithmic level of the fertility rate $\text{LOG}(\text{FERT})$ as a measure of the average number of children born to a woman over her lifetime. Furthermore, the standard growth model explains net increases of the stock of capital using investments less effective depreciation. Thus, the empirical framework will also include the ratio of investment to real GDP (*INVS*). In order to isolate the effect of investment on growth - rather than the reverse - we use lagged values of the

investment ratio in the list of instruments.

ALESINA et al. (1992) and ALESINA and PEROTTI (1996) were seminal contributions illustrating that political instability is harmful to growth. We take care of the political environment using an index that covers the rule of law of the particular countries (HOF). In addition, we include a dummy variable for democracy (DEM). Both variables are expected to raise growth rates as high values of HOF and DEM imply enhanced property rights as well as a government that commits itself to not confiscate capital from the private sector but creates a stable environment for investment. Our analysis will also include government consumption (GOVC) which decreases the steady state level of output per effective worker. This is because consumption expenditures of the government do not increase productivity and are rather likely to cause distortions in the private sector.

Finally, we account for the extent of foreign trade relations embedding the degree of openness (OPEN) as well as the terms of trade (TOTR) into the system. Endogenous growth theory emphasizes the role of technological spillovers as a main driver of vertical innovations and thus on growth. Yet, the extent of technological diffusion crucially depends on the openness of countries. Moreover, improvements of the terms of trade - gauged by the ratio of export prices to import prices - are assumed to raise the real income of countries and thus leads to an increase in domestic consumption. Furthermore, DIEWERT and MORRISON (1986) note that improvements in terms of trade also have direct effects on GDP that are very similar to technological progress, as such gains facilitate net output increases for any given amount of domestic input factors.

The system will also include dummy variables for South American (LATIN AMERICA) and Sub-Saharan countries (SUB-SAHARA).

Controlling for all the variables described above, we wish to examine if entrepreneurship provides additional explanatory power and whether this influence is significant or not. However, accounting for entrepreneurship in empirical studies, especially when investigating long time periods, is always limited due to data availability. As ACS et al. (2005) and PARKER (2004) point out, the self-employment rate has emerged as the standard measure of entrepreneurship in each analysis covering cross-sectional data. Even though this measure may not be considered ideal to reflect the entrepreneurial activity, it is still the only variable available for a large sample of countries. The advantage of using the self-employment rate is the investigation of the entrepreneurial impact including a large range of countries, while estimations using more appropriate

measures may be biased since many countries - especially less-developed nations - are neglected. However, entrepreneurship in developing countries may have completely different effects.

As a second measure, we will use the Total Entrepreneurship Activity (TEA) taken from the Global Entrepreneurship Monitor (GEM). The database contains various measures constructed on the basis of surveys, including the population share working as nascent entrepreneurs, as owners of a new business or as owners or managers of established businesses. As these variables are certainly more precise than the self-employment rate, the number of countries for which the data are available is limited. In addition, GEM only covers data from 1999 to present. In the sensitivity analysis, we account for several additional measures of entrepreneurship, evaluating if the influence remains stable. Most of these variables are taken from GEM (2012) and WORLD BANK (2012), such as the percentage share of population that is forced to self-employment due to unemployment (TEANESS), the population share that agrees that their national environment provides good opportunities to build a business (OPPORT), the percentage that does not consider themselves as being skilled enough to start a business (SKILLS), as well as the share that presently is owner or manager of a new (NEWBUS) respectively an established (ESTBUS) firm. Furthermore, we include the days required to legally start a business (DAYBUS) as a measure to proxy the entrepreneurial environment of countries. We already mentioned that the extent of risk-averseness is crucial for the decision to invest in innovations. Yet, as innovations are the key driver of growth in endogenous theory, growth can be expected to be lower when high risk-averseness prevails. Culture, defined as the collective mental programming of a society passed from one generation to another, thus is likely to influence growth, as it determines the subset of individuals E that fulfill the entrepreneurial properties, especially low risk-averseness. We test this hypothesis including uncertainty avoidance UIA in the sensitivity analysis.

We adjust the variables of entrepreneurship used within the basic regression system accounting for the size of firms. This is for two reasons: First, there is a rich literature emphasizing the importance of company size on firm growth. As HART and OULTON (1996) demonstrate, smaller firms tend to grow faster than mid-size or large companies. Second, owners of micro companies might not be regarded as entrepreneurs in the narrow sense, since the basic properties postulated by the German or Austrian school - that is low risk-averseness and the willing to invest in new opportunities - is most likely not met. As a result, our

ratio can be thought of as the effective self-employment respectively the effective TEA rate. Indeed, the latter argument is crucial: Figure 1 plots self-employment as well as the share of micro firms, measured by the ratio of micro enterprises in response to GDP, against GDP. Obviously, less-developed countries tend to have a much higher self-employment rate as industrialized countries. Yet, as the share of micro firms in dependence of GDP illustrates, this is due to the large amount of micro firms located in developing countries. The key question is, however, if the owners of this kind of firms can be considered entrepreneurs in the sense discussed in the previous sections. Figure 2 depicts that the answer is no. Higher self-employment rates apparently do not lead to a higher amount of patent applications. In fact, both variables are negatively correlated (-35 percent). Yet, if the investment in new and risky opportunities is one major inherent property of an entrepreneur, the self-employment rate obviously cannot be considered an adequate measure. By contrast, if the self-employment rate is adjusted by the share of micro firms, the influence on patents is positive. We regard this as a conclusive proof of the superiority of the adjusted self-employment rate. There has been an intense discussion in economic literature whether small or medium respectively large firms tend to be more innovative. SCHUMPETER (1942) believed that large firms generally produce more innovations. He argues that there are some advantages that can only be secured if market power is high. By contrast, the empirical findings of ACS and AUDRETSCH (1990) indicate that small firms produce higher total innovation rates (innovations per 1,000 employees) than large or medium firms. Yet, the assumption that small firms are more effective innovators only holds if the economic value of innovations is independent of the size of the firms responsible for their introduction. TETHER (1998) documents that the latter must be put in doubt. Even so, our adjustment does not generally eliminate the effect of small firms as we only adapt the self-employment rate for micro firms.

