The Regional Economic Value of Entrepreneurship: A Schumpeterian Approach to the Linkage between Entrepreneurship and Regional Development

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Abstract: This paper develops a regional-level total factor productivity (TFP)-based proxy measure of the economic value of the functions entrepreneurs perform in the economy. In providing the theoretical support for linking the economic value of entrepreneurship (EVE) and TFP, this paper integrates Schumpeter's definition of entrepreneurship within the neoclassical production function framework. The measure of EVE developed here builds upon Harberger's (1998) real cost reduction approach to industry-level and quality-adjusted TFP. The paper uses the European Union NUTS 2 regions as a case study and concludes that this innovative proxy measure of EVE opens promising avenues for a better understanding of the linkages between entrepreneurship and regional economic development.

Keywords: Entrepreneurship, Regional Development, Economic Development, Economic Growth, Real Cost Reduction.

1. INTRODUCTION

The literature on the role of entrepreneurship in the process of economic growth and development demonstrates that theoretically there is strong support for the argument that entrepreneurship is an important driver of regional economic development (Schumpeter 1934; Baumol 1968; Kirzner 1973; Holcombe 2007; Moretti 2012; Batabyal and Nijkamp 2012). But it also demonstrates that empirically the understanding of the contribution of entrepreneurship to regional economic growth and development is still blurred (Carree and Thurik 2003; Acs and Armington 2006; Audretsch *et al*. 2006;Van Praag and Versloot 2007; Henderson and Weiler 2010; Fritsch 2011). This largely reflects the considerable confusion in the way researchers use the term entrepreneurship and the metrics they apply to assess its influence on the regional economic performance.

A better understanding of the importance of entrepreneurship for regional development calls for empirical measures of the economic value of entrepreneurship that encompass as much as possible the myriad of functions the entrepreneurs play in the economy. This research contributes to filling this gap in the literature by developing a regional- and industry-level total factor productivity (TFP)-based proxy measure of the economic value of the several functions the entrepreneurs play in the economy.

The neoclassical-inspired theory of regional economic growth and development has been unable to convincingly explain what exactly causes long-term TFP improvement and thereby economic development. Solow (1957), Griliches (1963), Jorgenson *et al*. (1987), and Jorgenson (1995), among others, establish the increase in the quality of labor and capital as sources of TFP improvement. But the authors also show that the contribution of improved labor and capital quality falls short in fully explaining TFP change (Jorgenson and Griliches 1995). More recently, the endogenous growth theory has pointed to increasing returns caused by either knowledge spillover effects (Romer 1986), by human capital accumulation (Lucas 1988), or by R&D spillovers (Aghion and Howitt1992, Howitt 2000) as causes of economic growth. However, as the authors also recognize, the complexity of the growth and development process cannot be captured by a simple feedback mechanism (Romer 1990, 1994a,b; Lucas 1993). Clearly, as Prescott (1997) points out, the economic thought lacks a theory of TFP that goes beyond the growth in the stock of tangible (e.g., capital and labor) and intangible (e.g., human capital, R&D) inputs.

In providing the theoretical foundations for developing a TFP-based proxy measure of the economic value of entrepreneurship (EVE), this paper also addresses this theoretical gap in contemporary mainstream regional economic theory. It does so by integrating Schumpeter's theory of entrepreneurship and economic development within the neoclassical production function framework. In so doing this paper builds upon two major prior contributions. One is Harberger's (1998) real cost reduction approach to

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JEL codes: O12, O18, O47, O52, R11.

industry-level and quality-adjusted total factor productivity change. The other is the work by High (2004), which gives a first step to combine Schumpeter's theory of entrepreneurship and economic development with modern growth accounting.

The remaining of this paper is organized as follows. Section two discusses the strengths and weaknesses of the definitions and measures of entrepreneurship available in the economic literature from both a theoretical and empirical perspective. Sections three and four offer the theoretical and empirical rationale for developing a TFP-based measure of EVE. The regional- and industry-level EVE measure is developed in section five. Section six presents the EVE estimates for the EU regions. Section seven concludes by summarizing the major contributions and findings of this paper.

2. DEFINITIONS AND MEASURES OF ENTREPRENEURSHIP IN THE ECONOMIC[1] LITERATURE

The term entrepreneurship has several definitions in the theory of economic growth and development. Building on previous surveys of the distinct meanings of entrepreneurship,[2] and at the risk of oversimplification, it is possible to identify two major definitions of entrepreneurship in the economic literature: (1) a functional definition and (2) an occupational definition.

The functional definition of entrepreneurship is based on what the entrepreneurs do in the economy, that is, their contribution to the process of economic growth and development. This definition borrows primarily from the Austrian school of economics and defines the entrepreneur as someone who: (1) is alert to opportunities for pure economic profit (Kirzner 1973); (2) is willing to take risks (Knight 1921); and (3) is innovative and creative in exploiting such opportunities by introducing successful innovations or new combinations into the markets (Schumpeter 1934). These new combinations include new ideas, new goods/services, new markets, new production techniques, new supply sources, or new organizational methods. Theoretically, this is an appealing definition of entrepreneurship because it explicitly connects entrepreneurship with economic growth and development. Entrepreneurship is a process embedded in markets functioning that disrupts the existing market equilibrium by introducing successful new combinations into the economy. These new combinations boost productivity and resource allocation efficiency, which, in turn, fuel economic growth and development and move the economy towards a new equilibrium – the Schumpeterian process of creative destruction (Gunning 1997; High 2004; Douhan *et al*. 2007). Empirically, the functional definition of entrepreneurship has the advantage of clarifying what sorts of businesses should be included when assessing the levels and/or value added by entrepreneurs in the economy. Here, an entrepreneur can be someone who: (1) starts a new business; (2) owns or manages small businesses; or (3) works for a large company, regardless of whether he uses his alertness, creativity, innovative capacity, and good judgment to introduce successful new combinations into the economy. One important empirical weakness of the functional definition of entrepreneurship is the difficulty in assessing the number of entrepreneurs defined in this way.

The occupational definition of entrepreneurship simply defines the entrepreneur as someone who owns a small business[3] or starts a new business. Here, as Malecki (1994) notes, it is possible to identify three levels of meaning. At the lowest level, entrepreneurship simply refers to the existing small businesses. At the next level, entrepreneurship refers to the creation of new small businesses. At the highest level, entrepreneurship refers exclusively to small businesses, either existing or start-ups, that entails innovation (Acs and Szerb 2009; Fritsch 2011). The major theoretical and empirical strength of this definition is that it is easy to understand what is included and excluded from it, making it very easy to count the number of entrepreneurs in any particular geographical configuration. The first major theoretical weakness of the occupational definition is that it does not take into account those acting within existing firms whose actions play crucial roles in enhancing economic growth and development. Its second theoretical weakness is that it treats businesses with very different innovative capacities and growth potentials equally. By

[1]Other research fields, e.g., psychology, anthropology, and sociology have extensively studied entrepreneurship as well. Such approaches, focused essentially on a behavioral dimension of entrepreneurship, are beyond the scope of this paper. A survey can be found in Peneder (2009).
[2]For a review see, for example, Gartner (1990), Malecki (1994), Holcombe (1998), Wennekers and Thurik (1999), Harper (2003), Ahmad and Seymour (2008), Acs and Szerb (2009), and Peneder (2009).

[3]Being self-employed is a particular case of small business ownership.

