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ENTREPRENEURSHIP CAPITAL AND ECONOMIC PERFORMANCE

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ABSTRACT

Entrepreneurship Capital and Economic Performance*

The neoclassical model of the production function, as applied by Robert Solow to build the neoclassical model of growth, linked labour and capital to output. More recently, Romer and others have expanded the model to include measures of knowledge capital. In this Paper we introduce a new factor, entrepreneurship capital, and link it to output in the context of a production function model. This Paper explains what is meant by entrepreneurship capital and why it should influence economic output. A production function model including several different measures of entrepreneurship capital is then estimated for German regions. The results indicate that entrepreneurship capital is a significant and important factor shaping output and productivity. These results suggest a new direction for policy that focuses on instruments to enhance entrepreneurship capital.

JEL Classification: M13, O32 and O47
Keywords: entrepreneurship capital, production function and regional economic performance

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The Entrepreneur is the single most important player
in a modern economy
Edward Lazear (2002, p.1)

1. Introduction

Ever since Robert Solow (1956) based his model of economic growth on the neoclassical production function with its key factors of production, capital and labor, economists have relied upon the model of the production function as a basis for explaining the determinants of economic growth. Romer's (1986) critique of the Solow approach was not with the basic model of the neoclassical production function, but rather what he perceived to be omitted from that model – knowledge. Not only did Romer (1986), along with Lucas (1988) and others argue that knowledge was an important factor of production, along with the traditional factors of labor and capital, but because it was endogenously determined as a result of externalities and spillovers, it was particularly important.

The purpose of this paper is to suggest that another key factor has been omitted from the neoclassical production function – entrepreneurship capital. By entrepreneurship capital we mean the capacity for economic agents to generate new firms. As Gartner and Carter (2003) state, "Entrepreneurial behavior involves the activities of individuals who are associated with creating new organizations rather than the activities of individuals who are involved with maintaining or changing the operations of on-going established organizations."

Entrepreneurship has typically been referred to as an action, process, or activity. We propose that it can also be considered to constitute a stock of capital, since it reflects a number of different factors and forces, legal, institutional and social, which create a capacity for this activity (Hofstede et. al., 2002). A recent literature has emerged suggesting that entrepreneurship capital may be something of a missing link in explaining variations in economic performance (Acs and Audretsch, 2003). However, while a rich literature has emerged identifying the determinants of entrepreneurship, led by the pioneering study of Evans and Leighton

(1989), the link between entrepreneurship capital and performance remains largely ancedotal or based on case studies. For example, Saxenian (1994) provides compelling case study evidence attributing the superior performance of Silicon Valley to a high capacity for promoting entrepreneurship, which could be viewed as a rich endowment of entrepreneurship capital.

Baumol (2002, pp. 58-59) has argued that entrepreneurial activity may account for a significant amount of the growth left unexplained in traditional production function models. While the traditional factors of labor and capital, and even the addition of knowledge capital are important in shaping output, the capacity to harness new ideas by creating new enterprises is also essential to economic output. A counter-example is instructive. In the former Soviet Union, while the exact measures of the stocks of capital and labor, and even knowledge, were questionable, their existence was not. By contrast, entrepreneurship capital, at least as it could be legally applied, was minimal.

The second section of this paper is devoted to defining *entrepreneurship capital*, and explaining why is should be linked to output in the context of a production function model. In the third section we specify the production function to be estimated and expose the data. A production function model is estimated for German regions in the fourth section. The final section provides a summary and conclusion. In particular, the evidence suggests that various measures of entrepreneurship capital do, in fact, contribute to output. Those regions with a higher level of entrepreneurship capital exhibit higher levels of output and productivity, while those with a paucity of entrepreneurship capital tend to generate lower levels of output and productivity.

2. Entrepreneurship Capital

While it has become widely acknowledged that entrepreneurship is a vital force in the economies of developed countries, there is little consensus about what actually constitutes entrepreneurial activity. Scholars have proposed a broad array of definitions, which when operationalized, have generated a number of different measures (Hebert and Link, 1989). Similarly, there is no generally accepted definition of entrepreneurship for the developed countries of the OECD (OECD, 1998). The failure of a single definition of entrepreneurship to emerge undoubtedly reflects the fact that it is a multidimensional concept. The actual definition used to study or classify entrepreneurial activities reflects a particular perspective or emphasis. For example, definitions of entrepreneurship typically vary between the economic and management perspectives. From the economic perspective, Hebert and Link (1989) distinguish between the supply of financial capital, innovation, allocation of resources among alternative uses and decision-making. Thus, an entrepreneur is someone encompassing the entire spectrum of these functions: "The entrepreneur is someone who specializes in taking responsibility for and making judgmental decisions that affect the location, form, and the use of goods, resources or institutions" (Hebert and Link, 1989, p. 213).