The estimation technique of the basic regressions will be 3SLS where each 5-year-interval acts as a separate system equation. The sensitivity analysis in general follows the same approach, covering alternative definitions of entrepreneurship and will furthermore set the focus on entrepreneurial environment. In order to circumvent possible problems caused by endogeneity, we include lagged variables of each regressor in the list of instruments. Surplus instruments will be an alternative specification of the democracy variable using continuous values as well as the average years of primary schooling. We explicitly abandon the use of country fixed effects, which would eliminate the

Figure 1: The Relationship between Self-Employment, Micro Firms and GDP (Average 2005-2010)

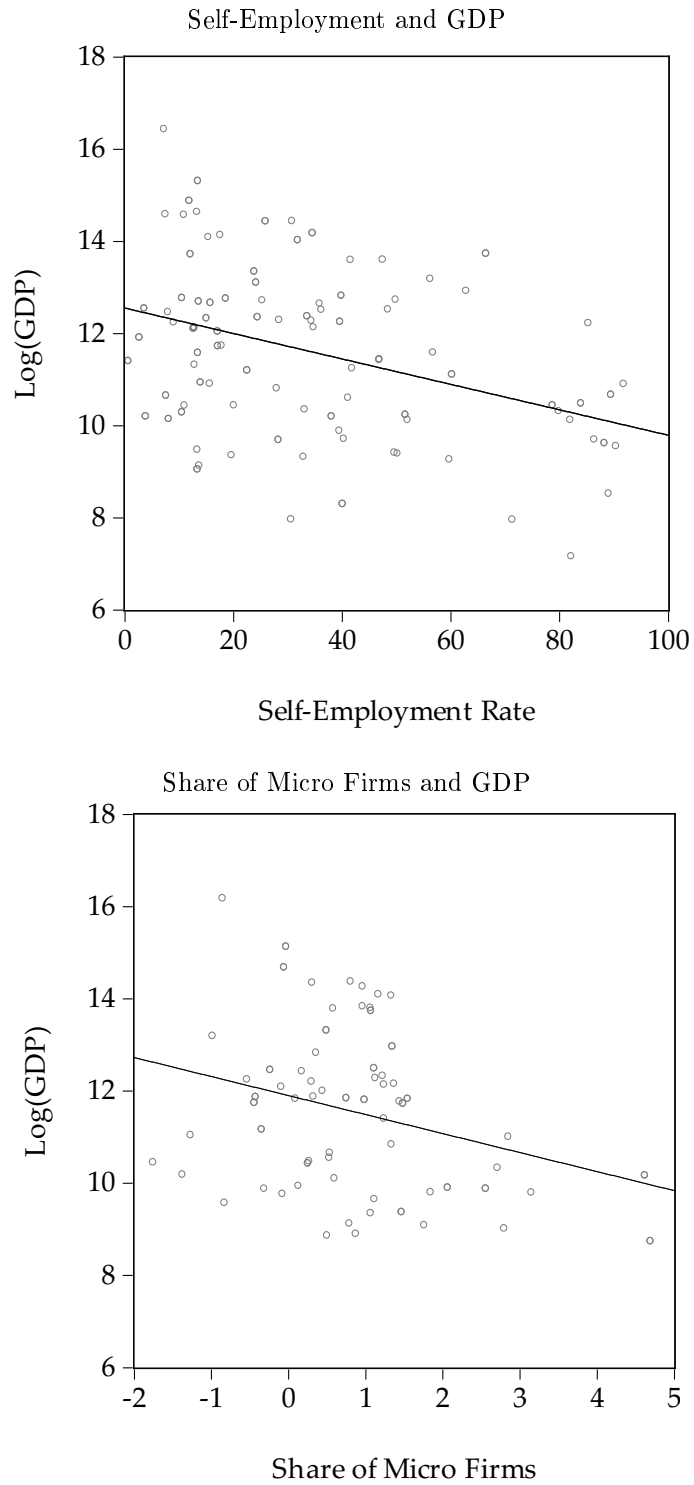
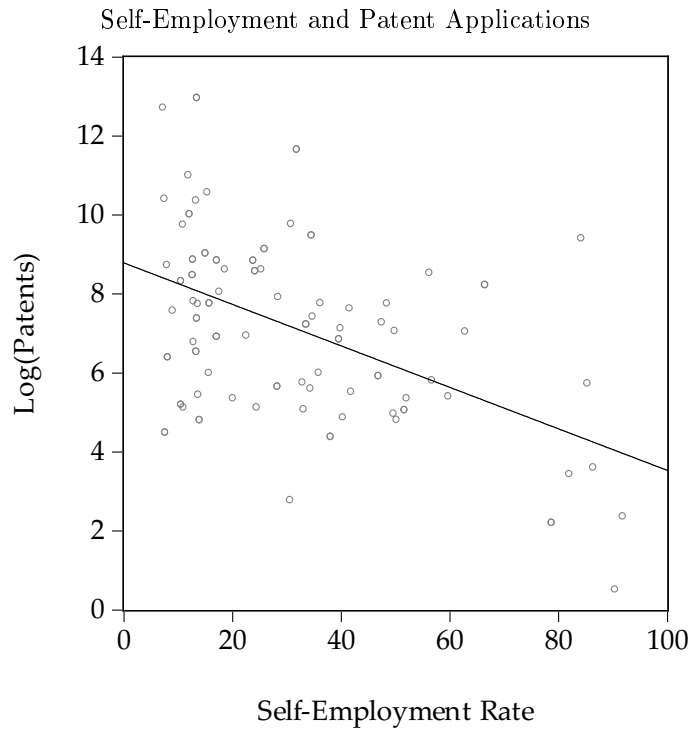
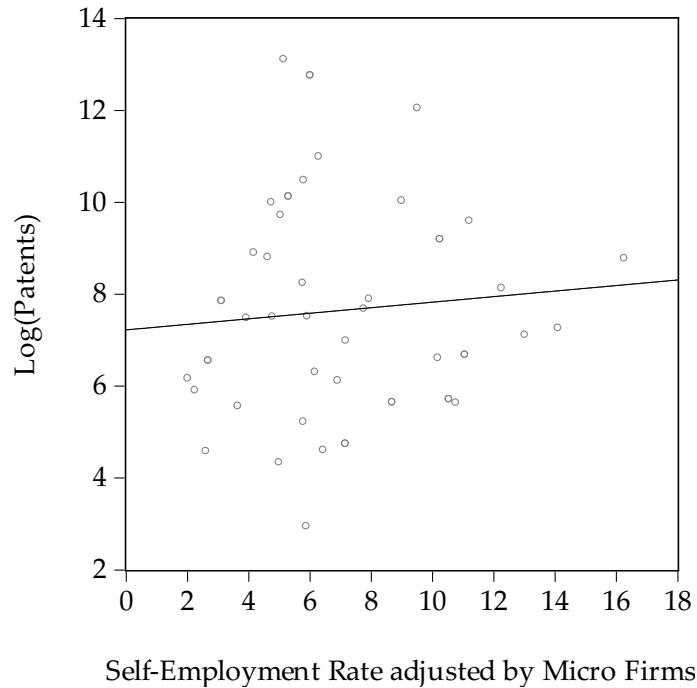