Table 1: Empirical Measures of Entrepreneurship in the Economic Literature

	Indicator	What it is intended to capture
1	Self-employed (number of)	Individual's occupation – firm structure. Risk-Taking (at the individual level).
2	Small business (number of)	Individual's occupation – firm structure. Risk-Taking (at the individual level).
3	Individual's preferences to become self-employed	Latent entrepreneurship as an individual's occupation. Propensity to risk-taking (at the individual level).
4	Firm entry and new venture creation (number of)	Firm dynamics. Opportunity-seeking and risk-taking.
5	Firm survival rate	Firm dynamics. Degree of success in exploiting opportunities. Assessing entrepreneurial performance.
6	Firm growth rate	Firm dynamics. Degree of success in exploiting opportunities. Assessing entrepreneurial performance.
7	Firms that introduced product and/or process innovations (number of)	Firm dynamics. Creativity, innovativeness, success in bringing new combinations into markets.
8	Global Entrepreneurship Index (composite index)	Individual's occupation and individual's entrepreneurial aspirations. Level and quality of business formation.
9	Change in Total Factor Productivity (dollar value)	All the features embodied in the functional concept of entrepreneurship.

Source: Author's construction based on High (2004), Ahmad and Hoffman (2008), Acs and Szerb (2009), Peneder (2009).

treating equally (small) business with very different capacities to promote structural economic change, the occupational definition of entrepreneurship has the important empirical weakness of being of little use when one is interested in assessing the linkages between entrepreneurship and regional economic development.

The economic literature also offers a variety of empirical measures of entrepreneurship. Table **1** systematizes the empirical measures available in the literature including the entrepreneurial features each measure is intended to capture. Indicators 1 to 4 are essentially dichotomous variables that fit well into the occupational definition of entrepreneurship. They have the major advantage of relying on readily available and easy-to-find data either at the regional, national, and international level.[4] But they fall short in capturing the entrepreneurial dynamics reflected in successfully exploiting the market opportunities carried on either by small firms or large corporations. Indicators 5, 6, and 7 are largely indicators of entrepreneurial performance and can be used as proxies for the success in exploiting and pursuing market opportunities – some of the features of the functional concept of entrepreneurship. They have the advantages of (1) incorporating most of the features of the functional concept of entrepreneurship, and (2) capturing entrepreneurial activity developed within existing firms in addition to new entrepreneurial ventures. They have the disadvantage of requiring detailed firm-level data collected under a common survey design.[5] Indicator 8, the Global Entrepreneurship Index (GEINDEX), developed by Acs and Szerb (2009), is a composite measure of entrepreneurship. It has the appealing advantage of collapsing several indicators of business formation and the individual's occupational options and aspirations into one single scale. The GEINDEX has the limitations of falling short in capturing both (1) the success achieved in exploiting and pursuing the market

[4]The Global Entrepreneurship Monitor dataset and the World Bank Group Entrepreneurship Survey dataset are two widely used sources of indicators 1 to 4, in particular in international comparative studies (Acs *et al.* 2008). Also, the OECD-Eurostat Entrepreneurship Indicators Programme offers a variety of international indicators of this sort (OECD 2009). International studies, focused only on the individual's preferences to become self-employed as a measure of entrepreneurship, have heavily relied on sources such as the OECD's Self-Employment Attitude Research and the EU Flash Euro Barometer Survey (Acs and Szerb 2009).

[5]The studies surveyed that use this indicator focus on European comparisons making use of the firm-level Community Innovation Survey (Peneder 2009).

opportunities by bringing new combinations into markets and (2) the entrepreneurial activity developed within existing firms. Indicator 9, suggested by High (2004), follows Harberger's (1998) growth accounting techniques to translate the industry-level change in TFP into a dollar value of entrepreneurship, using the US case to illustrate the methodology. This ex-post approach to the measurement of entrepreneurship has the advantage of having the potential of capturing all the features embodied in the functional definition of entrepreneurship. A second major advantage is that it measures the monetary value that entrepreneurship adds to the process of economic development. This feature makes this approach particularly appealing when one is interested in assessing the impact of entrepreneurship on economic development. One important limitation of this measure is that it requires industry-level TFP data for each geographical area one is interested in. A second limitation is that it is unclear whether the impact of elements other than entrepreneurship on TFP is properly accounted for.

In sum, the literature offers several measures of entrepreneurship that fit quite well the occupational definition of entrepreneurship. However, the research developed so far has not provided a standard indicator that fully captures the functional role of entrepreneurship in the process of economic growth and development. The only one that comes close is the TFP change approach suggested by High (2004). Though promising, this approach calls for the development of more refined methods, particularly in what concerns accounting for the impact of elements other than entrepreneurship on TFP. This is the subject of the next sections.

3. THEORETICAL RATIONALE FOR LINKING ENTREPRENEURSHIP AND TFP

Joseph Schumpeter's theory of economic development (Schumpeter 1934) provides the primary theoretical foundation for linking entrepreneurship and TFP. At the risk of some oversimplification, one can identify in Schumpeter's theory three key ideas of particular relevance in linking entrepreneurship and TFP. First, in Schumpeter's view, economic development means the introduction of successful innovations or new combinations into markets. The repeated introduction of new or improved products/services, new or improved production techniques, new or improved organizational methods, new markets, and new supply sources is what defines, in his view, economic development. Second, for Schumpeter, the entrepreneurs are the engine of economic development because they are the agents that bring the successful innovations or new combinations into the markets. Third, Schumpeter considers that the introduction of successful new combinations disrupts the old pattern of production and establishes a new and better one. In this developmental process, termed by Schumpeter as creative destruction, there are winners and losers. Those that succeed in introducing the new combinations into the markets are the winners. Those that lag behind in introducing new combinations are the losers, which sooner or later will be compelled by the market forces to go out of businesses. This is not a zero-sum process since, Schumpeter argues, ultimately the winners' positive outcome will outweigh the losers' negative outcome making everyone better off.

Post-Second World War mainstream economic development theory has not built on Schumpeter's contributions.[6] Rather, the mainstream framework of economic analysis, the neoclassical production function framework, has disregarded the role played by the entrepreneur in the process of economic development. Briefly stated, the contemporary neoclassical theory depicts economic growth and development as the outcome of using the best available technology to combine the optimal levels[7] of the quality-adjusted basic inputs: natural resources, labor (that is, human capital), and physical capital. In measuring the quality-adjusted basic inputs, contemporary neoclassical framework considers not only the quantity supplied, as in the original neoclassical framework developed by Solow (1956) and others, but also the quality features assumed to be responsible for a greater marginal product of each basic input (see Romer 1986; Lucas 1988; Maddison 1991).

Empirically, the neoclassical framework attributes to TFP the portion of economic growth not accounted for by changes in the amount of quality-adjusted basic inputs and in the marginal product of each basic input. Moreover, within the neoclassical framework economic development manifests itself by enhancements to

[6]Despite the attempts of some authors to build upon Schumpeter's ideas to set forth a general theory of entrepreneurship and economic development, entrepreneurship has largely been neglected in contemporary economic development analysis. Yet, some noteworthy contributions include Mises (1949), Kirzner (1973), and Baumol (1968, 1993). For a concise history of entrepreneurship in economic thought, see Herbert and Link (1988). A review and systematization of many of these contributions can be found in Holcombe (2007).