The most prevalent and compelling views of entrepreneurship focus on the perception of new economic opportunities and the subsequent introduction of new ideas in the market. Just as entrepreneurs are agents of change; entrepreneurship is thus about the process of change. This corresponds to the definition of entrepreneurship proposed by the OECD, "Entrepreneurs are agents of change and growth in a market economy and they can act to accelerate the generation, dissemination and application of innovative ideas… Entrepreneurs not only seek out and identify potentially profitable economic opportunities but are also willing to take risks to see if their hunches are right" (OECD, 1998, p. 11).

While the entrepreneur undertakes a definitive action, starting a new business, her action cannot be viewed in a vacuum devoid of context. Rather, as Audretsch et al. (2002) show, the determinants of entrepreneurship are shaped by a number of forces and factors, including legal and institutional but also social factors as well. The study of social capital and its impact on economic decision making and actions stems back to classic literatures in economics and sociology in which social and relational structure influence market processes (Granovetter

1985). Thorton and Flynne (2003) and Saxenian (1994) attribute the high economic performance of Silicon Valley to a rich endowment of what could be termed as entrepreneurship capital," It is not simply the concentration of skilled labor, suppliers and information that distinguish the region. A variety of regional institutions – including Stanford University, several trade associations and local business organizations, and a myriad of specialized consulting, market research, public relations and venture capital firms – provide technical, financial, and networking services which the region's enterprises often cannot afford individually. These networks defy sectoral barriers: individuals move easily from semiconductor to disk drive firms or from computer to network makers. They move from established firms to startups (or vice versa) and even to market research or consulting firms, and from consulting firms back into startups. And they continue to meet at trade shows, industry conferences, and the scores of seminars, talks, and social activities organized by local business organizations and trade associations. In these forums, relationships are easily formed and maintained, technical and market information is exchanged, business contacts are established, and new enterprises are conceived…This decentralized and fluid environment also promotes the diffusion of intangible technological capabilities and understandings"[1] (Saxenian, 1990, pp. 96-97).

Such contexts generating a high propensity for economic agents to start new firms can be characterized as being rich in entrepreneurship capital. Other contexts, where the startup of new firms is inhibited, can be characterized as being weak in entrepreneurship capital.

Entrepreneurship capital exerts a positive impact on economic output for a number of reasons. The *first* is that it is a mechanism for knowledge spillovers. Romer (1986), Lucas (1988 and 1992) and Grossman and Helpman (1991) established that knowledge spillovers are an important mechanism underlying endogenous growth. However, they shed little light on the actual mechanisms by which knowledge is transmitted across firms and individuals.

[1] Saxenian (1990, pp. 97-98) claims that even the language and vocabulary used by technical specialists can be specific to a region: "…a distinct language has evolved in the region and certain technical terms used by semi-

The answer to this question is important, because a policy implication commonly drawn from the new economic growth theory is that, as a result of convexities in knowledge and the resultant increasing returns, knowledge factors, such as R&D should be publicly supported. While this may be valid, it is also important to recognize that the mechanisms for spillover transmission may also play a key role and may also serve as a focus for public policy enhancing economic growth and development.

The literature identifying mechanisms actually transmitting knowledge spillovers is sparse and remains underdeveloped. However, one important area where such transmission mechanisms have been identified involves entrepreneurship. Entrepreneurship involves the startup and growth of new enterprises.

Why should entrepreneurship serve as a mechanism for the spill over of knowledge from the source of origin? At least two major channels or mechanisms for knowledge spillovers have been identified in the literature. Both of these spillover mechanisms revolve around the issue of appropriability of new knowledge. Cohen and Levinthal (1989) suggest that firms develop the capacity to adapt new technology and ideas developed in other firms and are therefore able to appropriate some of the returns accruing to investments in new knowledge made externally. This view of spillovers is consistent with the traditional model of the knowledge production function, where the firm exists exogenously and then undertakes (knowledge) investments to generate innovative output.