Figure 2: The Relationship between Self-Employment, Self-Employment adjusted by Micro Firms and Patent Applications (Average 2005-2010)



Self Employment adjusted by Micro Firms and Patent Applications



Notes: The data source of patent applications is World Bank (2012).

cross-sectional information in the data. In fact, as BARRO (1997) illustrates, the main information in panel growth regressions comes from the cross-sectional rather than the time dimension.

The data

The data of the control variables were obtained from standard sources of empirical growth research such as HESTON et al. (2012), BARRO and LEE (2010) and WORLD BANK (2012). Aside from these data bases, we use data from FREEDOM HOUSE (2011) to model the rule of law. The advantages of these data are the long time span (1972 to present) as well as the large coverage of 194 countries. Similar indices often used in growth research, such as the measures proposed by JODICE and TAYLOR (1983), GUPTA (1990) or ALESINA and PEROTTI (1996) are based on data limited in their availability. We also conducted estimations using the rule of law index from WORLD BANK (2012).⁴ Both outputs are highly comparable, but the lower scope of data leads to a decline in the number of observations. Democracy basically enters into the estimation using the democracy dummy of UTIP (2012). However, we use the index of democratization of VANHANEN (2012) as a surplus instrument. This index covers several issues concerning political participation and competition with continuous values between 0 and 100. As the distinction between democracies and non-democracies based on a dummy variable is quite rough and often rather ambiguous, this variable allows for a more in-depth differentiation. The specific data sources of all variables are listed in the appendix.

The self-employment rate SELF and the days required to start a business DAYBUS were taken from WORLD BANK (2012). SELF has been adjusted by the ratio of micro and small companies in relation to GDP. The share of micro or small firms can be found in AYYAGARI et al. (2011) and KOZAK and LEVENTHAL (2006). The definition of micro firms depends on the number of employees and differs slightly between several national classifications. In the majority of cases (72 percent of the observed countries), micro firms are companies with less than nine employees. Whenever the definition strongly deviates from this number (e.g. Moldova: < 19 employees or Jamaica: < 2 employees), we refrain from including the observation into the regression. The data source of the TEA index is GEM (2012). Furthermore, we use the following variables of GEM: OPPORT

⁴The results can be obtained upon request.

(the population share believing that their nation provides good opportunities for start-ups), TEANESS (the share of population forced into self-employment due to unemployment), ESTBUS (the share that currently is manager or owner of an established firm), NEWBUS (the share that currently is manager or owner of a new firm) and SKILLS (the share that does not believe to have enough skills to start a business). Uncertainty avoidance UIA will be taken from HOFSTEDE (2001).

Table 1 provides descriptive statistics of the variables used in our analysis, including the number of observations, the means, maxima, minima and standard deviations. In general, our data set contains 188 countries over the time period between 1980 and 2010. Yet, both the country sample as well as the time span are restricted in most of the estimations due to the unavailability of data.

5 Regression Results

Basic regressions

Table 2 provides the results of the basic regressions, covering the basic growth system as proposed by BARRO (1997, 2000, 2003) and BARRO and SALAI-MARTIN (2004) in column 1 as well as the systems enlarged by the self-employment rate (column 2), the adjusted self-employment rate (column 3) and the TEA index (column 4). The basic system and the system containing the self-employment rate include five periods: 1985-1990, 1990-1995, 1995-2000, 2000-2005 and 2005-2010. Due to limited data availability of TEA, the system shown in column 4 only covers the last two periods. Thus, the results cannot be directly compared. Another problem is caused by the limited cross-section that enters in (2)-(4). While column 1 includes 428 observations, this number is significantly reduced when accounting for entrepreneurship. As a result, the coefficients vary between the systems, although this variation mostly is not too severe.