[7]These levels are consistent with the equilibrium of markets.

production possibilities over a time period, empirically reflected in TFP improvement over time. But the neoclassical theory has been unable to convincingly explain what exactly causes production possibilities to enhance over time and, as such, what exactly underlies economic development (Baumol 1968; Holcombe 2007).

It is argued in this paper that Schumpeter's insights on economic development, briefly summarized above, offer a sound explanation for what underlies economic development or, in neoclassical terminology, what underlies the enhancement of production possibilities empirically reflected in TFP improvement: Entrepreneurship. The argument here is that, following Schumpeter's view closely, economic development occurs because of innovations successfully introduced into the economy, and innovations are the result of the actions of entrepreneurs. Economic development occurs because entrepreneurs introduce new or improved goods and services, new or improved production and organization methods, new or better inputs, and open new markets. Thus, entrepreneurship is what triggers TFP improvement – the empirical manifestation of economic development within the neoclassical framework. Schumpeter's theory of economic development provides, it is argued here, the theoretical foundations for tying together entrepreneurship and TFP improvement.[8]

Furthermore, it is also argued in this paper that one should look for the link between entrepreneurship and TFP at a disaggregated level, e.g., by industry or, even better, by firm, and by region. The overall value of entrepreneurship for the economy as a whole is then obtained by adding up the disaggregated values. Two reasons justify this argument. First, when TFP is estimated at a disaggregated level, the capacity for correcting for factors other than entrepreneurship affecting TFP (e.g., human capital, physical capital quality, scale economies, spillover effects, and agglomeration economies) improves substantially. This happens because one can use disaggregated rates of return on labor and capital rather than an overall average, thereby measuring the return on inputs by what they are actually paid for. The regional- and industry- or firm-level rates of return on labor and capital have the potential for including all sorts of externalities and other factors (e.g., human capital) impacting TFP. The second reason for calculating TFP change at a disaggregated level is that only at a disaggregated level do the winners and losers of the process of creative destruction become evident. TFP change calculated at the macro level bears the risk of failing to capture the dynamics of the creative destruction process.

It goes without saying that not all improvements in TFP can be attributed to economic development. Within the neoclassical framework economic development manifests itself by enhancements to production possibilities, empirically translated into TFP improvement. However, in the short-term several events may push the economy temporarily below its contemporary production possibilities frontier. In such cases, short-term TFP improvement has more to do with efficiency improvement resulting from moving the economy back to its contemporary production possibilities frontier, and not as much with the enhancement of production possibilities. This suggests that the TFP improvement attributable to economic development, that is, TFP improvement attributable to the action of Schumpeter's entrepreneurs, should be measured over a relatively long time period in order to average out the impact of business cycles on TFP.

4. EMPIRICAL RATIONALE FOR LINKING ENTREPRENEURSHIP AND TFP

To empirically support the argument advanced in the prior section that there is a close link between entrepreneurship and long-term region- and industry-level quality-adjusted TFP improvement, only studies offering quality-adjusted TFP figures by industry were selected, which happen to cover the cases of the US and Japan.[9] Tables **2** and **3** report the contribution of each industry to manufacturing TFP growth for the US

[8] A general theory linking entrepreneurship and TFP change is still in its infancy. One noticeable and path breaking contribution is the work by High (2004), which gives a first step to integrate the theory of entrepreneurship developed by Schumpeter and others with modern growth accounting using industry-level data. In so doing, High (2004) provides a first step towards a theory of TFP and entrepreneurship.

[9] Studies that do not clearly adjust industry-level TFP estimates from labor and capital quality improvements are irrelevant for this analysis. This is the case, for instance, of the study by Kendrick and Grossman (1980) for the US. Also, studies relying exclusively on graphics to document the industry-level (while quality-adjusted) TFP performance over time are useless for the purpose of this section because without knowing the actual TFP figures by industry one cannot identify the leading industries in terms of TFP performance in each period. Examples include study by Inklaar and Timmer (2007), which uses Gini indices and Lorenz curves to analyze industry-level TFP performance in the US, four European countries (France, Germany, Netherlands, and UK), Australia, and Canada. Another example is the study by Cho (2000), which reports the industry-level TFP performance for each OECD country, and a selection of non-OECD Asian and Latin American countries using the Sunrise/Sunset Productivity Diagrams. For an explanation on the mechanics of the Sunrise/Sunset Productivity Diagrams, see Harberger (1998).

and Japan, respectively. The contributions by industry are expressed in percentages and are additive. Thus, for a given period of time, the contributions from the different industries to the manufacturing TFP growth can be added and the sum over all industries is 100 percent. These contributions by industry were calculated by the author departing from industry-level TFP growth figures available in the studies by Robles (1997) and High (2004) for the US, and by Miyajima (2005) for Japan.[10]

Overall, the industry-level TFP data for both the US and Japan exhibit the four consistent features pointed out by Harberger (1998). First, a small-to-modest fraction of industries account for 100 percent of TFP improvement in a period. Second, the complementary fraction of industries includes winners (positive contributors) and losers (negative contributors), whose contributions to TFP cancel each other. Third, the losers are a very important portion of GDP most of the time, and contribute greatly to the observed variation in the aggregate TFP performance. Fourth, the set of leader industries in TFP performance tend to vary greatly from period to period.

A careful look into the composition of the set of leader industries in terms of TFP performance in each period and country provides compelling evidence of the linkage between entrepreneurship and TFP improvement. In fact, in each period and for each country, the industries commonly recognized as leaders in introducing new combinations into the markets are also the champions of TFP improvement. For the US, the empirical evidence offered in Table **2** largely corroborates this theoretical argument: in each period, leading industries in introducing successful new combinations into the markets tend to rank high in TFP performance. For instance, the late 1940s and 1950s in the US were the years of the mass-introduction into the markets of remarkable innovations such as the antibiotics and television[11] and this shows up clearly in the first column of Table **2**. Over the 1949-1958 decade, the chemical industry, including pharmaceuticals, ranked first in terms of its contribution to manufacturing TFP growth, and accounted for more than 20 percent of overall manufacturing TFP growth over the decade. The electric equipment industry, where televisions are classified, ranked fourth and accounted for about 11 percent of aggregate manufacturing TFP growth over the decade. Other American mass-production industries have prospered over this post-World War II decade, not boosted as much by breakthrough innovations but more by incremental innovations, improvements, and markets expansion – domestically as well as overseas. This is the case, for example, of the food industry (third in the rank and accounting for 13 percent to the aggregate manufacturing TFP growth), and automotive industry (fifth in the rank with a contribution of 8 percent).[12]

The disproportionate contribution of petroleum and coal industries to the US manufacturing TFP growth in the late 1970's has perhaps more to do with sharp changes in real oil prices than with entrepreneurial endeavors. The jump in oil prices during the oil shocks of 1972-73 and 1978-79 is expected to have contributed substantially to the extraordinary increase in TFP growth in petroleum and coal industries over this decade, which by itself was responsible for 56 percent of US manufacturing TFP growth in the late 1970s (Robles 1997).

The personal computer, the laptop computer, and microelectronics took over in the late 1970s and early 1980s,[13] and the introduction of new combinations in these industries has been rampant since then in the US. This trend is evident in TFP performance in the electric and electronic industry over the last decades, which has been among the best TFP performers consistently since the late 1970s. TFP in the electric and electronic industry was responsible for 39 percent of aggregate US manufacturing TFP growth over the 1975-1980 period (ranked second); 7 percent in 1980-1985 (ranked fourth); 18 percent in 1985-1991 (ranked third); and 41 percent in the 1990-1999 decade (ranked first).