By contrast, Audretsch (1995) proposes shifting the unit of observation away from exogenously assumed firms to individuals, such as scientists, engineers or other knowledge workers – agents with endowments of new economic knowledge. When the lens is shifted away from the firm to the individual as the relevant unit of observation, the appropriability issue remains, but the question becomes, *How can economic agents with a given endowment of new knowledge best appropriate the returns from that knowledge?* If the scientist or engi-

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conductor production engineers in Silicon Valley would not even be understood by their counterparts in Boston's neer can pursue the new idea within the organisational structure of the firm developing the knowledge and appropriate roughly the expected value of that knowledge, he has no reason to leave the firm. On the other hand, if he places a greater value on his ideas than do the decision-making bureaucracy of the incumbent firm, he may choose to start a new firm to appropriate the value of his knowledge. Small enterprises can compensate for their lack of R&D through spillovers and spin-offs. Typically an employee from an established large corporation, often a scientist or engineer working in a research laboratory, will have an idea for an invention and ultimately for an innovation. Accompanying this potential innovation is an expected net return from the new product. The inventor would expect to be compensated for his/her potential innovation accordingly. If the company has a different, presumably lower, valuation of the potential innovation, it may decide either not to pursue its development, or that it merits a lower level of compensation than that expected by the employee.

In either case, the employee will weigh the alternative of starting his/her own firm. If the gap in the expected return accruing from the potential innovation between the inventor and the corporate decision maker is sufficiently large, and if the cost of starting a new firm is sufficiently low, the employee may decide to leave the large corporation and establish a new enterprise. Since the knowledge was generated in the established corporation, the new start-up is considered to be a spin-off from the existing firm. Such start-ups typically do not have direct access to a large R&D laboratory. Rather, these small firms succeed in exploiting the knowledge and experience accrued from the R&D laboratories with their previous employers.
The research laboratories of universities provide a source of innovation-generating knowledge that is available to private enterprises for commercial exploitation. Jaffe (1989) and Audretsch and Feldman (1996) found that the knowledge created in university laboratories "spills over" to contribute to the generation of commercial innovations by private enterprises. Acs, Audretsch, and Feldman (1994) found persuasive evidence that spillovers from university

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Route 128."

research contribute more to the innovative activity of small firms than to the innovative activity of large corporations.

In the metaphor provided by Albert O. Hirschman (1970), if voice proves to be ineffective within incumbent organizations, and loyalty is sufficiently weak, a knowledge worker may resort to exit the firm or university where the knowledge was created in order to form a new company. In this spillover channel the knowledge production function is actually reversed. The knowledge is exogenous and embodied in a worker. The firm is created endogenously in the worker's effort to appropriate the value of his knowledge through innovative activity. Thus, entrepreneurship serves as the mechanism by which knowledge spills over from the source creating to a new firm where it is commercialized.

A *second* way that entrepreneurship capital exerts a positive influence on economic output is through the increased competition by the increased number of enterprises. Jacobs (1969) and Porter (1990) argue that competition is more conducive to knowledge externalities than is local monopoly. It should be emphasised that by local competition Jacobs does not mean competition within product markets as has traditionally been envisioned within the industrial organisation literature. Rather, Jacobs is referring to the competition for the new ideas embodied in economic agents. Not only does an increased number of firms provide greater competition for new ideas, but in addition, greater competition across firms facilitates the entry of a new firm specializing in some particular new product niche. This is because the necessary complementary inputs and services are likely to be available from small specialist niche firms but not necessarily from large, vertically integrated producers.

Both Feldman and Audretsch (1999) as well as Glaeser, Kallal, Sheinkman and Schleifer (1992) found empirical evidence supporting the hypothesis that an increase in competition, as measured by the number of enterprises, in a city increases the growth performance of that city.

A *third* way that entrepreneurship capital generates economic output is by providing diversity among the firms. Not only does entrepreneurship capital generate a greater number of enterprises, but it also increases the variety of enterprises in the location. A key assumption made by Hannan and Freeman (1989) in the population ecology literature is that each new organization represents a unique approach. There has been a series of theoretical arguments suggesting that the degree of diversity, as opposed to homogeneity, in a location will influence the growth potential.