The outputs in system (3) and (4) confirm our assumption that entrepreneurship has positive effects on economic growth. Both the adjusted self-employment rate and the TEA index possess coefficients with positive signs. The influence is significant in both cases, albeit the self-employment rate ($p < .01$) has a lower exceedance probability than TEA ($p < .10$). Surprisingly, the marginal impact of a one standard deviation change in TEA (.64) and SELF (.63) is almost ex-

Table 1:
Descriptive Statistics of Regression Variables, 2000-2010

Variable	No. of observations	Mean	Maximum	Minimum	Standard deviation
Δy	188	3.071	17.719	-5.472	2.940
LOG(CGDP)	180	8.637	11.126	5.611	1.284
SCHOOLY	146	7.560	12.809	1.145	2.702
LIFEEX	182	67.324	82.012	43.611	10.361
LOG(FERT)	182	.995	1.990	.188	.503
DEM	153	.690	1.000	.000	.452
OPEN	188	93.756	407.251	2.000	49.792
HOF	188	3.354	7.000	1.000	1.972
TOTR	183	105.786	160.376	35.169	18.495
GOVC	188	12.636	55.046	2.890	9.009
INVS	188	24.191	70.187	2.612	9.644
SELF	97	33.672	92.350	.9000	23.309
SELF/MICRO	57	7.779	37.046	1.153	6.704
TEA	83	12.761	52.100	1.960	9.224
TEA/MICRO	49	3.800	16.708	.570	3.053
OPPORT	83	40.008	81.000	8.500	16.638
TEANESS	83	25.388	58.250	4.100	12.247
ESTBUS	49	2.974	17.446	.251	2.730
SKILLS	68	50.74	82.00	12.20	15.79
DAYBUS	132	41.54	694.00	2.00	66.66
NEWBUS	49	1.827	11.991	.173	1.908
UIA	97	64.979	112.000	8.000	21.511

Notes: Data sources can be found in the appendix.

actly the same, even though the number of observations differs between system (3) and (4), indicating a stable influence of entrepreneurship on growth.

The influence of the original self-employment rate is essentially negative. We already pointed out in the previous section the importance of the adjustment of the self-employment rate. Our concern of a bias caused by the large amount of micro firms thus turned out to be justified.

The control variables possess the expected sign in most of the cases. Yet, there are two exceptions: First, health, measured with the life expectancy at age one, turns out to have a negative influence on growth. One explanation may be that a high life expectancy has the same effect as population growth. In this case, the negative sign would not be too surprising. Moreover, the marginal effect in the basic regression system is not significant at all. This confirms the results of BARRO (2003) who reports a p-value of .81 considering life expectancy. The second deviation from our assumptions refers to the political and environmental variables, the rule of law index and the democracy dummy. The negative sign of democracy endorses political models that stress the incentive of electoral majorities to use their power to transfer resources from the rich to the poor. However, the influence of the democracy dummy is not significant in any of the estimations. The rule of law index, by contrast, is significant and possesses a positive sign. Though, political stability becomes irrelevant when entering the entrepreneurship variables. This may be for two reasons: First, the inclusion of entrepreneurial variables reduces the number of observations. As this reduction is not normally distributed among different income groups and political systems, the standard deviation of HOF is reduced from 1.86 to 1.21, leading to a 35 percent reduction in the variation. Second, the correlation between the entrepreneurship variables and HOF is high (40 percent) indicating possible problems caused by multicollinearity. In fact, if the extent of entrepreneurial activities is strongly influenced by political stability, then SELF and TEA are very likely to contain information also covered by HOF.

Aside from these exceptions, all of the other variables have the expected sign.

Sensitivity Analysis

The basic regressions illustrate that entrepreneurship has positive effects on economic growth. This section discusses if these results remain stable when

Table 2:
Basic Growth Regression

	(1) Basic System	(2) Self Employment	(3) Adjusted Self Employment	(4) TEA
Constant	14.403*** [5.802]	26.323*** [4.780]	15.990*** [3.720]	21.969*** [4.168]
LOG(GDP)	-1.291*** [-6.161]	-1.180*** [-3.572]	-1.014*** [-3.125]	-.414 [-.697]
SCHOOLY	.168* [1.880]	.090 [.845]	.523*** [3.960]	.089 [.453]
LIFEEX	-.019 [-.538]	-.149*** [-2.783]	-.156** [-2.589]	-.284*** [-2.777]
LOG(FERT)	-3.795*** [-7.064]	-3.438*** [-4.555]	-2.956*** [-4.928]	-2.460*** [-2.821]
DEM	-.041 [-.114]	.154 [.273]	-.522 [1.101]	.363 [.314]
OPEN	.003 [.914]	.003 [1.010]	.007** [2.547]	.004 [1.237]
HOF	.184* [1.719]	-.046 [.765]	-.094 [-.478]	-.178 [-.567]
TOTR	.012** [2.532]	.010 [1.103]	.006 [.553]	.016 [.846]
GOVC	-.008 [-.279]	-.022 [-.588]	-.003 [-.095]	.069 [.862]
INVS	.051*** [3.038]	.071*** [2.624]	.093*** [3.520]	.119** [2.371]
LATIN AMERICA	-.092 [-.253]	.213 [.493]	1.575*** [3.347]	1.020 [1.491]
SUB-SAHARA	-.334 [.543]	-.963 [-1.290]	1.821 [1.622]	-2.278 [-1.046]
SELF		-.943** [-2.241]	.094*** [3.691]	
TEA				.212* [1.773]
Number of Observations	428	244	126	61
R-squared	.10, .34, .09, .33., .24	.14, .31, .01, .26, .22	.42, .59, .10, .31, .31	.54, .42
Standard Error	2.84, 2.41, 2.86, 3.29, 2.91	2.66, 2.14, 3.04, 3.35, 3.90	2.03, 1.77, 2.97, 5.12, 5.36	1.84, 3.89

Notes: Estimation is by three-stage least squares. t-Statistics are shown in parentheses. The dependent variables in systems (1) and (2) are the growth rates of real per capita GDP for 1985-1990, 1990-1995, 1995-2000, 2000-2005, 2005-2010. System (3) covers the periods 2000-2005 and 2005-2010 due to limited data availability of TEA. Instruments are mainly lagged exogenous variables. Surplus instruments are described in section 4. *p<.10, **p<.05, ***p<.01.

accounting for other proxies of entrepreneurship. The basic system will not be part of the sensitivity analysis, since this framework has been extensively discussed by BARRO (2003). Table 3 shows the results of the adjusted systems using several additional measures for entrepreneurship. In order to provide a clear presentation of the results, the table does not show the control variables. Yet, the marginal impacts, the signs as well as the significance of these variables are very similar to the outputs in table 2.⁵ Due to data availability, the systems of column 1-6 include data from 2000 to 2012 covering the same time span as in column 4 of table 2. System 7, however, includes data from 1985 to 2010.