The US evidence for the late 1980s and all the 1990s would be more meaningful if TFP performance for all industries were analyzed rather than just for manufacturing. In this way, industry-level TFP performance would quite certainly capture the shift to a services economy, and innovative industries such as communications, entertainment, health, finance, and

[10]Detailed tables compiling the background data and detailing the methodology employed can be provided by the author upon request.
[11]A list of the great inventions can be found in the Encyclopedia Britannica Almanac 2010, available online at: http://corporate.britannica.com/press/inventions.html.

[12]For a review on the US industrial performance in post-World War II see, for example, French (1997).
[13]The Encyclopedia Britannica's great inventions list (http://corporate.britannica.com/press/inventions.html), documents that the personal computer was invented in 1974, the laptop computer was introduced in 1983, and the compact disc was invented in 1980.

Table 2: Contribution to Manufacturing TFP Growth, by Industry – US. (Industries are Ranked According to their Share in Manufacturing TFP Growth)

1949-1958[(a)]		1970-1975		1975-1980		1980-1985		1985-1991		1990-1999	
Chemicals	**20.4%**	**Primary metals**	**28.5%**	**Petroleum & Coal**	**55.5%**	**Transportation equipment**	**46.3%**	**Petroleum & Coal**	**24.0%**	**Electric & Electronic**	**41.1%**
Textiles	**18.2%**	**Fabricated metals**	**27.7%**	**Electric & Electronic**	**38.5%**	**Food**	**14.1%**	**Chemicals**	**19.2%**	**Machinery**	**36.1%**
Food	**12.9%**	**Food**	**27.6%**	Machinery	33.5%	**Chemicals**	**8.1%**	**Electric & Electronic**	**17.6%**	**Other Transportation**	**4.3%**
Electric & Electronic	**10.7%**	**Miscellaneous**	**13.0%**	Publishing	22.5%	**Electric & Electronic**	**7.2%**	**Food**	**15.3%**	**Motor vehicles**	**3.9%**
Motor vehicles	**7.6%**	Furniture	11.4%	Fabricated metals	18.5%	**Fabricated metals**	**6.5%**	**Instruments**	**10.3%**	**Primary metals**	**3.9%**
Apparel	**6.8%**	Publishing	11.2%	Primary metals	17.7%	**Ceramic & Glass**	**6.4%**	**Primary metals**	**8.6%**	**Rubber & Plastics**	**3.1%**
Wood	**6.6%**	Electric & Electronic	11.0%	Wood	14.6%	**Publishing**	**4.9%**	**Machinery**	**7.9%**	**Textiles**	**3.0%**
Ceramic & Glass	**5.7%**	Apparel	8.3%	Apparel	9.9%	**Rubber & Plastics**	**4.6%**	Tobacco	4.7%	**Chemicals**	**2.8%**
Fabricated metals	**5.2%**	Wood	7.4%	Textiles	7.5%	Paper	4.2%	Paper	4.1%	Fabricated metals	2.5%
Miscellaneous	**4.4%**	Chemicals	7.0%	Instruments	6.4%	Miscellaneous	3.9%	Wood	3.8%	Paper	2.3%
Paper	3.7%	Paper	4.5%	Leather	5.9%	Furniture	3.0%	Apparel	3.0%	Instruments	2.2%
Instruments	2.9%	Rubber & Plastics	4.0%	Ceramic & Glass	4.5%	Textiles	2.6%	Fabricated metals	2.2%	Apparel	1.9%
Other transportation	2.8%	Leather	1.7%	Miscellaneous	3.3%	Apparel	2.4%	Miscellaneous	2.1%	Food	1.8%
Publishing	2.1%	Ceramic & Glass	0.0%	Paper	1.9%	Wood	1.7%	Textiles	1.7%	Ceramic & Glass	1.7%
Furniture	1.4%	Machinery	0.0%	Rubber & Plastics	-2.6%	Tobacco	1.5%	Rubber & Plastics	1.1%	Furniture	1.1%
Petroleum & Coal	0.7%	Instruments	-4.1%	Furniture	-5.0%	Primary metals	0.7%	Leather	0.6%	Petroleum & Coal	0.8%
Rubber & Plastics	0.0%	Textiles	-7.8%	Tobacco	-8.6%	Instruments	-0.4%	Publishing	0.5%	Leather	0.3%
Leather	-0.1%	Petroleum & Coal	-14.0%	Chemicals	-15.9%	Leather	-0.5%	Furniture	-1.1%	Miscellaneous	0.2%
Machinery	-0.3%	Transportation equipment	-18.6%	Transportation equipment	-42.9%	Machinery	-4.6%	Ceramic & Glass	-2.3%	Tobacco	-2.3%
Primary metals	-4.8%	Tobacco	-18.9%	Food	-65.4%	Petroleum & coal	-12.6%	Transportation equipment	-23.4%	Wood	-4.2%
Tobacco	-6.8%									Publishing	-6.6%
	100.0%		100.0%		100.0%		100.0%		100.0%		100.0%

Source: Author's calculations using the data available in the studies by Robles (1997) and High (2004). The calculations follow Harberger's real cost reduction approach to industry-level TFP measurement. The detailed calculations can be provided by the author upon request.
Notes: (a) The gap between 1958 and 1970 is due to lack of comparable data.
Positive (negative) values correspond to positive (negative) contributions to TFP change.
The **bold** industries correspond to the top performers responsible for about 100percent of aggregate manufacturing TFP growth.

internet-related services would be expected to be among the best TFP performers (O'Sullivan and Keuchel 1989). Unfortunately, reliable data on quality-adjusted TFP growth in services is not readily available in the empirical literature.

In Japan, the evidence on the linkage between entrepreneurship and TFP improvement is also clear-cut. Over the last decades, the Japanese economy has shown a strong competitive performance in the global markets in the mass-production processing-assembling type of industries such as electric and electronic equipment and transportation equipment. A major reason for this is that Japan has succeeded in repeatedly introducing innovations in these industries in the form of accumulation of small improvements to the products and significant improvements in the production process as, for example, standardization, automation, and quality control (Miyajima 2005). As expected, these industries consistently account for the bulk of the manufacturing TFP improvement of the Japanese economy in the three decades reported in Table **3**: 1970-79, 1980-89, and 1990-98. Electric and electronic industries and transportation equipment were

Table 3: Contribution to Manufacturing TFP Growth, by Industry – Japan. (Industries are Ranked According to their Share in Manufacturing TFP Growth)

1970-1979		1980-1989		1990-1998	
Electric & Electronic	**34.2%**	**Electric & Electronic**	**24.3%**	**Electric & Electronic**	**84.2%**
Transportation equipment	**20.3%**	**Transportation equipment**	**16.2%**	**Chemicals**	**10.5%**
Primary metals	**18.9%**	**Primary metals**	**13.1%**	**Transportation equipment**	**10.5%**
Textiles	**12.6%**	**Chemicals**	**10.9%**	Food	6.6%
Machinery	**11.3%**	**Machinery**	**10.6%**	Paper	5.3%
Ceramic & Glass	10.8%	**Fabricated metals**	**7.2%**	Textiles	3.9%
Fabricated metals	6.3%	**Other manufacturing industries[(a)]**	**6.2%**	Machinery	1.3%
Paper	3.2%	**Textiles**	**4.4%**	Other manufacturing industries [(a)]	-3.9%
Chemicals	1.8%	**Food**	**3.4%**	Fabricated metals	-5.3%
Food	-4.1%	**Ceramic & Glass**	**3.4%**	Ceramic & Glass	-6.6%
Other manufacturing industries [(a)]	-15.3%	**Paper**	**0.3%**	Primary metals	-6.6%
	100.0%		100.0%		100.0%

Sources: Author's calculations using the data available in the study by Miyajima (2005). The calculations follow Harberger's real cost reduction approach to industry-level TFP measurement. The detailed calculations can be provided by the author upon request.
Notes: (a) Other manufacturing industries include: apparel, lumber and wood products, publishing and printing, petroleum and coal products, instruments and related products, and miscellaneous manufacturing industries.
Positive (negative) values correspond to positive (negative) contributions to TFP change.
The **bold** industries correspond to the top performers responsible for about 100percent of aggregate manufacturing TFP growth.