The theoretical basis linking diversity to economic performance is provided by Jacobs (1969), who argues that the most important source of knowledge spillovers are external to the industry in which the firm operates and that cities are the source of considerable innovation because the diversity of these knowledge sources is greatest in cities. According to Jacobs, it is the exchange of complementary knowledge across diverse firms and economic agents which yields a greater return on new economic knowledge. She develops a theory that emphasizes that the variety of industries within a geographic region promotes knowledge externalities and ultimately innovative activity and economic growth.

The first important test linking diversity to economic performance, measured in terms of employment growth was by Glaeser, Kallal, Sheinkman and Schleifer (1992), who employ a data set on the growth of large industries in 170 cities between 1956 and 1987 in order to identify the relative importance of the degree of regional specialization, diversity and local competition play in influencing industry growth rates. The authors find evidence that diversity promotes growth in cities.

Feldman and Audretsch (1999) identified the extent to which the extent of diversity influences innovative output. They link the innovative output of product categories within a specific city to the extent to which the economic activity of that city is concentrated in that industry, or conversely, diversified in terms of complementary industries sharing a common science base.

Entrepreneurship capital therefore can contribute to output and growth by serving as a conduit for knowledge spillovers, increasing competition, and by injecting diversity. Inclusion of measures of entrepreneurship capital would be expected to be positively related to output.

3. Production Function Model and Measurement Issues

The goal of this paper is include a measure of entrepreneurship capital in estimating a production function model for German regions. Using a specification of the Cobb-Douglas type we obtain

$$Y_i = \alpha K_i^{\beta_1} L_i^{\beta_2} R_i^{\beta_3} E_i^{\beta_4} e^{\varepsilon_i}\ , \tag{1}$$

where K represents the factor of *physical capital*, L represents *labor*, R represents *knowledge capital*, and E represents *entrepreneurship capital*. The subscript i refers to German regions.

Measurement of entrepreneurship capital is no less complicated than is measuring the traditional factors of production. Just as measuring capital, labor and knowledge invokes numerous assumptions and simplifications, creating a metric for entrepreneurship capital presents a challenge. Many of the elements determining entrepreneurship capital defy quantification. In any case, entrepreneurship capital, like all of the other types of capital, is multifaceted and heterogeneous. However, entrepreneurship capital manifests itself in a singular way – the startup of new enterprises. Thus, we propose using new-firm startup rates as an indicator of entrepreneurship capital. *Ceteris paribus*, higher startup rates reflect higher levels of entrepreneurship capital. Our data will consist in a cross-section of 327 West-German regions or *Kreise* for the year 1992 if not indicated otherwise. Sources and construction of the data is as follows.

Output is measured as Gross Value Added corrected for purchases of goods and services, VAT and shipping costs. Statistics are published every two years for *Kreise* by the

Working Group of the Statistical Offices of the German Länder, under "Volkswirtschaftiche Gesamtrechnungen der Länder'".

Physical Capital: The stock of capital used in the manufacturing sector of the *Kreise* has been estimated using a perpetual inventory method which computes the stock of capital as a weighted sum of past investments. In the estimates we used a □-distribution with p=9 and a mean age of q=14. Type of survival function as well as these parameters have been provided by the German Federal Statistical Office in Wiesbaden. This way, we attempted to obtain maximum coherence with the estimates of the capital stock of the German producing sector as a whole as published by the Federal Statistical Office. Data on investment at the level of German *Kreise* is published annually by the Federal Statistical Office in the series ``E I 6''. These figures however are limited to firms of the producing sector, excluding the mining industry, with more than 20 employees. The vector of the producing sector as a whole has been estimated by multiplying these values such that the value of the capital stock of Western Germany - as published in the Statistical Yearbook - was attained. Note that this procedure implies that estimates for *Kreise* with a high proportion of mining might be biased. Note also that for protection purposes, some *Kreise* did not publish data on investment (like e.g. the city of Wolfsburg, whose producing sector is dominated by Volkswagen). Therefore five *Kreise* are treated as missing.

Labor: Data on labor is published by the Federal Labor Office, Nürnberg which reports number of employees liable to social insurance by *Kreise*.