The first column contrasts voluntary and involuntary entrepreneurs. Involuntary entrepreneurs are individuals who are forced by labor market situations to work as entrepreneurs, mainly because of a lack of job vacancies. Yet, this group may not be considered entrepreneurs in the sense of low risk-averseness and the willing to invest in new opportunities. The variable TEANESS in column 1 indeed proves that involuntary entrepreneurs do not contribute to economic growth. While TEA is still strongly significant, the influence of TEANESS is negligible. Furthermore, the marginal effect of TEA is more than twice as large as the effect of TEANESS. The Wald test does not reject the null hypothesis of equality of the TEA coefficients in table 2 and in table 3, indicating that multicollinearity between TEA and TEANESS in column 1 does not cause biases.

Columns 2 and 3 account for the specific political and social environment relevant for entrepreneurship. The variable OPPORT gives the percentage of the population that agrees that their close environment provides good opportunities to start a new business. The second measure, DAYBUS, reports the average number of calendar days needed to complete the procedures to legally operate a firm. This measure can be regarded as a good proxy for the general entrepreneurial conditions within an economy. Both variables imply that the entrepreneurial environment matters: The better the subjective assessment of the opportunities for start-ups, the faster will be the growth of nations.⁶ Furthermore, the more days needed to legally establish a firm, the lower is the growth rate. Yet, both the standard error and the coefficient of determination show that the deviation concerning DAYBUS is significantly higher. As this may indicate

⁵The whole system estimations can be attained on request.

⁶The number of observations in column 3 are higher than those in column 1. This is because the variables in column 1 are adjusted accounting for the amount of micro firms as described in section 4. However, the availability of micro firm data is limited.

that the subjective assessment has a higher explanatory power, the differences are very likely to emerge due to the larger sample of the DAYBUS regression.

The third group of control regressions is shown in columns 4 and 5, contrasting the impact of established entrepreneurs ESTBUS (owners or managers of established firms) and new entrepreneurs NEWBUS (owners or managers of start-ups). Both variables reveal positive influences on the growth rate. However, the marginal impact of new firms is higher. This finding supports the results of HART and OULTON (1996) who show that smaller firms tend to grow faster than mid-size or large companies. It furthermore emphasizes the necessity to adjust the entrepreneurship proxies in the basic regression by the effect of micro firms. However, the correlation between ESTBUS and NEWBUS is high (80 percent). As this explains the highly comparable measures of r-squared and standard errors, it also provides an interesting economic implication. Apparently, economies that have a high stock of active entrepreneurs do not have difficulties to care for intellectual offspring. This may be for two reasons: First, the environment for entrepreneurship in countries with high values of ESTBUS is advantageous. Indeed, the correlation between OPPORT and ESTBUS is high. As a consequence, nations have a high number of established firms whenever the opportunities for entrepreneurship are fortunate. This, however, directly implies that the level of NEWBUS is high, too. Second, established entrepreneurs may arouse the desire in the population to achieve a comparable status. In such an environment, established entrepreneurs serve as instructors for the upcoming generation of new business owners.

Even so, the latter argument depends on the culture of the particular countries. If people do not dare to start businesses because they do not trust in their own abilities, then culture will hinder the entrepreneurial activity and the above argument will be invalid. SKILLS gives the percentage of population that does not believe to have sufficient skills to become an entrepreneur. A very similar measure is the extent of uncertainty avoidance UIA. If people are afraid of taking risks, then they probably will not start a business. Moreover, section 3 demonstrated that UIA is a very crucial variable for the creation of innovations and must be considered the most important property of P . Indeed, the level of risk-averseness in our model turned out to be the key element in transmitting entrepreneurship into growth. Thus, UIA can be considered the purest proxy of entrepreneurship as it measures the cultural entrepreneurial tendencies in the mental programming of individuals, passed from one generation to the next and therefore strongly influences the cardinality of the subset E .

Table 3:
Sensitivity Analysis for the Basic Growth Regressions

	(1) Voluntary vs. Involuntary En- trepreneurs	(2) Environment I: Subjective Assessment	(3) Environment II: Days to Start a Business	(4) Established En- trepreneurs	(5) New Entrepreneurs	(6) Assessment of individual abilities	(7) Uncertainty Avoidance
TEA	.165** [2.070]						
TEANESS	.070 [1.375]						
OPPORT		.029* [1.673]					
DAYBUS			-.012* [-1.963]				
ESTBUS				.186** [2.012]			
NEWBUS					.292* [1.747]		
SKILLS						-.007 [-.426]	
UIA							-1.137* [-1.700]
Number of Observations	61	95	151	61	61	104	170
R-squared	.56, .53	.71, .44	.32, .38	.54, .43	.55, .40	.65, .39	.49, .48, .33, .32, .51
Standard Error	1.83, 2.70	1.67, 1.98	2.38, 1.98	1.83, 2.97	1.81, 3.06	1.82, 2.06	1.86, 2.53, 3.36, 3.68

Notes: Estimation is by three-stage least squares. t-Statistics are shown in parentheses. The dependent variables in systems (1) and (6) are the growth rates of real per capita GDP for 2000-2005 and 2005-2010 due to limited data availability of GEM (2012). System (7) covers the periods 1985-1990, 1990-1995, 1995-2000, 2000-2005, 2005-2010. Instruments are mainly lagged exogenous variables. Surplus instruments are described in section 4. *p<.10, **p<.05, ***p<.01.

