

**Entrepreneurship and Regional Growth in
Portugal**

2008-04

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Abstract: Scientific literature linked to New Growth Theory field and to the Neo-Schumpeterian one always have tried (with some success) to link innovation to regional growth, but the link between knowledge creation and growth hasn't been one that was easy to demonstrate. As proposed by other authors we argue that the "missing link" is entrepreneurship which allows turning new knowledge into economic knowledge that constitutes a commercial opportunity. We try to survey this concept and to recently proposed model where regional growth is linked to both new ventures and incumbent firms. This paper tests this model in a panel data of Portuguese regions.

1. Introduction

This paper is divided in 9 sections. The first one is this introduction. In the second one we make a brief introduction to the concept of knowledge and innovation. The third section we try to summarize important concepts from New Growth Theory and to address the importance of “knowledge spillovers”. In the next section we try to link entrepreneurship, innovation and technology, demonstrating the importance of entrepreneurship as a mechanism that enables knowledge to attain a specific value. In the fifth section we present the theoretical model developed by Acs et Al (2007), which will be the base for our empiric model. In the next section we present the present state of the Portuguese regions trying to understand the growth dynamics. In the seventh part we present the data, the empiric model and in the eighth we discuss the results. Finally in the last section we discuss the global picture that was drawn in the article and discuss flaws of the methodology and new research path for the future.

2. Knowledge and Innovation

Since the beginning of time that Men as tried to use knowledge, that was created by himself or others, in new applications that would allow him to attain certain goals with an higher probability of success (from the mastering of fire, to the development of tools, to the use of knowledge about chemical elements and metals). The advance of oral communication allowed the spread of knowledge through generations, and later on, Writing has allowed the register of knowledge through information, making easier the accumulation of knowledge, the generation of new knowledge and its dissemination.

Mankind's History shows us that the societies that have more capabilities to explore and generate new knowledge are those that ultimately grow larger in terms of wealth (this is the case of some civilizations such as the Roman, Persian, Egyptian, Chinese, etc. whose knowledge of civil engineering, metal alloys, tactics of war, medicine, etc., led to a development of wealth above their contemporaries and neighbour civilizations, even if this wealth was not equally distributed¹). In fact, this role seems to be more evident, as Braunerhjelm states (2007), in the revolution (or revolutions, vide Louçã and Freeman, 2001), which resulted from the industrial exploitation of knowledge (much thanks to the scientific and technical revolutions of the eighteenth century) enabling the development of new technologies and techniques that have led to new products, processes and industrial sectors.

This knowledge acts as fuel for innovation, or is incorporated into new processes, products and organizational forms, in a market context (basic definition of innovation). In turn, innovation is essential for economic growth, since its role involves the introduction of novelty (and diversity) in the economic sphere (Fagerberg, 2004), being essential in development of competences and growth of different businesses, sectors, regions and countries (Fagerberg, 2004). The most innovative companies tend to gain temporary monopolies or cost benefits, or greater capacity for differentiation, gaining market share or turnover. The most innovative sectors, regions and

¹ The technological progress of these civilizations, mainly the Chinese, though it has resulted in a significant increase of wealth, comparing against the "nations" surrounding them, the truth is that it never produced significant and general economic growth, especially when compared with what happened in Europe in the eighteenth century. However, ahead will try to discern some of the roots of this issue, which seems to lie in the concepts discussed in this article.

countries end up having greater productivity and income than non-productive (Fagerberg, 2004).

We have then a link between knowledge and innovation would appear that the theoretical point of view very clear. However, from the empirical point of view, the contribution of knowledge to economic growth is something far more complex and difficult to connect (Mueller, 2005).

3. New Growth Theory and Spillovers

The traditional growth theories sought to explain growth as a process of accumulation of physical capital over time, where a particular technology enables a combination of capital and labour which generates an output. In the 50s, Robert Solow (1957) developed a neoclassical model of growth, maintaining diminishing marginal returns in labour and capital, which allowed discerning the influence of exogenous factors, explaining per capita growth above what would be expected through re-investment of capital. This growth results from what became known as the residue of Solow and understood as a measure of technological change during the period under review (Harris and Kells, 1997). The work of Solow allowed him to conclude that the majority of growth observed in the United States could be attributed to this technical change.

However, the Solow model could not explain the differences in productivity per capita from differences in the rate of accumulation of capital and stated that in the steady state the economy should grow at the rate of technological progress, which was exogenous, i.e. a kind of “manna from heaven”, that economies could access freely. Later, other authors argued that a more precise specification of empirical factors could reduce the value of this residue.