Knowledge Capital is expressed as *number of employees engaged in R&D* in the public (1992) and in the private sector (1991). With this approach we follow the examples of of Griliches (1979), Jaffe (1989), and Audretsch and Feldman (1996). Data have been communicated by the *Stifterverband für die Wissenschaft* under obligation of secrecy. With these data, it was impossible to make a distinction between R&D-employees in the producing and non-producing sectors. Regression results therefore will implicitly include spillovers from R&D of the non-producing sector to the producing sectors. We presume however that this effect is rather low.

Entrepreneurship Capital is computed as the *number of startups in the respective region relative to its population*, which reflects the propensity of inhabitants of a region to start a new firm. The data on startups is taken from the ZEW foundation panels that is based on data provided biannually by *Creditreform*, the largest German credit-rating agency. This data contains virtually all entries – hence startups – in the German Trade Register, especially for firms with large credit requirements as e.g. high-technology firms.[2] By now, there are 1.6 million entries for Western-Germany. Since number of startups is subject to a greater level of stochastic disturbance over short time periods, it is prudent to compute the measure of entrepreneurship capital based on startup rates over a longer time period. We therefore used the number of startups between 1989-1992. Lagged values of start-up rates are used in order to avoid problems of simultaneity between output and entrepreneurship. This lagged relationship reflects causality between entrepreneurship capital in one period and economic output in subsequent periods. While we argue in this paper that entrepreneurship capital should include startup activity in any industry, some scholars have suggested that it should only apply to startups involving innovative activity. Therefore, we compute two modified measures of entrepreneurship. The first one restricts entrepreneurship capital to include only startup activity in high-technology manufacturing industries (whose R&D-intensity is above 2.5%). The second measure restricts entrepreneurship capital to include only startup activity in the ICT industries, i.e. firms in the hard- and software business. Some of these industries are also classified under high-technology manufacturing.

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[2] Firms with low credit requirements, with a low number of employees or with illimited legal forms are registered only with a time lag. These are typically retail stores or catering firms. See Harhoff and Steil (1997) for more detail on the ZEW foundation panels.

Table 1: Regions ranked by startup intensity (startups 1989 – 1992 per population) of all industries

Rank	Region	Startup Intensity
1	München, surrounding area	24,634561
2	Düsseldorf, city	20,241409
3	Hamburg, city	19,669706
4	Offenbach, surrounding area	18,606913
5	Wiesbaden, city	17,671311
6	Starnberg	17,101142
7	München, city	16,081293
8	Frankfurt a.M., city	15,956175
9	Hochtaunuskreis	15,866653
10	Speyer, city	15,395183
11	Passau, city	15,254072
12	Freising	14,850592
13	Memmingen, city	14,805079
14	Landsberg a. Lech	14,792960
15	Offenbach a. M., city	14,620285
16	Segeberg	14,572237
17	Diepholz	14,435722
18	Main-Taunus-Kreis	14,232831
19	Ebersberg	13,811470
20	Dachau	13,779904
...		
308	Wesermarsch	6,006103
309	Wolfsburg, city	6,001654
310	Cham	5,991514
311	Sankt Wendel	5,919445
312	Neckar-Odenwald-Kreis	5,912736
313	Donnersbergkreis	5,896884
314	Schweinfurt	5,896509
315	Emsland	5,774027
316	Uelzen	5,758620
317	Salzgitter, city	5,668607
318	Lichtenfels	5,551670
319	Trier-Saarburg	5,541770
320	Herne, city	5,526887
321	Grafschaft Bentheim	5,428270
322	Höxter	5,287556
323	Bremerhaven, city	5,258049
324	Tirschenreuth	5,198918
325	Coburg	5,193940
326	Cuxhaven	5,168823
327	Kusel	4,793161