TFP champions in the three decades accounting for about 45 percent of manufacturing TFP improvement in the 1970s, 40 percent in the 1980s, and 95 percent in the 1990s.

In sum, the data available on industry-level and quality-adjusted TFP for both the US and Japan provide compelling evidence that there is a close link between Schumpeter's entrepreneur and industry-level and quality-adjusted TFP improvement. In each time period, the industries that distinguish themselves by introducing successful new combinations (new or improved products, services, inputs, technologies, organizational methods, and new markets) contribute disproportionately to the aggregate TFP improvement. The empirical data presented here also provide clear evidence of Schumpeter's process of creative destruction. In any particular time period and country analyzed one can see that there are a few innovative industries experiencing very high TFP improvements (the "creative" part of the process); whereas others, hit by products and technology obsolescence, production inefficiencies, or incapacity to cope with new markets, experience significant TFP declines (the "destruction" part of the process).

5. A TFP-BASED EMPIRICAL MEASURE OF THE ECONOMIC VALUE OF ENTREPRENEURSHIP (EVE)

Both the theoretical rationale and empirical evidence discussed in the prior sections give support to the argument that the monetary value of the disaggregated (e.g., region-industry) and quality-adjusted TFP change over a relatively long period of time is, at least in theory, a good measure of EVE. The EVE measure developed below builds upon Harberger's real cost reduction (RCR)[14] method (Harberger 1998) where regions are included as a third dimension, in addition to the method's industry and time span dimensions. RCR is a method of calculating the monetary value of TFP change that combines industry-level data over time with a two-deflator method[15] of accounting for quality changes in labor and capital inputs.

In particular, the annual value of the regional- and industry-level EVE is obtained as a (T+1)-year moving average of the annual regional- and industry-level RCR value:

$$\mathrm{EVE}_{\mathrm{r,i,}(t-\frac{T}{2})} = \frac{1}{T+1}\sum\nolimits_{z=t-T}^{t} \mathrm{RCR}_{\mathrm{r,i,z}} \quad (1)$$

[14]Harberger (1998) labels the industry-level and quality adjusted TFP improvement "real cost reduction" in order to emphasize that it is a measure of the extent to which industries and firms successfully reduce the amount of real costs.

[15]Harberger's two-deflator method is a growth accounting method that uses only two deflators, the GDP deflator and the standard wage, in accounting for quality changes in labor and capital inputs. Although less sophisticated than the Jorgenson *et al*.'s growth accounting method (see Jorgenson *et al*. 1987, Jorgenson and Stiroth 2000), Harberger's two-deflator method has the advantage of being less data demanding. This feature makes the two-deflator method a powerful tool for TFP estimations in contexts where data limitations are an issue, as it is the case of studies using EU regional-level data. Moreover, Miyajima (2005), using industry-level data for the US for the 1958-1996 period, finds that TFP estimations using the two-deflator method are similar to those of Jorgenson *et al*.'s method.

Where: EVE= real economic value of entrepreneurship; RCR = value of real cost reduction; r= region; i= industry; t= time (year); T = moving average lag (even number).

The EVE obtained in this way is attributed to the mid-term year (t-T/2). By using the moving average RCR value rather than its year-on-year value, one is smoothing out the regional- and industry-specific business-cycle effect on RCR change. For better accomplishing this it is desirable to choose a long moving average period, say a 10-year period or longer.

The regional- and industry-level monetary value of RCR is calculated in the following way:

$$RCR_{r,i,t} = \Delta Y_{r,i} - \sum_{c} w_{c,r,i,t-1} \Delta L_{c,r,i} - \rho_{r,i,t-1} \Delta K_{r,i} \qquad (2)$$

Where: RCR = value of real cost reduction; ΔY = change in real gross value added (GVA) at basic prices between t and t-1; w= real wage; ΔL = change in labor input between t and t-1; ρ= real rate of return on capital (gross of depreciation); ΔK = change in the real value of capital stock between t and t-1; c= categories of labor (educational level); r= region; i= industry; t= time (year).

The annual regional- and industry-level RCR is determined by subtracting the contributions of both change in quality-improved labor input and change in quality-improved capital stock from the industry's regional output change.

The labor term $\sum_{c} w_{c,r,i,t-1} \Delta L_{c,r,i}$ of equation (2) assumes that the presumed regional- and industry-level marginal product of labor, measured by the real wage *w,* vary over categories of labor *c*, which correspond to the worker's educational level. In this way, the contribution of human capital to output change is measured by what workers are paid for, rather than by their educational attainment or skill group. As such, the human capital contribution to output change can be positive even if the quantity of labor input remains unchanged ($\sum_{c} \Delta L_{c,r,i} = 0$) just as a result from an upward reshuffling of the same labor force, translated into higher real wages. Moreover, by using an education-, region-, and industry-specific wage rate, rather than an overall average, knowledge spillovers (Lucas 1988) and other sorts of agglomeration economies impacting the labor market are, at least in theory, reflected in the education-region-industry level wage rates and thereby excluded from the value of RCR.

In the absence of data on wages and labor input by labor category (i.e., educational level) at the region-industry level, the labor term $\sum_{c} w_{c,r,i,t-1} \Delta L_{c,r,i}$ can be calculated as follows:

$$\sum_{c} w_{c,r,i,t-1} \Delta L_{c,r,i} = \sum_{c} \left(wr,i,t-1 \times \frac{\overline{w}_{c,t-1}}{\overline{w}_{t-1}} \right) (\Delta L_{r,i} \times s_{c,r,i,t}) \quad (3)$$

Where: w = real wage; $\overline{w}$ = median wage at the national level; ΔL = change in labor input between t and t-1; s = share of each labor category in labor force; c= categories of labor (educational level); r= region; i= industry; t= time (year).

In estimating the labor term using equation (3) one assumes that the educational wage premium, measured by the term $\left(\frac{\overline{w}_{c,t-1}}{\overline{w}_{t-1}} \right)$, is the same for all regions and industries of the same country, but different among countries and over time. Assuming the same wage premium for all regions and industries of the same country is a limitation that only arises when regional- and industry-level data on wages by educational level is not available.