At the end of the 80s, a New Economic Growth Theory, Romer (1986, 1990) and Lucas (1988) was created based on two very important aspects. First, technological progress can be seen as something endogenous, a product of economic activity and second, unlike physical capital, knowledge and technology generate increasing returns to scale. In these models, the most important source of knowledge, and the one that's modelled within, is the R&D sector (Audretsch and Keilbach, 2005), but not the only the authors mentioned (we can add a high level of human capital, the workforce skills, etc. - Lucas, 1988; Romer, 1996).

Knowledge will play a central role in these new theories. Thus, investments in human capital and knowledge generate economic growth, not only from the production factors, capital and labour, which are more productive, but also in an indirect way through knowledge "spillovers".

Indeed, the new models emphasize that knowledge has almost public good characteristics (not only the New Growth Theories emphasize this but also whole the new Schumpeterian literature). Therefore, this knowledge will generate benefits not only for those who apply it in the form of an innovation, but also for others through "spillovers" (the involuntary transfer of ideas and not compensated and techniques).

Citing only some recent empirical studies (Plummer & Acs, 2004; Varga & Schalk, 2004; Acs & Varga, 2004; Audretsch & Keilbach, 2004) we find that knowledge "spillovers" positively affect technological progress and economic growth (Mueller, 2005). The knowledge "spillovers" are key elements in the transfer of knowledge from industry to industry, representing an opportunity for companies increase their efficiency and develop innovations that we mentioned before (Romer 1986.1990; Acs and Plummer, 2005).

The NGT models assume that these "spillovers" are almost automatic and even new specifications of these models which sought to incorporate the possibility of knowledge being partially excludible (eg patents) still consider them as virtually automatic, without cost and not limited by geography (Acs, 2004) (an analogy that the physical could be considered as "action at a distance").

Taking into account importance of these "spillovers", a vast literature has been developed around them, both in theoretical terms and in empirical terms. However, these studies found little evidence of the automatic mechanism, whereas in fact the knowledge "spillovers" tend to be limited by geography, by cost and by legal restrictions (Anselin et al. 1997, 2000, Cohen et al. 2000, Jaffe 1989, Jaffe et al. 1993, Cohen, Nelson and Walsh, 2002). Langlois and Roberstson (1996) refer, following Nelson (1982), that the idea that knowledge is free is extremely misleading, that in fact it is "sticky" due to its sometimes tacit nature, or to the

existence of transaction costs² or even because of problems of perception about the real value of certain knowledge (Harris and Kells, 1997). The fact of "spillovers" are geographically (according to Feldman, 1994a, the proximity increases the ability of companies to exchange ideas and recognize the importance of certain types of knowledge) has been argued in numerous theoretical and empirical studies (e.g. Jaffe, 1989; Feldman, 1994a and 1994b; Audretsch and Stephan, 1996; Anselin, Acs and Varga, 1997 and 2000; Manski, 2000; Agrawal 2002, etc.) with some authors even considering that the impact of knowledge "spillovers" is limited to specific distances that can be measured (following Anselin et al., 1997 and 2000; Keller, 2002, we have an impact that reaches between 50 and 75 miles from the point where knowledge was created).

Finally, and linked to the issue of automatic "spillovers", these theories do not take into account the uncertainty and risk associated with the use of knowledge as a factor of production, since the value of this knowledge is so asymmetrical seized by the agents.

A new stream of scientific literature has nevertheless highlighted the role that entrepreneurship can have as a factor of connection between the knowledge produced and the creation of innovations, a vehicle that enhances the use of "spillovers" of knowledge. Basically, the entrepreneurs end up betting on a given product, running the risks of such bets, using the knowledge that "bought" to develop its activity (Audretsch and Keillbach, 2005s).

² For example, the Resource Based View of the Firm (Peteraf 1993, Rumelt 1991, Barney 1986, etc.), and the theory of Dynamic Capabilities (Teece et al, 1997), make reference to the difficulties of transmitting business knowledge when constructing new competences, and how this fact lead to obtaining a market advantage.

Technology, Innovation and Entrepreneurship³

One of the keywords related to the current "neo-Schumpeterian" literature, and also if we prefer and/or Evolutionists, is innovation.

However, as we have seen, innovation requires a connection to the market, a realization. The key between having knowledge and achieve a return from this knowledge passes through its application on the market. However, the current scientific literature is in the majority of times focused on the production of knowledge, using data on R&D and considering this as the main fuel that leads to the production of new knowledge (Cohen and Klepper, 1991), and secondly, using patents as a measure innovation. The truth is that these two measures are far from perfect to the capture the phenomena they intend to.

As we have seen, the knowledge generated by R&D does not automatically overflows and some of it will never be used in the short or medium term. Furthermore, patents are not a perfect measure of innovation thus they do not give us a faithful picture of exploitation of economic opportunities.