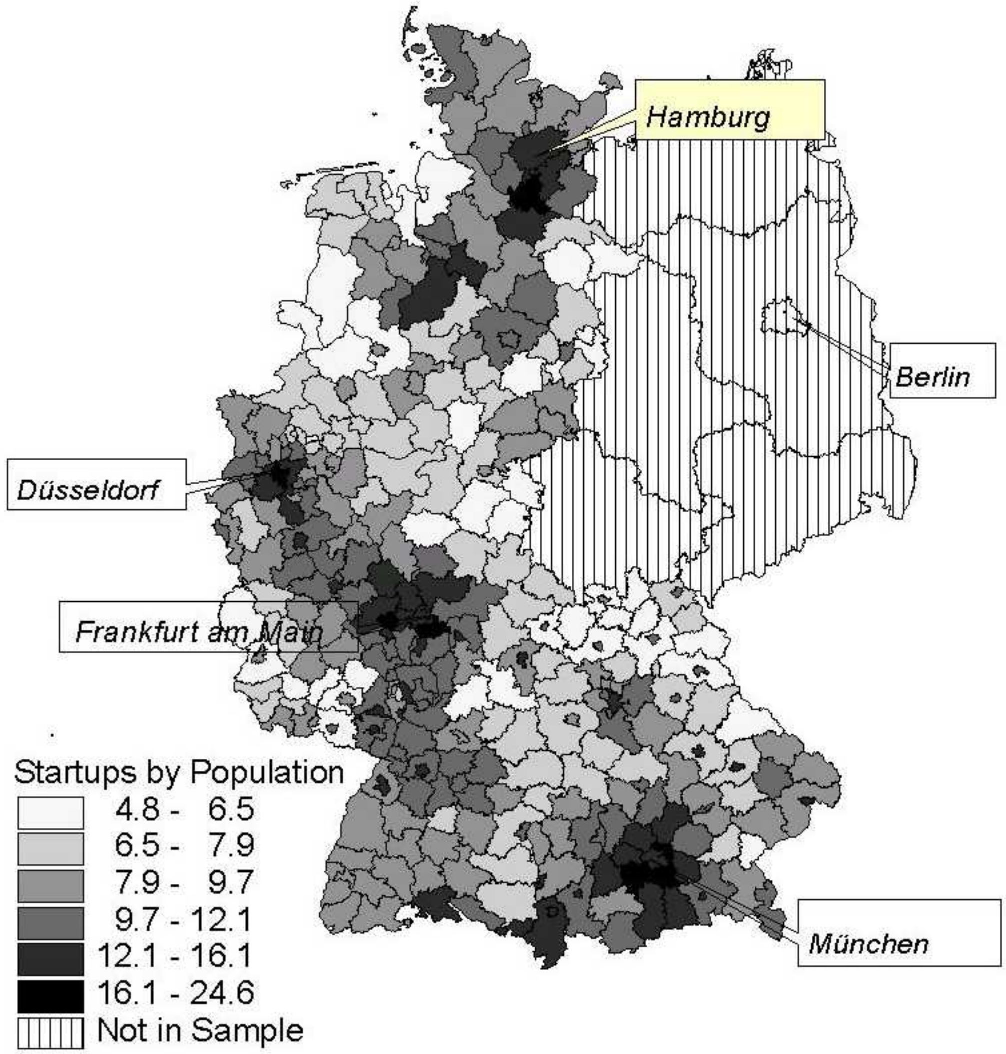

Figure 1: Spatial distribution of Entrepreneurship Capital measured as the number of startups in all industries relative to population in each region.

The spatial distribution of the measure of Entrepreneurship capital based on all industries is shown in Figure 1. As Table 1 makes clear, the regions exhibiting the highest amounts of Entrepreneurship Capital are Munich, Düsseldorf, and Hamburg. By contrast, the regions with the lowest amount of Entrepreneurship Capital are Kusel, Cuxhaven and Coburg. This ranking will differ slightly, though not fundamentally if we use startups in high-tech manufacturing industries or in ICT industries instead of startups in all industries. This is indicated by the positive and significant correlation between all three measures of entrepreneurship shown in Table 2. Table 5 and Table 6 (page 20) show the ranking of regions (showing again the 20 strongest and the 20 weakest regions) when using the two alternative measures of entrepreneurship capital.

Table 2: Correlation between different measures of entrepreneurship capital and between these measures and population density for 327 German Kreise

	Population Density	Startups in all industries	High-tech manuf. startups
Startups in all ind.	0.338***		
High-tech startups	0.028	0.510***	
ICT startups	0.287***	0.816***	0.612***

*Note: *** correlation is significant at 1% based on a two sided t-test*

4. Empirical Results

Estimation of the production function model of Equation 1 produced the results displayed in Table 3. The first equation estimates the traditional Solow model of the production function. As the positive and statistically significant coefficients suggest, both physical capital and labor are important factors of production in determining output in German regions. In the second column the factor of knowledge capital is added. The positive and statistically significant coefficients of all three variables lend support to the Romer view that knowledge matters as a factor of production.