Our results demonstrate that SKILLS does not have a significant influence at all. The descriptive data show why: The mean of SKILLS is 50.17, meaning that on average, one half of the population does not believe to have enough skills to become an entrepreneur. The country with the highest level of SKILLS is Uganda (82 percent). Yet, the mean of ESTBUS, the percentage that is presently owner or manager of an established firm is 8.06. Even if a high fraction does not consider themselves good entrepreneurs, the mean rate of ESTBUS can easily be achieved. In contrast, the level of uncertainty avoidance has a significantly negative influence. Considering a one standard deviation change of the exogenous variables, the marginal effect of UIA is conspicuously higher than any of the entrepreneurship measures used in table 2 or table 3. Furthermore, this estimation contains the highest number of observations in table 3, evaluating the effect of the variable on a relatively broad basis. The coefficient of UIA confirms our hypothesis of section 3 that entrepreneurship has a positive impact on growth due to the low risk aversion of entrepreneurs that creates innovations and thus economic growth.

6 Conclusions

Entrepreneurship matters. This can be considered the general conclusion of the present paper. We first demonstrated that entrepreneurship, interpreted as a special kind of collective mental programming, influences the accumulation of both horizontal and vertical innovation and thus exerts a positive influence on economic growth. The main driver behind this mechanism is the extent of risk-averseness shared by inhabitants of different countries. Our basic regression system supports this conclusion, discovering a significant influence of entrepreneurship on growth within a 3SLS system that controls for environmental and political effects. The adjustment of the system accounting for different proxies of entrepreneurship does not refute these findings. By contrast, most of the measures of entrepreneurship used in the sensitivity analysis reveal a positive influence. The regression contrasting voluntary and non-voluntary entrepreneurs illustrates that the positive influence emerges due to the inherent individualistic characteristics of an entrepreneur to be a risk-taking innovator rather than the mere fact of being the owner of a firm. This is why the adjustment of the ratio of micro firms is crucial and moreover why the amount of uncertainty avoidance

is the purest proxy of what literature calls an entrepreneur. Indeed, the level of uncertainty avoidance takes a strong positive influence on growth.

What are the policy implications of our findings? First, political stability and property laws are prerequisites for growth. While the impact on investments of the first argument has long before been postulated by ALESINA et al. (1992) and ALESINA and PEROTTI (1996), the latter is of great importance as otherwise investments in innovations can never be expected to produce positive capital values. In an environment without political stability and property rights, the level of entrepreneurial activity is irrelevant for growth. Second, the entrepreneurial environment matters: Countries whose citizens assess the opportunities of starting a business in their nearby environment as advantageous have higher growth rates. The same accounts for the number of days to legally operate a business. Whenever the framework for entrepreneurial involvement is good, the growth rate will ascend. However, this process is limited by a crucial cultural nature: the extent of risk-averseness. As this is part of the mental programming of a group (or, in our understanding, a country) passed from one generation to the next, risk-averseness is a feature that is very difficult - if at all - to be changed.

Appendix

Table A1: Data Sources

Variable	Data Source
Δy	HESTON et al. (2012)
LOG(CGDP)	HESTON et al. (2012)
SCHOOLY	BARRO and LEE (2010)
LIFEEX	WORLD BANK (2012)
LOG(FERT)	WORLD BANK (2012)
DEM	UTIP (2012), VANHANEN (2012)
OPEN	HESTON et al. (2012)
HOF	FREEDOM HOUSE (2011)
TOTR	WORLD BANK (2012)
GOVC	HESTON et al. (2012)
INVS	HESTON et al. (2012)
SELF	WORLD BANK (2012)
MICRO	AYYAGARI et al. (2011), KOZAK and LEVENTHAL (2006)
TEA	GEM (2012)
OPPORT	GEM (2012)
TEANESS	GEM (2012)
ESTBUS	GEM (2012)
NEWBUS	GEM (2012)
SKILLS	GEM (2012)
DAYBUS	WORLD BANK (2012)
UIA	HOFSTEDE (2001)

References

- ACS, Z. / AUDRETSCH, D. (1990): Innovation and Small Firms, Cambridge (US) and London (UK): MIT-Press, 1990.
- ACS, Z. / AUDRETSCH, D. / BRAUNERHJELM, P. / CARLSSON, B. (2004): The Missing Link: The Knowledge Filter and Endogenous Growth, *CEPR Discussion Papers*, No.4783.
- ACS, Z. / AUDRETSCH, D. / BRAUNERHJELM, P. / CARLSSON, B. (2005): Growth and Entrepreneurship: An Empirical Assessment, *Discussion Papers on Entrepreneurship, Growth and Public Policy*, No.3205.
- AGHION, P. / HOWITT, P. (1992): A Model of Growth Through Creative Destruction, *Econometrica*, Vol.60, No.2 (March 1992), pp.323-351.
- AGHION, P. / HOWITT, P. (1998): Endogenous Growth Theory, Cambridge (US) and London (UK): MIT-Press, 1998.
- ALESINA, A. / ÖZLER, S. / ROUBINI, N. / SWAGEL, P. (1992): Political Instability and Economic Growth, *NBER Working Paper*, No.4173 (September 1992).
- ALESINA, A. / PEROTTI, R. (1996): Income Distribution, Political Instability, and Investment, *European Economic Review*, Vol.40, No.6 (June 1996), pp.1203-1228.
- ARORA, S (2001): Health, Human Productivity, and Long-Term Economic Growth, *The Journal of Economic History*, Vol.61, No.3 (September 2001), pp.699-749.
- ARROW, K.J. (1962): Economic Welfare and the Allocation of Resources for Invention, in *The Rate and Direction of Inventive Activity: Economic and Social Factors*, edited by NELSON, R.R., Princeton (US): Princeton University Press (for NBER), 1962, pp.609-625.
- AUDRETSCH, D.B. (2007): Entrepreneurship Capital and Economic Growth, *Oxford Review of Economic Policy*, Vol.23, No.1 (Spring 2007), pp.63-78.
- AUDRETSCH, D.B. / KEILBACH, M. (2003): Entrepreneurship Capital and Economic Performance, *CEPR Discussion Papers*, No.3678.
- AUDRETSCH, D.B. / KEILBACH, M. (2004): Entrepreneurship Capital: Determinants and Impact, *Discussion Papers on Entrepreneurship, Growth and Public Policy*, No.3704 (August 2004).
- AUDRETSCH, D.B. / KEILBACH, M. (2008): Resolving the knowledge paradox: Knowledge-spillover entrepreneurship and economic growth, *Research Policy*, Vol.37, No.10 (December 2008), pp.1697-1705.
- AUDRETSCH, D.B. / BÖNTE, W. / KEILBACH, M. (2008): Entrepreneurship capital and its impact on knowledge diffusion and economic performance, *Journal of Business Venturing*, Vol.23, No.6 (November 2008), pp.687-698.
- AYYAGARI, M. / DEMIRGUC-KUNT, A. / MASKIMOVIC, V. (2011): Small vs. Young Firms across the World, *Policy Research Working Paper*, No.5631.