These problems are examined by Acs and Audretsch (2005). The authors point out some problems with the measurements of technological progress, which are usually conducted at three levels:

³ We won't enter the long discussion about the meaning of entrepreneur. For example, only Wennekers and Thurik (1999) mention 13 definitions, but the most common, as Braunerhjelm (2007) stated, are those of Schumpeter (1911), Knight (1921) and Kirzner (1973), which originated 3 distinct lines of thought, German, based on von Thünen (1826) and Schumpeter (1911), of Chicago, based on Knight (1921, 1944) and Schultz (1980) and the Austrian, based on Kirzner (1973) and Shackle (1982).

Summarising it, Schumpeter saw the entrepreneur as someone who induced the process of creative destruction, challenging existing structures and disrupting the existing economic balance through innovation (in this case the entrepreneur could be internal or external). The vision of Kirzner is based on micro-economic level, and states that the entrepreneurs are those whose competitive behaviour leads the processes of the market (recognizing that action and decision are fundamental in the market context). Finally, Knight (1921) identifies the entrepreneur as someone who transforms the uncertainty in a calculated risk (Braunerhjelm, 2007).

- (1) Measurement of innovation inputs using data on R&D expenditures and workers involved in this activity;
- (2) An intermediate measure represented by the volume of invention, given by the data on patents and finally;
- (3) A measure of innovative activity built through surveys and studies (Acs and Audretsch, 2005).

The first measure (R&D), despite being one of the first used to account technological progress (Scherer, 1965; Mansfield, 1968, etc., the truth is that it is an input to the process of innovation and not an innovative output (Acs and Audretsch, 2005).

As for patents, its use has spread dramatically through scholars in the field, but there are several basic problems with them. First, they represent a measure of the intermediate process, they quantify new technological knowledge but not the economic value of new knowledge, that is, although related, invention and innovation are not the same thing (this is a central issue in this article) (Acs and Audretsch, 2005). Secondly, the Management literature tells us that patents are used (or not) as competitive variables. Many companies prefer to use trade secret instead of patents as a form of protection (since the latest represent a sometimes undesirable dissemination of knowledge), other companies use patents as a way to ban competitors a particular area, and finally there are even sectors where patents are virtually nonexistent but where innovation exists (see the service sector). This shows us that the propensity to patent varies greatly between sectors⁴ (and even countries).

Finally, we note that many studies aimed at measuring directly innovation (identifying them directly in sectors) ultimately do not count the economic impact of these innovation (i.e., each innovation is considered equal) (Acs and Audretsch, 2005).

Therefore, there are some difficulties in measuring/evaluating innovation and consequently the contribution of its inputs/outputs to economic growth, especially in the analysis of how these inputs generate knowledge that leads to economically useful innovations.

⁴ Scherer (1983) and Mansfield (1984) discuss the different propensities to patent.

These problems extend to the evaluation of the importance of large and small companies in innovation.

About a century ago, Schumpeter (1911) described a number of processes that today can connect to contemporary NGT of Romer (Braunerhjelm, 2007), recognizing that there was a clear difference between raw knowledge that came from inventor and the one who was boosted by the economic application by the entrepreneur (Schumpeter, 1947). However, for many years it seemed that the entrepreneur had lost its place in the economic sphere, with the big companies playing a more active role in the creation of new knowledge and its translation into innovations, using their scale economies and other advantages⁵ (Williamson, 1968; Chandler 1977 and Schumpeter himself "Mark II," 1942). Evidence supports the theory that the effort of research is directly linked to the size of companies (Acs and Audretsch, 2005). In addition, some studies also showed that small and medium-sized enterprises provided less possibility of compensation for employment (Brown and Medoff, 1989) and less involved in FDI (Horst, 1972).

However, as Braunerhjelm stated (2007) the empirical evidence has shown that while for some decades of the twentieth century large companies have played that role the truth is that since the seventies that there has been an opposing trend, both in the United States and in Europe (Brock and Evans, 1989; Evans 1991; Loveman and Sengenberger 1991; Brown et al., 1990; Acs and Audretsch, 1993), with some SMEs being the engines of innovation in specific sectors (Acs and Audretsch, 2005 and Schane, 2001, with his study on the importance of creation of new enterprises in technological change) and contributing positively to the aggregate level of innovation (Audretsch 1995b; Feldman and Audretsch 1999).