Table 3: Results of Estimation of the Production Function Model for German Regions

	(1)	(2)	(3)	(4)	(5)
Constant	-2.755*** (-10.749)	-2.305*** (-7.807)	-1.822*** (-4.866)	-1.810*** (-4.363)	-1.474*** (-3.804)
Capital	0.270*** (5.312)	0.279*** (5.366)	0.276*** (5.333)	0.294*** (5.587)	0.287*** (5.603)
Labor	0.805*** (13.241)	0.736*** (11.410)	0.748*** (11.606)	0.715*** (10.897)	0.734*** (11.554)
Knowledge		0.030** (2.199)	0.022 (1.540)	0.027** (1.987)	0.014 (0.954)
Entrepreneurship			0.112** (2.078)		
High-Tech Entrepreneurship				0.043* (1.694)	
ICT Entrepreneurship					0.104*** (3.244)
R2	0.911	0.908	0.910	0.909	0.911

Notes: t-statistic in brackets.
** Statistically significant at the two-tailed test for 90% level of confidence*
*** Statistically significant at the two-tailed test for 95% level of confidence*
**** Statistically significant at the two-tailed test for 99% level of confidence*

The third column shows the results when entrepreneurship capital is also included in the production function model (1). The positive and statistically significant coefficient indicates that entrepreneurship is a key factor in explaining variations in output across German regions. Those regions with a greater degree of entrepreneurship capital exhibit higher levels of output, *ceteris paribus*. Columns (4) and (5) show the results for equation (1) if we use startup rates in high-tech manufacturing or in ICT industries instead of startup rates of all industries. The results indicate that using these two alternative measures of entrepreneurship capital still generates a positive and statistically significant coefficient, suggesting that entrepreneurship capital is an important addition to the model of the production function.

An alternative specification estimates *labor productivity*. This is obtained by dividing both sides of Equation (1) by L. In this equation, we also restrict the production elasticities of capital and labor to sum to unity, hence in terms of equation (1) we have $\beta_1 + \beta_2 = 1$. Hence we obtain

$$(Y_i / K_i) = \alpha (K_i \; / L_i)^{\gamma_1} R_i^{\gamma_2} E_i^{\gamma_3} e^{\varepsilon_i} \tag{2}$$

The results for estimating labor productivity in Equation (2) are presented in Table 4. As the positive and statistically significant coefficients indicate, not only do labor, capital intensity and knowledge influence labor productivity, but entrepreneurship capital does as well. Those regions with a greater degree of entrepreneurship capital exhibit systematically higher levels of labor productivity than do those regions with lower endowments of entrepreneurship capital. These results prove to be robust for the two alternative measures of entrepreneurship capital, which are restricted to high technology and ITC industries.

Table 4: Results of Estimation of the Model of Labor Productivity in German Regions

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Constant	1.888*** (-19.235)	-2.175*** (-16.683)	-1.645*** (-5.566)	-1.730*** (-6.060)	-1.299*** (-6.060)
Capital Intensity	0.332*** (6.814)	0.283*** (5.535)	0.283*** (5.551)	0.296*** (5.747)	0.293*** (5.807)
Knowledge		0.035*** (3.673)	0.030*** (3.028)	0.030*** (3.005)	0.021** (2.032)
Entrepreneurship			0.107** (1.993)		
High-Tech Entrepreneurship				0.044* (1.747)	
ICT Entrepreneurship					0.102*** (3.203)
R2	0.125	0.169	0.179	0.177	0.195

Notes: t-statistic in brackets.
** Statistically significant at the two-tailed test for 90% level of confidence*
*** Statistically significant at the two-tailed test for 95% level of confidence*
**** Statistically significant at the two-tailed test for 99% level of confidence*

Conclusions

Subsequent to publication of Solow's seminal article depicting the neoclassical model of the production function as a basis for analyzing economic growth, a series of new policy directions were developed at enhancing the two traditional factors of production, physical capital and labor. Similarly, endogenous growth theory has triggered a new policy direction focusing on enhancing knowledge capital through investments in R&D, education, and human capital. The results of this paper suggest, that at least in the case of Germany, a different and new policy direction – the enhancement of entrepreneurship capital. While these findings certainly do not contradict the conclusions of earlier studies linking growth to factors such as labor, capital, and knowledge, the evidence from this paper points to an additional factor, entrepreneurship capital, that also plays an important role in the model of the production function. It may be that, under certain conditions, policies focusing on enhancing entrepreneurship capital can prove to be more effective than those targeting the more traditional factors. In any case, future research research needs to map out more precisely the exact links and channels that policy can influence and augment entrepreneurship in such a way as to raise productivity and growth, as suggested by the results of this paper.