In what concerns the capital term $\rho_{r,i,t-1} \Delta K_{r,i}$ of equation (2), the estimation of both the presumed marginal product of capital (ρ) and the capital stock *(K)* requires a detailed explanation. The regional- and industry-level rate of return on capital (ρ) is obtained by dividing the gross-of-depreciation capital gains by the capital stock, as follows:

$$\rho_{r,i,t} = \frac{K^{G}_{r,i,t}}{K_{r,i,t}} \qquad (4)$$

Where: ρ = real rate of return on capital (gross of depreciation); K^G= real capital gains (gross of depreciation); K = real value of capital stock; r= region; i= industry; t= time (year)

In this way, the presumed regional- and industry-level marginal product of capital, measured by the gross-of-depreciation real rate of return on capital, ρ, is assumed to be the same for the different types of capital inputs used by a given industry. But the same industry has different ρ_s over regions and over time.[16]

[16]A more refined measure of the contribution of capital quality to regional output change would require data for each type of capital inputs (as suggested by Dougherty and Jorgenson 1996, Jorgenson 1988, and Harberger 1998), broken down by region and industry. Unfortunately, such disaggregated data on capital inputs is seldom available at the regional level.

By using a region- and industry-specific rate of return on capital, rather than an overall average, all the sorts of economies of scale, agglomeration economies, and spillover effects internal to the industry (but external to the firm) and internal to the region (but external to the industry) are, at least in theory, reflected in the region- and industry-specific rate of return on capital and thereby excluded from the value of RCR.[17]

The regional- and industry-level gross-of-depreciation capital gains, K^G, result from the algebraic manipulation of the GVA formula[18] in the following way:

$$K^G_{r,i,t} = Y_{r,i,t} - L^G_{r,i,t} - \varphi_{r,i,t}\tau_{i,t} \quad (5)$$

Where: K^G = real capital gains (gross of depreciation); Y = real gross value added (GVA) at basic prices; L^G = real labor gains as measured by the real compensation of employees; τ = real taxes, net of subsidies, on production; φ = share of each region's GVA in national GVA; *r*= region; *i* = industry; *t*= time (year)

That is, the region- and industry-level K^G is obtained by subtracting from GVA (measured at basic prices)the labor gains and the net taxes on production. The only term in equation (5) that needs further explanation is the regional- and industry-level net taxes on production, measured by the term $\varphi_{r,i,t}\tau_{i,t}$. In a formulation like (5), for each industry, the national-level net taxes on production are broken down by regions according to each region's share in the industry's national GVA. This procedure is only necessary when the data on taxes on production is available at the national level but not at the regional level.

Capital stock (K) data by region is not readily available on a comparable basis in many countries. One possible procedure to circumvent this limitation is to depart from comparable industry-level capital stock figures for the nation (whenever available) and then break them down by region according to the region's share in the industry's national GVA, that is:

$$K_{r,i,t} = \varphi_{r,i,t}K_{i,t} \quad (6)$$

Where: K = real value of capital stock; φ = share of each region's GVA in national GVA; *r* = region; *i* = industry; *t* = time (year)

Finally, the regional-level estimate of EVE is obtained by adding up the industry-level EVE within each region:

$$EVE_{r,t} = \sum_i EVE_{r,i,t} \quad (7)$$

Where: EVE = real economic value of entrepreneurship; *r* = region; *i* = industry; t = time (year)

6. AN EMPIRICAL ILLUSTRATION OF THE EVE MEASURE: THE CASE OF THE EU

This section uses the case of the European Union (EU) regions at the NUTS-2 level[19] to illustrate the regional-level EVE measure developed in the prior section. The EVE figures obtained here are the annual average over a moving average period of 13 years spanning from 1995 to 2007.[20] The major data source is the Eurostat, Regio Dataset. Additional data sources include: (1) Eurostat, National Accounts Dataset; (2) Eurostat, EU Income and Living Conditions Survey; and (3) Eurostat, Labor Force Survey.

Figure **1** displays the regional annual average EVE for the economy as a whole expressed in euros per capita at prices of the year 2000. Figures **2** to **7** present similar EVE figures for each of the six broad industrial groups[21] for which the data required by the EVE methodology is available for the EU regions.[22]

The results allow five major findings. First, only a small-to-modest number of EU regions show high-to-

[17]Naturally, if one uses firm-level data, the regional- and firm-level rate of return on capital has the potential for incorporating all the sorts of economies of scale, agglomeration economies, and spillover effects internal to the firm, in addition to the effects internal to the industry but external to the firm, and internal to the region but external to the industry.

[18]The gross value added (GVA) at basic prices can be expressed by the following equation: GVA at basic prices = compensation of employees + gross-of-depreciation capital gains (labeled gross operating surplus) + taxes, net of subsidies, on production.

[19]The Nomenclature of Territorial Units for Statistics (NUTS) classification is a hierarchical statistical classification of the EU regions with four levels of disaggregation: (1) NUTS-0 level, corresponding to countries (27 regions); (2) NUTS-1 level, major socio-economic regions (97 regions); (3) NUTS-2 level, basic regions for the application of regional policies (271 regions); and (4) NUTS-3 level – small regions for specific diagnoses (1,303 regions).

[20]In accordance with equation (1), the regional EVE estimates for the economy as a whole were obtained assuming *t*=2007, *T*=12, *r*=EU NUTS-2 regions, and *i*=industries. The regional EVE figures were attributed to the mid-term year of 2001, as stipulated by equation (1).

[21]They are: (1) Agriculture, Hunting, Forestry, and Fishing (SIC codes A-B); (2) Industry; Electricity, Gas and Water Supply (SIC codes C-E); (3) Construction (SIC code F); (4) Trade, Hotels and Restaurants, Transport, Storage and Communications (SIC codes G-I); (5) Finance, Real Estate, renting, and Business Services (SIC codes J-K); and (6) Health, Education, and Public Administration (SIC codes L-P).

[22]In addition to the euro-value figures, the regional per capita EVE estimates for the economy as a whole and for each industrial group were also computed in purchasing power parities (PPPs) of the year 2000, as measured by the national-level PPPs, to account for price level differences across regions. The differences between the euro figures and the PPPs figures are nearly imperceptible graphically. Since the euro-value figures are easier to interpret, Figures **1** to **7** display the regional per capita EVE in euros, at prices of the year 2000. The per capita EVE figures measured in both euros and PPPS are available from the author upon request.

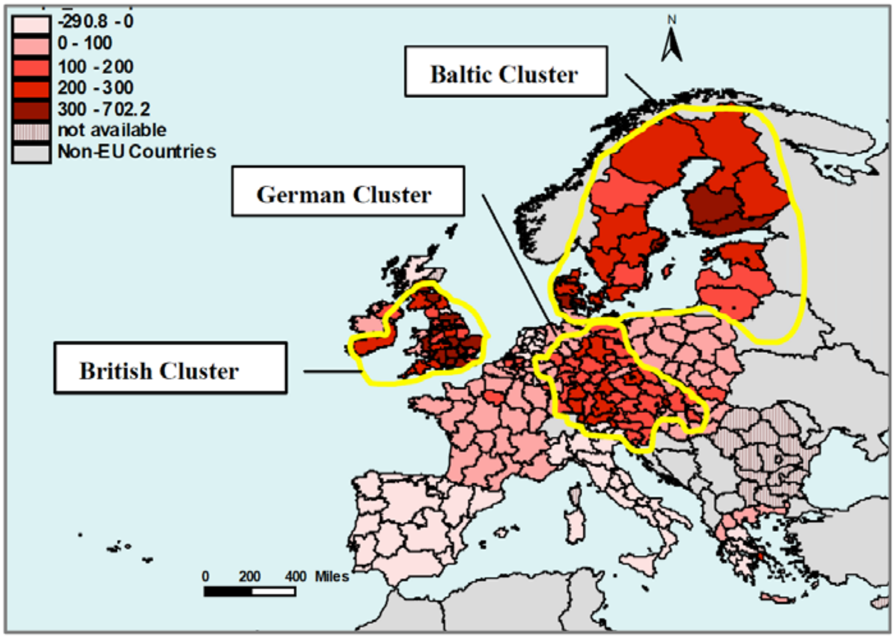

Figure 1: Per capita EVE for the economy as a whole – annual average over the 1995-2007 period; euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

very-high EVE per capita values for the economy as a whole (Figure **1**). This suggests that EVE tends to be highly concentrated in a small-to-modest number of EU regions.