Moreover, Link and Rees (1990) and Acs and Audretsch (1991) show that there aren't increasing returns to scale on R&D in the production of innovation (with a few exceptions, the decreasing returns are the rule). Basically, this fact helps us to solve the apparent paradox that

⁵ Acs and Audretsch (2005) refer five reasons usually identified in the literature for the largest companies to be more innovative: Existence of economies of scale in R&D; Only companies with a market power choose innovation as a way of maximizing; larger companies can mitigate the risk of innovation through diversification, economies of scale in production are related to economies of variety in innovation; Innovations that reduces costs have greater impact on larger companies.

tells us that the inputs of R&D increase more than proportionately with the size of the companies, but not the creation of patents, i.e. it is true that larger companies have advantages in achieving R&D, but every new euro spent on R&D has an additional increasingly smaller benefit in the generation of innovation (Acs and Audretsch, 2005).

Also Audretsch and Turik (2001) say that SMEs have benefited's comparative advantage in the sphere of the so-called "the knowledge economy". Indeed, if we look at some of the largest and most innovative companies in the world today, a few years ago some of them did not exist and many have been created with very little capital by one or two entrepreneurs (vide DELL, Google, YouTube, MySpace, Microsoft etc.). Indeed, the knowledge about, for example, algorithms, programming or an electronic invention, give new entrepreneurs the advantage they need, relegating to the background the need for large investments in capital. In addition, when such investments are required, there are funding tools (venture capital and other) that enable entrepreneurs develop their businesses, creating opportunities for the emergence of many new companies.

Also, Audretsch and Keillbach (2005) refer that the weight of SMEs also tends to grow due to the delocalization of large production companies from high-cost countries to low-cost countries.

Indeed, when a company is faced with growing competition from low-cost countries, such as China or India, the choice is between delocalize to an alternative country, to lower wages and hence labour costs or to achieve increasing productivity through the use of new technologies , reducing the dependence of the work that is costly (Audretsch Keillbach, 2005). Many companies in Europe (which Portugal is no exception) have adopted the relocation (and some the increased productivity path - here Portugal seems to be an exception).

Many studies have answered the question of what is role of innovation in welfare⁶, demonstrating that it is the driving force behind the regional and urban growth (Acs, 2002 and Verspagen, 2004, just to mention a few examples from the literature that summarise more than a

⁶ Innovation should not be seen as an automatic phenomenon, but arising from the creation and use of knowledge (Acs and Audretsch, 2005).

decade of work), but few had until recently linked this phenomenon of innovation with the role of SMEs in the new modern economy.

Indeed, how these SMEs generate innovations (if unable to compete with larger ones companies at the level of R&D) and what is the role of the creation of new businesses in innovation, are relevant issues that address the phenomena described.

The first question, the source of knowledge to the smaller companies, seems to be other companies, individuals or universities and other institutions of research (Jaffe, 1990). It is not uncommon to read a story about Silicon Valley on how someone created a new company (Spinoff) after having developed research in a given area in their company of origin, which enabled them to realize the economic opportunity of this specific knowledge. Basically, these companies often seem to take up the knowledge "spillovers" that we mentioned before (and here we also mention a business agglomeration area, because, as we have seen, "spillovers" tend to be geographically concentrated).

As for the role of entrepreneurship, Audretsch et al. (2006) introduced a new factor of production called entrepreneurship capital, linked to the extensive literature of Social Capital. This capital reflects a number of institutional and social factors (efficiency of the legal system, efficiency of the financial system, cultural aspects).

Acs et al. (2004), Audretsch and Keilbach (2005) argue that the exploitation of knowledge depends on several factors institutional and regulations, which are in their opinion the "knowledge filter". This filter is the gap between new knowledge and knowledge that is marketed. Then, the entrepreneurs play a crucial role transforming knowledge into new products and services (i.e. the "spillovers" of knowledge are often enhanced by the work of entrepreneurs).

Audretsch and Keilbach (2005) describe the entrepreneurship as a mechanism for the transmission of "spillovers" of knowledge. " For these authors, entrepreneurship can be defined by two criteria, the first involves the fact that the agents can detect economic opportunities

arising from new knowledge created, and the second, involving the economic behaviour which leads to the creation of a new company that enables them to capture the economic value of this knowledge (Audretsch and Keilbach, 2005). Basically, the knowledge can take the unused entrepreneurs will generate economic growth.

Audretsch and Keilbach (2004b) identified two other forms of entrepreneurship influence in economic growth. The first involves the increased competition, and the second involves the increasing diversity (Glaeser et al., 1992; Feldman and Audretsch 1999; Henderson and Thisse 2004).

Entrepreneurship and Regional Growth

According to Braunerhjelm (2007) in the last decade there have been several attempts to clarify the relationship between entrepreneurship and regional growth. Reynolds (1999) found a positive relationship between entrepreneurship and growth in the United States, Audretsch and Fritsch (1996) failed to find similar evidence for Germany in the 80s, although they have succeeded when they repeated the same methodology (Audretsch and Fritsch, 2002) for a subsequent period, Fölster (2000) and Braunerhjelm and Borgman (2004), found evidence of this link in Sweden.