- BARROSSI-FILHO, M. / SILVA, R.G. / DINIZ, E.M. (2005): The Empirics of the Solow Growth Model: Long-Term Evidence, *Journal of Applied Economics*, Vol.8, No.1 (May 2005), pp.31-51.
- BARRO, R.J. (1991): Economic Growth in a Cross Section of Countries, *The Quarterly Journal of Economics*, Vol.106, No.2 (May 1991), pp.407-443.
- BARRO, R.J. (1997): Determinants of Economic Growth: A Cross-Country Empirical Study, Cambridge (US) and London (UK): MIT-Press, 1997.
- BARRO, R.J. (2000): Inequality and Growth in a Panel of Countries, *Journal of Economic Growth*, Vol. 5, No.1 (March 2000), pp.5-32.
- BARRO, R.J. (2003): Determinants of Economic Growth in a Panel of Countries, *Annals of Economics and Finance*, Vol.4, No.2 (November 2003), pp.231-274.
- BARRO, R.J. / SALA-I-MARTIN (1991): Convergence, *Journal of Political Economy*, Vol.100, No.2 (May 1992), pp.223-251.
- BARRO, R.J. / McCLEARY, R.M. (2003): Religion and Economic Growth Across Countries, *American Sociological Review*, Vol.68, No.5 (October 2003), pp.760-781.
- BARRO, R. J. / SALA-I-MARTIN, X. (2004): Economic Growth, Cambridge (US) and London (UK): MIT-Press, second edition, 2004.
- BARRO, R.J. / LEE, J.W. (2010): A New Data Set of Educational Attainment in the World, 1950-2010, *NBER Working Paper*, No.15902.
- CANTILLON, R. (1755): Essai sur la Nature du Commerce en Général, Trans. SAUCIER, C., Auburn (US): Ludwig von Mises Institute, 2010.
- CASS, D. (1965): Optimum Growth in an Aggregate Model of Capital Accumulation, *Review of Economic Studies*, Vol.32, No.3 (July 1965), pp.233-240.
- COASE, R.H. (1937): The Nature of the Firm, *Economica*, Vol.4, No.16 (November 1937), pp.386-405.
- DEWERT, W.E. / MORRISON, C.J. (1986): Adjusting Output and Productivity Indexes for Changes in Terms of Trade, *Economic Journal*, Vol.96, No.383 (September 1986), pp.659-679.
- DIXIT, A.K. / STIGLITZ, J.E. (1977): Monopolistic Competition and Optimum Product Diversity, *American Economic Review*, Vol.67, No.3 (June 1977), pp.297-308.
- ETHIER, W.J. (1982): National and International Returns to Scale in Modern Theory of International Trade, *American Economic Review*, Vol.73, No.3 (June 1982), pp.389-405.
- EVANS, D.S. / LEIGHTON, L.S. (1989): The Determinants of Changes in U.S. Self-Employment, *Small Business Economics*, Vol.1, No.2, pp.111-120.
- EVANS, D.S. / LEIGHTON, L.S. (1990): Small Business Formation by Unemployed and Employed Workers, *Small Business Economics*, Vol.2, No.4, pp.319-330.

- FREEDOM HOUSE (2011): Freedom in the World database, Washington D.C. (US), 2011.
- GEM (2004): Global Entrepreneurship Monitor database, London (UK), 2004.
- GEM (2012): Global Entrepreneurship Monitor database, London (UK), 2012.
- GROSSMAN, G.M. / HELPMAN, E. (1991): Innovation and Growth in the Global Economy, Cambridge (US) and London (UK): MIT Press, 1991.
- GUPTA, D.K. (1990): The Economics of Political Violence, New York (US): Praeger, 1990.
- HART, P.E. / OULTON, N. (1996): Growth and the Size of Firms, *The Economic Journal*, Vol.106, No.438 (September 1996), pp.1242-1252.
- HÉBERT, R.F. / LINK, A.N. (1989): In Search of the Meaning of Entrepreneurship, *Small Business Economics*, Vol.1, No.1, pp.39-50.
- HESTON, A. / SUMMERS, R. / ATEN, B. (2012): Penn World Table Version 7.1, Center for International Comparisons of Production, Income and Price at the University of Pennsylvania, 2012.
- HOFSTEDE, G. (2001): Cultures Consequences, Comparing Values, Behaviours, Institutions, and Organizations Across Nations, Thousand Oaks (US): Sage, 2nd Edition, 2001.
- JODICE, D.A. / TAYLOR, C.L. (1983): World Handbook of Political and Social Indicators, Volume 2: Political Protest and Government Change, New Haven (US): Yale University Press, 3rd Edition, 1983.
- KIHLSTROM, R.E. / LAFFONT, J.J. (1979): A General Equilibrium Entrepreneurial Theory of Firm Formation Based on Risk Aversion, *The Journal of Political Economy*, Vol.87, No.4 (August 1979), pp.719-748.
- KIRZNER, I.M. (1973): Competition and Entrepreneurship, Chicago (US): University of Chicago Press, 1973.
- KNIGHT, F.H. (1921): Risk, Uncertainty, and Profit, Boston (US): Houghton Mifflin, 1921.
- KOOPMANS, T.C. (1965): On the Concept of Optimal Economic Growth, The Econometric Approach to Development Planning, Amsterdam (NL): North Holland Publishing, 1965.
- KOZAK, M. / LEVENTHAL, S. (2006): Micro, Small, and Medium Enterprises: A Collection of Published Data, International Finance Corporation (IFC), Washington D.C. (US), 2006.
- MANKIW, N.G. / ROMER, D. / WEIL, D. (1992): A Contribution to the Empirics of Economic Growth, *The Quarterly Journal of Economics*, Vol.107, No.2 (May 1992), pp.407-437.
- MARSHALL, A. (1891): Principles of Economics, Philadelphia (US): Porcupine Press, 1891.