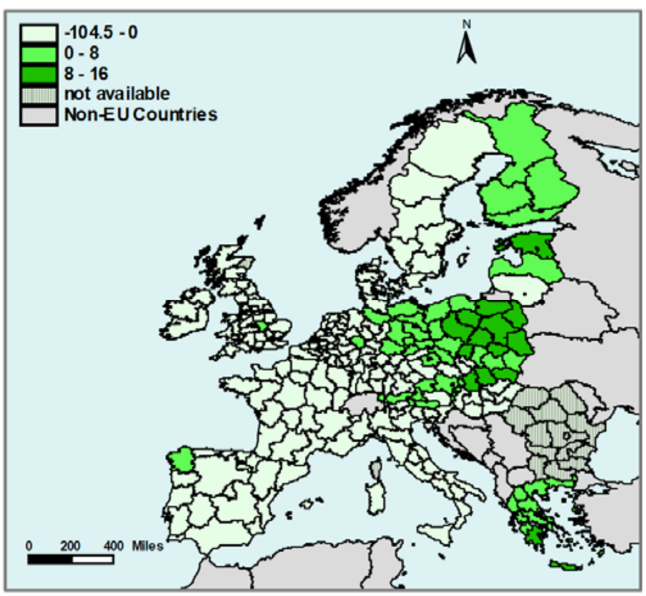

Figure 2: Per capita EVE for agriculture, hunting, forestry, and fishing – annual average over the 1995-2007 period; euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

Second, the regions with high-to-very-high overall EVE values are clustered in three geographical areas, highlighted in Figure **1**: (1) Baltic Cluster: formed by the EU regions around the Baltic Sea, which includes all the regions of Denmark, Sweden, Finland, Estonia, Latvia, and Lithuania; (2) British Cluster: which includes most of the UK regions and some Irish regions; and (3) German Cluster: formed by many of the regions of Germany, most of the regions of Austria, some regions of Belgium, some regions of Czech Republic, some regions of Slovakia, and all the regions of Slovenia.

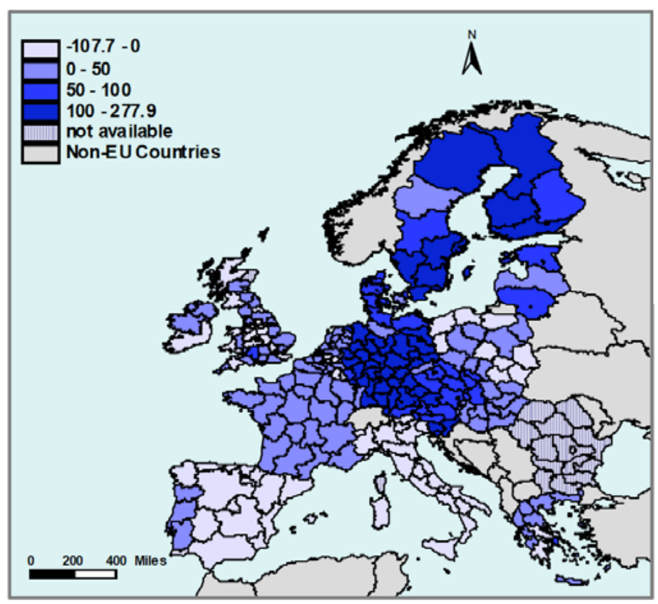

Figure 3: Per capita EVE for manufacturing, electricity, gas, and water supply – annual average over the 1995-2007 period; euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

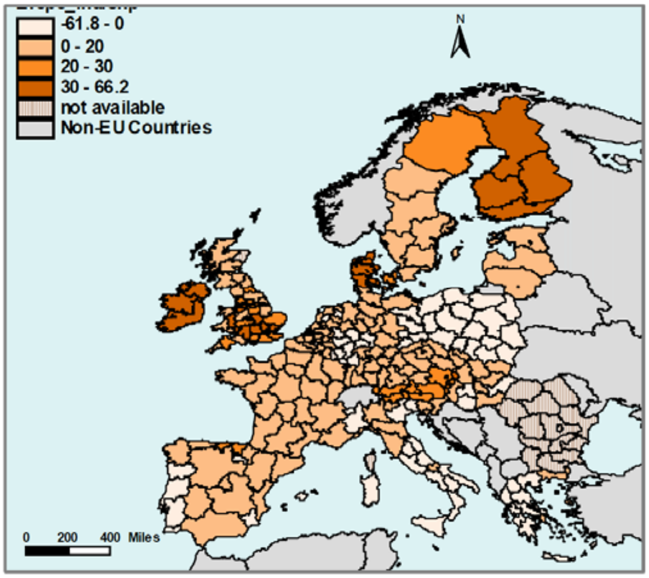

Figure 4: Per capita EVE for construction – annual average over the 1995-2007 period; euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

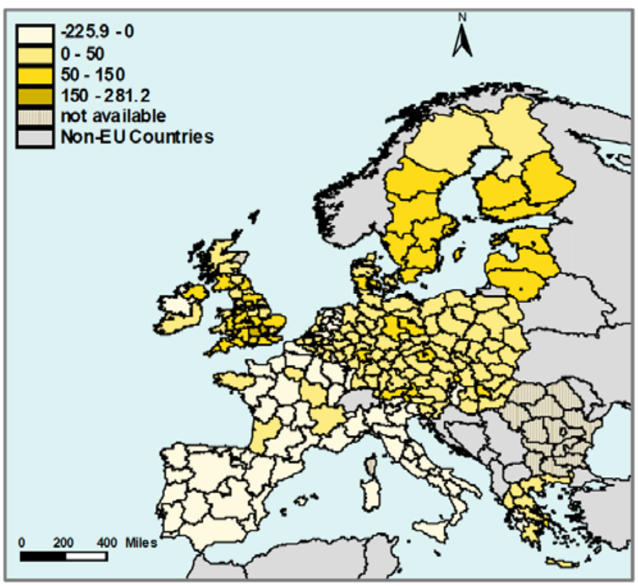

Figure 5: Per capita EVE for trade, hotels and restaurants, transport, storage, and communications – annual average over the 1995-2007 period; euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

Third, the three entrepreneurial clusters have different magnitudes among industries. The Baltic Entrepreneurial Cluster has medium-to-high per capita EVE in all industries except the Agriculture, Hunting, Forestry, and Fishing (AHFF) industry (Figure **2**). The British Entrepreneurial Cluster is weak in the Manufacturing, Electricity, Gas, and Water Supply (MEGW) industry (Figure **3**) and very strong in the Finance, Real Estate, Renting, and Business Services (FRERBS) industry (Figure **6**). The opposite is true for the German Entrepreneurial Cluster, which is