Baptista and Thurik, 2004 and Baptista et al. (2005) use a theoretical framework close to the one defined here to estimate the effect of the creation of new businesses in a region in the employment growth of the region. The study proves that the new businesses not only contribute to economic growth through employment created but also through the general competitiveness.

A large number of studies link the role of universities to regional growth and agglomeration (Feller 1990, Phelps 1998, Boucher et al. 2003, Andersson et al. 2004, Chesire and Malecki 2004, among others).

That is, a large number of studies confirm that entrepreneurship, concentration of knowledge and regional growth are linked, although this connection is often complex and poorly defined (Braunerhjelm, 2007).

Theoretical Model

In this model we follow a methodology for by Audretsch and Keilbach (2004 a, 2004b, 2005) and the AABC model (Acs et al., 2007).

This model is a simple adaptation of an endogenous growth model. The authors follow the ideas of Romer (1990). In this model rather than a sector that enhances the development new products, and that contributes to technological progress (A), there are two sectors, one that enhances the creation of new knowledge (the invention) in existing companies - the area of R&D - and another that powers innovation through new businesses. Again, as in Romer (1990), these new products are seen as new types of capital or productive schemes that are sold to producers of final goods, making the final production more efficient. Grossman and Helpman (1991), show that these new varieties of capital can be seen as final goods, entering directly in the utility function of consumers.

Note that this model addresses some of the problems we discussed before. Using an entrepreneurship sector enables us to tap what was called by Acs et al. as the “Knowledge filter”, using the new sector in the model as a mean to represent one of the paths to transform knowledge in economic valuable Knowledge. Also, using the Audretsch and Kelbach (2005) perspective, entrepreneurship capital is a form of social capital, which allows us to indirectly measure other things.

Next we will explain the assumptions of this recent specification of the model (Acs et al., 2007).

Assumptions

1. There are a number of individuals (\bar{L}) that may be employed in the sector of production of final goods (L_F), in the production of knowledge (L_R) or the entrepreneurship (L_E).
2. The “entrepreneurship ability” is exogenously distributed on individuals and is not homogeneous. Individuals make maximizing inter-time decisions on being employed or become entrepreneurs.
3. The efficiency (σ) of the transformation of general knowledge in economically useful knowledge is influenced by national or regional policy, the institutions and the path-dependency that influences the technology transfer.
4. There are, as we have seen, two ways to transform knowledge (A) in economically useful knowledge. The first involves existing firms and the second Schumpeterian Start-ups.
5. The existing companies develop and transform knowledge into economically useful knowledge through employment of researchers (L_R) which results in new inventions and varieties of products (x_i). σ_R is the parameter that determines how efficient are companies on generating new knowledge and transforming it into marketable products. Note that $0 < \sigma_R < 1$, and a σ_R closer to zero means that they are less efficient in the development of knowledge.
6. A start-up (entrepreneurial innovation) represents a new combination of new knowledge, where individuals (L_E) rely upon their entrepreneurial capacity, exogenous, and the aggregate stock of knowledge (A) to develop new products. Also, entrepreneurial activities are governed by the efficiency of transformation of knowledge into goods ($0 < \sigma_E < 1$). The entrepreneurs do not engage in the R&D but they develop new products and new business models.
7. The activities of incumbent firms and entrepreneurs lead to an increased stock of social partly available knowledge.

These assumptions imply that for the increasing stock of knowledge to materialise in higher economic growth, knowledge must be transformed into economically useful knowledge and the economy must be equipped with inputs that are able to select, evaluate and transform knowledge into commercial activities (Acs et al., 2007).

In this model the function of production for the sector of research activities can be described as follows:

$$Z_R(L_R) = \sigma_R L_R A$$

Where the R&D activity is influenced by the stock of existing knowledge (A) and a measure of efficiency σ_R . Here labour is our only production factor. This function has constant returns to scale, and although an amendment to decreasing returns would be more realistic, the truth is that this would not have implications in the conclusions of the model (Acs et al., 2007).

The production function for the sector entrepreneur takes the following form

$$Z_E(L_E) = \sigma_E L_E^\gamma A, \quad \gamma < 1.$$

Our entrepreneurial activities have decreasing returns to scale (an assumption that stems from the assumption that the skills for entrepreneurship are distributed on a non-homogeneous way in the population). The function is very similar to the R&D sector, with the difference in the returns.

We also believe that researchers and entrepreneurs produce different types of capital goods (x_i) which are combined with work in the field of production of final goods (Y),

$$Y = (L - L_E - L_R)^\alpha \int_0^A x(i)^{1-\alpha} di$$

where, α ($0 < \alpha < 1$) represents a scale parameter.