- MENGER, C. (1871): Grundsätze der Volkswirtschaftslehre, Wien (AT): Wilhelm Braumüller, 1871.
- MISES, VON L. (1940): Nationalökonomie: Theorie des Handels und Wirtschaftens, Genf (CH): Editions Union, 1940.
- NOOTEBOOM, B. (1993): Schumpeterian and Austrian Entrepreneurship: A Unified Process of Innovation and Diffusion, Groningen (NL): University of Groningen Press, 1993.
- PARKER, S. (2004): The Economics of Self-Employment and Entrepreneurship, Cambridge (UK): Cambridge University Press, 2004.
- PEROTTI, R. (1996): Growth, Income Distribution, and Democracy: What the Data Say, *Journal of Economic Growth*, Vol.1, No.2 (June 1996), pp.149-187.
- PICOT, G.M. / MANSER, M. / LIN, Z. (1998): The Role of Self-Employment in Job Creation in Canada and the U.S., OECD-CERF-CILN International Conference on Self-Employment, Burlington, Ontario (CA).
- REYNOLDS, P.D. (1999): Creative Destruction: Source or Symptom of Economic Growth, in Entrepreneurship, Small and Medium-Sized Enterprises and the Macroeconomy, edited by ACS, Z.J. / CARLSSON, B. / KARLSSON, C., Cambridge (UK): Cambridge University Press, 1999, pp.97-136.
- REYNOLDS, P.D. / STOREY, D.J. / WESTHEAD, P. (1994): Cross-National Comparisons of the Variation in New Firm Formation Rates, *Regional Studies*, Vol.28, No.4, pp.443-456.
- ROMER, P. (1987): Growth Based on Increasing Returns Due to Specialization, *American Economic Review*, Vol.77, No.1 (May 1987), pp.56-62.
- ROMER, P. (1990): Endogenous Technological Change, *Journal of Political Economy*, Vol.98, No.5 (October 1990), pp.71-102.
- SCHUMPETER, J.A. (1911): Theorie der wirtschaftlichen Entwicklung, Leipzig (DE): Duncker & Humblot, 1911.
- SCHUMPETER, J.A. (1939): Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process, New York (US): McGraw-Hill, 1939.
- SCHUMPETER, J.A. (1942): Capitalism, Socialism and Democracy, New York (US): Harper and Row, 1942.
- SOLOW, R.M. (1956): A Contribution to the Theory of Economic Growth, *The Quarterly Journal of Economics*, Vol.70, No.1 (February 1956), pp.65-94.
- SOLOW, R.M. (1957): Technical Change and the Aggregate Production Function, *The Review of Economics and Statistics*, Vol.39, No. 3 (August 1957), pp.312-320.
- SOLOW, R.M. (2007): The last 50 years in growth theory and the next 10, *Oxford Review of Economic Policy*, Vol.23, No.1 (Spring 2007), pp.3-14.

- SWAN, T.W. (1956): Economic Growth and Capital Accumulation, *Economic Record*, Vol.32, No.2 (November 1956), pp.334-361.
- TETHER, B. (1998): Small and Large Firms: Sources of Unequal Innovations?, *CRIC Discussion Paper*, No.11 (March 1998).
- THÜNEN, VON J.H. (1826): Der Isolierte Staat in Beziehung auf Landschaft und Nationalökonomie, Hamburg (DE): Perthes, 1826.
- THURIK, R. / WENNEKERS, S. (1999): Linking Entrepreneurship and Economic Growth, *Small Business Economics*, Vol.13, No.1 (August 1999), pp.27-55.
- UTIP (2012): Political Regime Dataset, University of Texas Inequality Project, Austin (US), 2012.
- VAN STEL, A. / CARREE, M. / THURIK, R. (2005): The effect of entrepreneurial activity on national economic growth, *Discussion Papers on Entrepreneurship, Growth and Public Policy*, No.0405 (January 2005).
- VAN STEL, A. / STOREY, D.J. (2004): The Link between Firm Births and Job Creation: Is there a Upas Tree Effect?, *Regional Studies*, Vol.38, No.8 (June 2004), pp.893-909.
- VANHANEN, T. (2012): Polyarchy Dataset 2.0, Oslo (DK), 2012.
- WEIL, D. (2005): Economic Growth, Boston (US): Addison-Wesley, 2005.
- WONG, P.K. / HO, Y.P. / AUTIO, E. (2005): Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data, *Small Business Economics*, Vol.24, No.3 (2005), pp.335-350.
- WORLD BANK (2012): World Development Indicators (WDI) database, Washington D.C. (US), 2012.