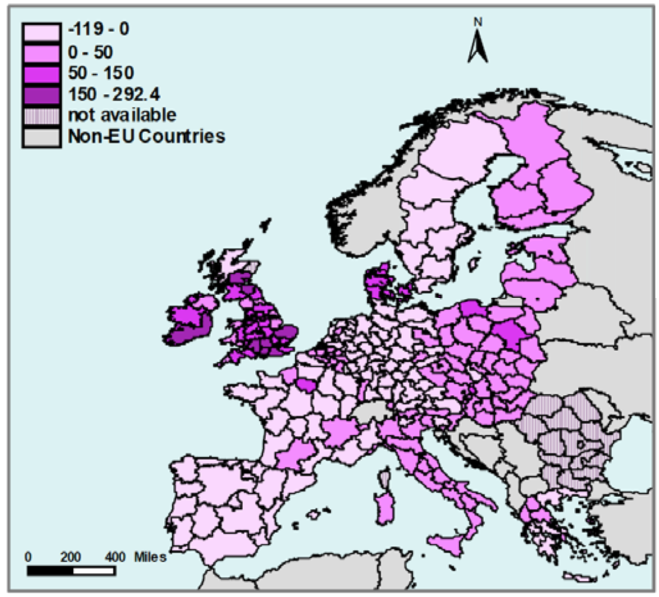

Figure 6: Per capita EVE for finance, real estate, renting, and business services– annual average over the 1995-2007 period; Euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

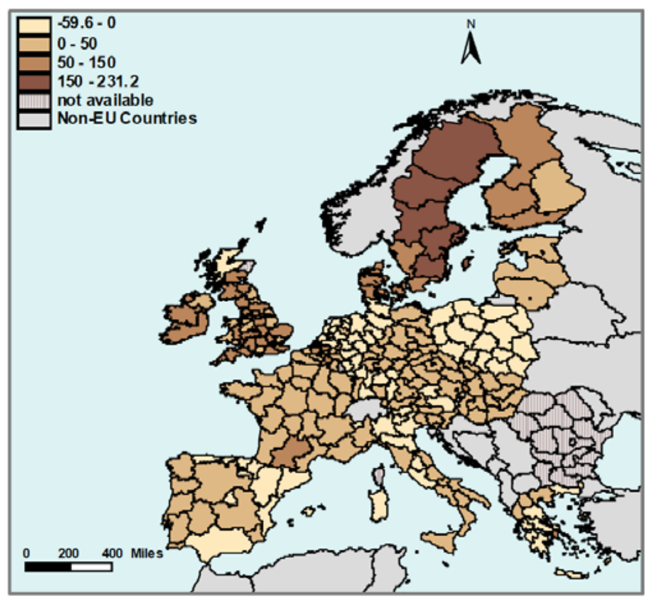

Figure 7: Per capita EVE for health, education, and public administration– annual average over the 1995-2007 period; Euros per person at 2000 prices.
(Note: Data can be provided by the author upon request).

particularly strong in the MEGW industry (Figure **3**), showing the highest per capita EVE values among the EU regions for this industry; whereas it is weak in the FRERBS industry (Figure **6**).

Fourth, a considerable number of EU regions show negative-to-slightly-positive annual EVE per capita over the 1995-2007 period for the economy as a whole, and this pattern tends to be consistent over industries. This is the case of all the regions of Italy, the Netherlands, Portugal, and Spain, and most of the Greek regions. All these regions have a negative overall-economy annual per capita EVE over this period. At the industry level, some of these regions show slightly positive per capita figures in some industries at best. This is the case of some of the regions of the Netherlands and Portugal in the MEGW industry (Figure **3**); all the regions of Spain and some regions of Italy in the Construction industry (Figure **4**); all Italian regions in the FRERBS industry (Figure **6**); and several regions of Portugal, Spain, and Italy in the Health, Education, and Public Administration (HEPA) industry (Figure **7**).

The fifth and final finding relates to the different magnitudes of the per capita EVE among industries in the EU regions. Among the six industries considered in the analysis, the AHFF industry (Figure **2**) and the Construction industry (Figure **4**) are the least entrepreneurial industries. In the AHFF industry EVE ranges from -105 euros per person to a modest 16 euros per person (2000 prices) per year, on average. In the Construction industry these figures range from -62 euros to 66 euros per person-year (2000 prices). The highest regional annual average EVE occurs in the FRERBS industry (Figure **6**), which ranges from a minimum of -119 euros per person and a maximum of 292 euros per person (2000 prices).

7. CONCLUSIONS

The economic literature offers several definitions of entrepreneurship and uses many different indicators to measure entrepreneurship empirically. The balance between strengths and weaknesses of each definition suggests that when the goal is to investigate the role of entrepreneurship in regional economic performance, entrepreneurship should be defined by what the contribution of the entrepreneurs to the process of economic development is (functional definition of entrepreneurship). The functional definition of entrepreneurship is rooted in the contributions of the Austrian school of economics and defines the entrepreneur as someone who uses his (1) alertness, (2) risk-taking capacity, (3) creativity, (4) innovative capacity and (5) good judgment to exploit and pursue the market opportunities by introducing successful innovations or new combinations in the markets. Accordingly, when it comes to investigate the links between entrepreneurship and regional economic development, entrepreneurship should be empirically measured by the value that entrepreneurs add to the process of economic development by bringing successful innovations or new combinations into markets – the economic value of entrepreneurship (EVE).

This paper finds sound theoretical and empirical support for the development of a TFP-based regional EVE measure provided it fulfills three criteria: (1) to be calculated at a disaggregated level, e.g., industry level or firm level and then added up to arrive at the regional EVE value for the economy as a whole; (2) to correct for quality changes in labor and capital inputs as well as for the impact of externalities on TFP; and (3) to be measured over a relatively long time period to average out the impact of business-cycles on TFP. Building upon the prior path-breaking works by Harberger (1998) and by High (2004), the empirical measure of regional-level EVE developed in this paper incorporates these three desirable features.

In applying the EVE measure to the EU regions at the NUTS-2 level over the period from 1995 to 2007, this paper offers five major findings about the entrepreneurial performance of the EU regions. First, only a small-to-modest number of EU regions show high-to-very-high overall-economy EVE values. Second, the best performing regions are clustered in three geographical areas: the Baltic Entrepreneurial Cluster, the British Entrepreneurial Cluster, and the German Entrepreneurial Cluster. Third, the three Entrepreneurial Clusters have different magnitudes among industries: the Baltic Cluster is relatively strong in all except one industry (AHFF industry); the British Cluster is particularly strong in the FRERBS industry but weak in the MEGW industry; and the German Cluster is very strong in the MEGW industry and weak in the FRERBS industry. Fourth, EVE figures are negative-to-slightly-positive in most of the regions of Greece, Italy, the Netherlands, Portugal, and Spain, and many regions of France and of Eastern European countries, both for the overall economy and for each industry. Fifth, different industries have different EVE magnitudes in the EU regions. Over the 1995-2007 period, the worst performer is the AHFF industry where the annual average EVE is less than 16 euros per person (2000 prices) in any EU region. The best performer is the FRERBS industry where the annual average EVE can achieve up to 292 euros per person (2000 prices) in some regions.

ACKNOWLEDGEMENTS

This paper is largely the result of the research developed as a postdoctoral research fellow at the

Center for Regional Analysis, School of Public Policy, George Mason University, USA.

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Received on 14-03-2013 Accepted on 12-04-2013 Published on 17-04-2013

DOI: http://dx.doi.org/10.6000/1929-7092.2013.02.7