Having in mind that in equilibrium the demand for all types of goods is symmetric $x_i = \bar{x}$, then for all $i \leq A$, we can rewrite the above equation as:

$$Y = (L - L_E - L_R)^\alpha A \bar{x}^{1-\alpha}$$

Assuming that capital goods are produced in the same way as other goods and we need to k units of capital goods to produce one unit of capita, it can be shown that (Chiang, 1992),

$$K = \kappa A \bar{x}$$

and we have the following production function,

$$Y = (L - L_R - L_E)^\alpha A^\alpha K^{1-\alpha} \kappa^{\alpha-1}$$

the all knowledge creation sector can be described by,

$$\dot{A} = Z_R(L_R) + Z_E(L_E)$$

That is, the evolution of the stock of knowledge in terms of work channelled to the R&D and entrepreneurship sectors.

Combining both sectors,

$$\dot{A}/A = \sigma_R L_R + \sigma_E L_E'$$

This is the rate of growth of the stock of knowledge, or the rate of technological progress, which is an increasing function on R&D and entrepreneurship and on the efficiency of both of these

activities.

However, if we consider that demand is governed by consumption function with a constant inter-temporal elasticity of substitution, we can maximize the following equation,

$$\max_{C, L_E, L_R} \int_0^{\infty} \frac{C^{1-\theta}}{1-\theta} e^{-\rho t} dt$$

With the next restrictions,

$$\dot{A} = \sigma_R L_R A + \sigma_E L_E^\gamma A$$

$$\dot{K} = Y - C = (L - L_E - L_R)^\alpha A^\alpha K^{1-\alpha} \kappa^{\alpha-1} - C.$$

We then have the Hamiltonian for the representative consumer:

$$H_C = \frac{C^{1-\theta}}{1-\theta} + \lambda_A (\sigma_R L_R A + \sigma_E L_E^\gamma A) + \lambda_K (\kappa^{\alpha-1} A^\alpha K^{1-\alpha} (L - L_R - L_E) - C)$$

Solving it we'll obtain:⁷

$$L_E = \left(\frac{\sigma_R}{\gamma \sigma_E} \right)^{\frac{1}{\gamma-1}},$$

In the balanced growth path, when both R&D and entrepreneurship are profitable, the resources involved in entrepreneurship are independent of consumer preferences, and entrepreneurship is increasing σ_E and declining in σ_R .

Solving the equation for the balanced growth path, where $\frac{\dot{Y}}{Y} = \frac{\dot{K}}{K} = \frac{\dot{C}}{C} = \frac{\dot{A}}{A}$ e using the equations of motion for the shadow prices of capital and knowledge, we have

⁷ See the complete resolution in Acs et al. (2007).

$$L_R = \frac{1}{\theta\sigma_R} \left(\sigma_R (L - L_E) + (1 - \theta) \sigma_E L_E^\gamma - \rho \right)$$

The balanced growth rate will be,

$$g = \frac{1}{\theta} \left(\sigma_R L - \rho + (1 - \gamma) \gamma^{\gamma/(1-\gamma)} \left(\frac{\sigma_E}{\sigma_R^\gamma} \right)^{1/(1-\gamma)} \right)$$

It appears that growth is an increasing function of labour, and of the efficiency of the of R&D and entrepreneurship sectors.

As Acs et al. (2005) observe, growth is then given by $g = f(A, R, E, \lambda)$, that is, growth is a function of the stock of existing knowledge, the efforts of research, entrepreneurship and all other factors (λ represents such factors as the capital intensity, institutions, etc.).

Empiric Model and Data

The purpose of this article is to measure the influence of entrepreneurship in regional growth. To do this we will seek to estimate the following function:

$$g_{i,t} = \alpha_1 + \alpha_2 A_{1,i,t} + \alpha_3 E_{i,t} + \alpha_4 \lambda_{i,t} + \varepsilon_{i,t}$$

Where i e t refer to the years and regions. The variable (A) is the new knowledge and (E) represents the entrepreneurship. λ represents all other factors that influence economic growth and g is growth rate of GDP of the region.

To capture knowledge we used two common variables in the economic growth literature, the number of workers in R&D in the region (in relation with the total workforce) (ID) and the average years of schooling of the population over 25 years (ESCOL) (Acs et al., 2005; Audretsch and Keilbach 2004). This last variable can also be seen as a proxy for human capital. An economy's human capital endowment is defined as average years of schooling. More schooling is expected to positively impact growth (Sala-i-Martin, 1995).