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Appendix

Table 5: Regions ranked by startup intensity (startups 1989 – 1992 per population) of high-tech manufacturing industries

Rank	***Region***	***High-tech manuf. Startup intensity***
1	Tuttlingen	0,600451
2	München	0,582258
3	Aachen, krfr. St.	0,517982
4	Ravensburg	0,442391
5	Landsberg a. Lech	0,438991
6	Starnberg	0,404163
7	Enzkreis	0,377389
8	Miesbach	0,361141
9	Ebersberg	0,358143
10	Solingen, krfr. St.	0,355480
11	Bad Tölz-Wolfratshausen	0,354417
12	Offenbach	0,351651
13	Darmstadt, krfr. St.	0,345167
14	Bodenseekreis	0,344225
15	Speyer, krfr. Stadt	0,343462
16	Fürstenfeldbruck	0,339916
17	Aachen	0,338475
18	Herford	0,338254
19	Segeberg	0,337696
20	Rottweil	0,333336
...		
308	Salzgitter, krfr. Stadt	0,050916
309	Werra-Meissner-Kreis	0,050894
310	Gifhorn	0,050387
311	Neuburg-Schrobenhausen	0,047102
312	Haßberge	0,046271
313	Cochem-Zell	0,046240
314	Trier-Saarburg	0,045116
315	Hersfeld-Rotenburg	0,045077
316	Schwalm-Eder-Kreis	0,041891
317	Uelzen	0,041881
318	Donnersbergkreis	0,039844
319	Wittmund	0,036625
320	Wolfsburg, krfr. Stadt	0,031505
321	Aschaffenburg, krfr. St.	0,030290
322	Kusel	0,025294
323	Regen	0,024462
324	Lüchow-Dannenberg	0,019536
325	Emden, krfr. St.	0,019303
326	Freyung-Grafenau	0,012302
327	Kitzingen	0,011511

Table 6: Regions ranked by startup intensity (startups 1989 – 1992 per population) of ICT industries (Hardware, software, consulting, database services)

Rank	***Region***	***ICT Industry Startup intensity***
1	München	2,519525
2	Offenbach	2,030401
3	Starnberg	1,835573
4	Ebersberg	1,561137
5	Karlsruhe, krfr. St.	1,483696
6	Freising	1,472786
7	Darmstadt, krfr. St.	1,423815
8	Hamburg	1,383457
9	Hochtaunuskreis	1,366637
10	Fürstenfeldbruck	1,332686
11	Wiesbaden, krfr. St.	1,319147
12	München, krfr. St.	1,309578
13	Aachen, krfr. St.	1,218066
14	Landsberg a. Lech	1,214881
15	Darmstadt-Dieburg	1,160630
16	Main-Taunus-Kreis	1,139757
17	Frankfurt a.M., krfr. St.	1,105130
18	Koblenz, krfr.Stadt	1,095390
19	Rheingau-Taunus-Kreis	1,091414
20	Offenbach a. M., krfr. St.	1,081712
...		...
308	Cloppenburg	0,241666
309	Wilhelmshaven, krfr. St.	0,241149
310	Emsland	0,234035
311	Lichtenfels	0,228346
312	Wesermarsch	0,225632
313	Trier-Saarburg	0,225581
314	Kelheim	0,224252
315	Bremerhaven, krfr. St.	0,221633
316	Salzgitter, krfr. Stadt	0,212148
317	Südwestpfalz	0,209798
318	Freyung-Grafenau	0,209128
319	Helmstedt	0,206010
320	Neustadt a.d. Waldnaab	0,202612
321	Kusel	0,202350
322	Wittmund	0,201439
323	Regen	0,195700
324	Cham	0,178735
325	Coburg	0,177571
326	Donnersbergkreis	0,159375
327	Cuxhaven	0,157092