For entrepreneurship (EMP) we used to the number of new businesses created in a region divided by its population. This rate reflects the inhabitant's ability of a given region to create a new company Audretsch and Keilbach (2004). As the number of new firms creation is subject to a large degree of stochastic disturbance in a short period of time, following Audretsch and Keilbach (2004), we used a 3 years moving average.⁸

Regarding other variables, following Solow (1957) we tried to incorporate classic regional capitalist intensity (KL), since the capital stock of each region divided by employment, which is a measure of wealth (or capital-intensity), is also expected to positively impact economic growth. However if the data for regional employment was readily available, to determine the stock of regional capital proved to be a gigantic task. To determine the regional capital stock of

⁸ Also, following Audretsch and Keilbach (2004) we divided entrepreneurship in low(ELT) and hi-tech (EHT), in order to see if this had an impact on the different results of estimation. If we follow the theory of the Knowledge filter and the entrepreneurship capital, then all entrepreneurship should be accounted for, but if we follow a view were entrepreneurship is exclusively linked to the production of new knowledge, and then we can conjecture that new hi-tech firms would be most suitable to grasp the opportunities converting knowledge into economic valuable knowledge. As the authors we used a NACE classification were we considered hi-tech start-ups as the ones from sectors were R&D expenditures are above 2,5% (though this classification won't surely apply to Portugal, but can be broadly view as general classification of this sectors around Europe).

using the method followed by Freitas (2004), where we computed each year's investment in a region and we tried to use a function to determine past years capital stock.

The dependent variable, Growth (Y), is defined as the annual difference in log real GDP per capita growth (expressed in 2000 prices) for the seven Portuguese Nuts2 regions over the period 1995-2005.

All data was taken from Eurostat Database and INE Database. The chosen period is provided without breaks in the statistical series (or with the breaks already computed).

All variables are in log.

Estimation

Data has been pooled over regions and years for the period 1995 to 2005.

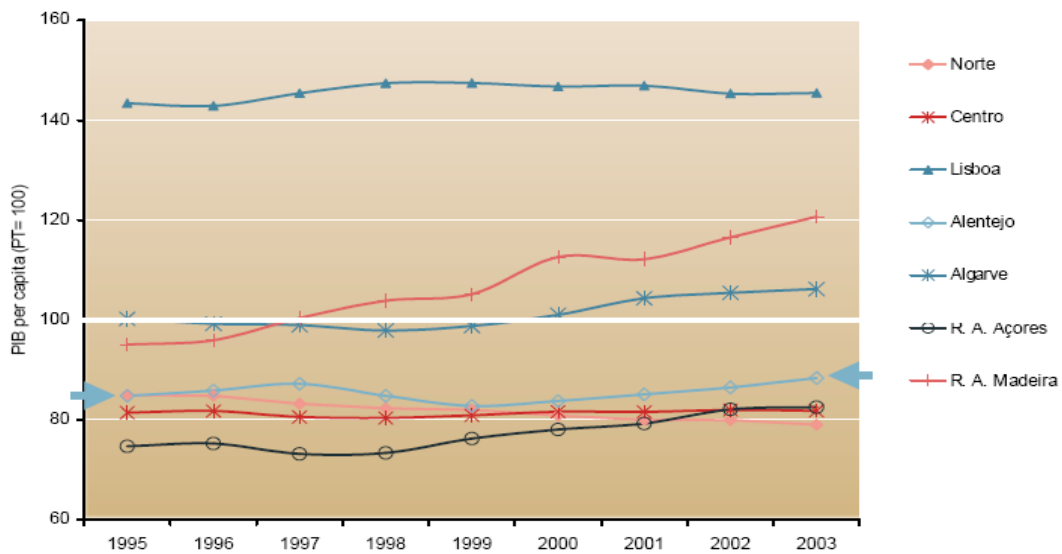
We performed a Wald test Modified for fixed effects groups, and detected the presence of heteroskedsticity and the Wooldrige Test for panel data and detected Serial autocorrelation.

Therefore, in the regressions we used a specific generalized least squares (GLS) which controls for heteroskedastic panels (PCSE) and an autoregressive (AR) structure. This structure implies that the error term is serially correlated, such that the current error term partly is a function of previous error terms. An AR1 process means that the current error term depends on just one lagged error term. Also we implemented fixed effects since this was the model that seemed to cope better with non-observable heterogeneity.

Results

As we can see in the following graphics entrepreneurship seems to be more important in regions with a recent dynamic growth.

Graphic 1- GDP per capita Evolution, 1995-2003

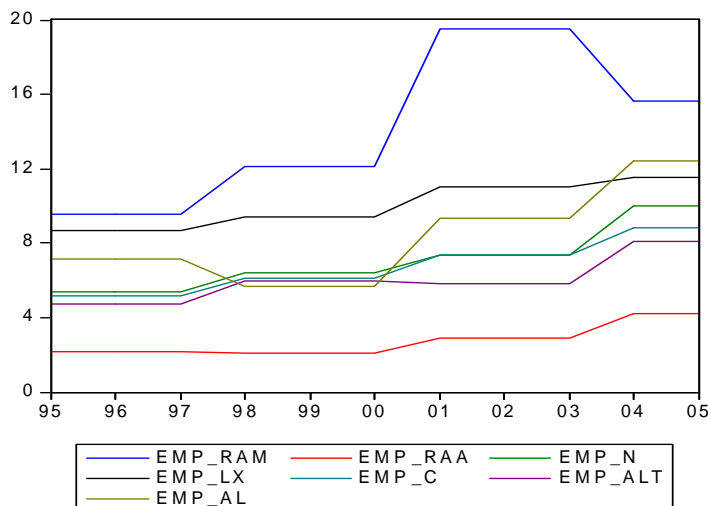


Source: Mateus (2006)

As shown in the graphic, there are large disparities in both the levels of GDP per capita and the growth rates of different regions. The region Lisboa e Vale do Tejo(LVT) has a per capita GDP more than 40% above the country mean, and only the Algarve and RA Madeira are above country average. We can also detect that the majority of regions are more or less stagnated in terms of growth, with the exception of Algarve and Ra Madeira.

The regions with higher growth are specialized in tourism, as the regions were more traditional industries prevail, register small or negative growths (the case of Centro and Norte).

Graphic 2 – Entrepreneurship rate evolution



RAM (Madeira), one of the most dynamic regions in terms of growth registers the highest level of entrepreneurship. Also Algarve (AL) and Lisbon (LX) show high levels of entrepreneurship.

In future versions of this work will provide an augmented descriptive analysis.

After various estimations none of the specifications found that ESCOL and ID were statistically significant explaining growth. This can be due to the specification of the model or to the quality of the method. Unfortunately since this is an early stage of our work we were not able to provide a comparative analysis of different estimation methods.

For now we provide some estimations results were we show that entrepreneurship and capital intensity are statistically significant in explaining growth (LEMP? and LKL).

Dependent Variable: Y?
 Method: Pooled Least Squares
 Date: 04/17/08 Time: 03:23
 Sample (adjusted): 1996 2005

Total pool (balanced) observations: 70
 Period weights (PCSE) standard errors & covariance (no d.f. correction)
 Convergence achieved after 7 iterations

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------------------|-------------|------------|-------------|--------|
| C | 1.483585 | 0.269859 | 5.497624 | 0.0000 |
| LEMP? | 0.042744 | 0.017341 | -2.464832 | 0.0166 |
| LKL? | 0.199210 | 0.043556 | -4.573648 | 0.0000 |
| AR(1) | -0.259341 | 0.119389 | -2.172233 | 0.0338 |
| Fixed Effects (Cross) | | | | |
| _AL--C | 0.013459 | | | |
| _ALT--C | -0.010902 | | | |
| _C--C | -0.077135 | | | |
| _N--C | -0.076736 | | | |
| _LX--C | 0.079716 | | | |
| _RAA--C | -0.021268 | | | |
| _RAM--C | 0.092866 | | | |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|--------------------|----------|-----------------------|-----------|
| R-squared | 0.509377 | Mean dependent var | 0.044138 |
| Adjusted R-squared | 0.435784 | S.D. dependent var | 0.038898 |
| S.E. of regression | 0.029218 | Akaike info criterion | -4.096524 |
| Sum squared resid | 0.051220 | Schwarz criterion | -3.775310 |
| Log likelihood | 153.3783 | Hannan-Quinn criter. | -3.968934 |
| F-statistic | 6.921498 | Durbin-Watson stat | 2.330088 |
| Prob(F-statistic) | 0.000001 | | |

In future versions of this empirical analysis we'll include some comparative analysis of different methods. We'll incorporate new variables that can explain growth (urban concentration and others). Also, since some of the Portuguese NutsII regions are very heterogeneous we're working on an analysis in the NutsIII level.

Conclusions

When we examine the knowledge-based endogenous growth theory we found out that these theories assume that knowledge spills automatically.

We try to elaborate on these “flaw” and look at the knowledge spillover theory and find that one important actor is missing - entrepreneurship. Then we review the literature to find the link between technology, innovation and entrepreneurship.

Following other authors we have suggested an extension to the endogenous growth model that we believe will narrow the gap between the model and real world behavior. This suggestion includes the role of entrepreneurship, which can be seen as a conduit for the spillover of new knowledge. Hence entrepreneurial activity also plays an important role in generating economic productivity.

Our early version of the empiric model seems to prove the link between entrepreneurship and economic growth in Portuguese regions. Though this is an early stage work and we would like to perform a more broad analysis of these phenomena, using different regional levels and estimating spatial effects.

Once again we would like to emphasize that is an early version of the final work.

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