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Entrepreneurship Capital – Determinants and Impact on Regional Economic Performance

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Abstract

We investigate what determines regions' entrepreneurial behavior and the impact of it on regional economic performance. We argue that economic knowledge differs not only from traditional factors of production due to its public goods characteristic but it is also uncertain. In that perspective, the role of entrepreneurship is to take on the corresponding risk by starting up a new firm. This implies knowledge spillovers, hence a positive impact on economic performance. We test this hypothesis using a production function approach using data on German regions. We estimate a two-equation system that regresses on both variables, entrepreneurship and economic performance, simultaneously. We find significant impact of entrepreneurship capital on economic output. On the other hand, spatially specific entrepreneurship capital is shaped by regional-specific factors. The extent of these findings differs for knowledge based and non-knowledge based measures of entrepreneurship capital.

JEL-Codes: M13, O32, O47

Keywords: Entrepreneurship, Economic Output, Production Function, Endogeneity Bias, Three Stage Least Squares

1 Introduction

The role of entrepreneurship in society has changed drastically over the last half century. During the post-World War II era, the importance of entrepreneurship and small businesses seemed to be fading away. While alarm was expressed that small business needed to be preserved and protected for social and political reasons, few

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made the case on the grounds of economic efficiency. Hence small firms and entrepreneurship were viewed as a luxury, perhaps needed by the west to ensure a decentralization of decision making, but in any case obtained only at a cost to efficiency (Pratten, 1971; Weiss, 1976). Moreover, SME were shown to provide lower levels of employee compensation (Brown and Medoff, 1989; Brown, Hamilton and Medoff, 1990), to be less engaged in foreign direct investment (Horst, 1972), to be less involved in innovative activities (based on R&D measures, see Audretsch, 1995) and consequently, the relative importance of SMEs was declining over time in both North America and Europe.

However, this trend has reversed in recent years. While in the US, the relative importance of SMEs, measured through average GDP per firm, decreased between 1947 and 1980, it has reincreased since then (Brock and Evans, 1989; Loveman and Sengenberger, 1991; Acs and Audretsch, 1993). Similar evidence is found when considering only the manufacturing industry (Acs and Audretsch, 1990). This trend reversal was not limited to North America. Audretsch *et al.* (2002) report that business ownership rate in the Netherlands decreased systematically until the beginning of the 1980's only to rise again since then. The same trend is found when measuring the importance of Dutch SMEs though employment shares (EIM, 2002). Similar evidence has been found for Western Germany, Portugal and Italy (Acs and Audretsch, 1993; Audretsch and Thurik, 2001).

Audretsch and Thurik (2001) argue that SMEs have become more important as the comparative advantage has shifted towards knowledge-based economic activity. This has occurred for two reasons. *First*, large enterprises in traditional manufacturing industries offering standardized products have lost their competitiveness in producing in the high-cost domestic countries. *Second*, small entrepreneurial enterprises take on new importance and value in a knowledge-based economy. Let us discuss these two arguments in turn.

The loss of competitiveness by large-scale producers in high-cost locations is manifested by the fact that, confronted with lower cost competition in foreign locations, producers in the high-cost countries have three options apart from doing nothing and losing global market share: (8) reduce wages and other production costs sufficiently to compete with the low-cost foreign producers, (9) substitute equipment and technology for labor to increase productivity, and (3) shift production out of the high-cost location and into the low-cost location. Many of the European and American firms that have successfully restructured resorted to the last two alternatives. Substituting capital and technology for labor, along with shifting production to lower-cost locations has resulted in waves of *Corporate Downsizing* throughout

Europe and North America. Indeed, it has become a kind of common knowledge among executives, consultants and professional associations that a firm has to dislocate its production in low cost countries e.g. in Eastern Europe or Latin America in order to maintain its competitiveness. This trend has led to a decrease in employment of large domestic firms while the same firms increased employment in low cost countries (e.g. BMWT, 1999, 2002 for Germany).

That SMEs would emerge as becoming more important in a knowledge-based economy seems to be contrary to many of the conventional theories of innovation. The starting point for most theories of innovation is the firm. In such theories the firms are exogenous, i.e. given, and their performance in generating technological change is endogenous (Arrow, 1962). For example, in the most prevalent model found in the literature of technological change, the model of the knowledge production function, formalized by (Griliches, 1979), firms exist exogenously and then engage in the pursuit of new economic knowledge as an input into the process of generating innovative activity. The most decisive input in the knowledge production function is new economic knowledge.

Knowledge as an input to production is inherently different than the more traditional inputs such as labor and capital. This is for two reasons. 1) Knowledge has a public goods characteristic and 2) the economic value of knowledge is intrinsically uncertain and its potential value is asymmetric across economic agents. The first aspect has been addressed and formalized within the endogenous growth theory (see e.g. Romer, 1990, p.S73). There, the most important, although not the only source of new knowledge is considered to be research and development (R&D). Other key factors generating new economic knowledge include (a high degree of) human capital, a skilled labor force, and a high level of research and development (Lucas, 1988; Romer, 1996). The dynamics of knowledge creation in these models lead to constant or increasing returns in production. However, these theories do not necessarily refer to returns at the level of observation most familiar in the industrial organization literature – the plant, or at least the firm – but rather at the level of a spatially distinguishable unit, say a national state, a region or an area. In fact, it is assumed that it is externalities across firms and even industries that yield convexities in economic activity on the regional level. Again, these theories assume firms to exist exogenously, i.e. being on a macro level, they do not consider the demography of firms.

The second aspect of knowledge differing from traditional production factors is uncertainty. The endogenous growth theory implicitly assumes that knowledge, once it has been generated, spills over more or less automatically to other firms.[1]

[1]This view has been challenged by the literature on absorptive capacity. See e.g. Cohen and

This is not the case. Transforming generally available new economic knowledge into viable new products or technologies requires investment with uncertain outcomes and therefore bears risks. Often, this investment is made by entrepreneurs. By starting up a business, an entrepreneur literally "bets" on the product he offers (or will be offering) and thus is willing to take the risk that this process bears. He or she do so, since they believe that the potential returns are greater than the potential losses. The economic implication of that process is transformation of generally available knowledge into a new product, which is the essence of *knowledge spillovers*. Hence entrepreneurship can be considered as an important, though in our view neglected mechanism in the transmission of knowledge and the actual spillover process. Acs *et al.* (2003) refer to the gap between knowledge and commercialized knowledge as the 'knowledge filter'. By commercializing ideas that otherwise would not be pursued and commercialized, entrepreneurship serves as one mechanism facilitating the spillover of knowledge. Thus, entrepreneurship capital promotes economic performance by serving as a conduit of knowledge spillovers.

2 Entrepreneurship Capital and its Impact

The literature identifying mechanisms that actually transmit knowledge spillovers is sparse and remains underdeveloped. In the process described above, we have identified entrepreneurship as one possible transmission mechanism. Entrepreneurship has been defined as consisting of two criteria. The first involves the state of (asymmetric) knowledge and is the ability of economic agents to recognize economic opportunities that can only or best be realized through the creation of a new enterprise. The second criterion involves economic behavior and specifically the creation of a new enterprise to appropriate the economic value of that knowledge. 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.

If this mechanism holds, entrepreneurship will have a positive impact on economic performance. In their study, Audretsch and Keilbach (2004b) identify two more channels how entrepreneurship might influence economic performance. One involves the increase in competition emerging from entrepreneurship. As Jacobs (1979) and Porter (1990) emphasize, the impact on competition from entrepreneurship may be more in the input market for new ideas than in the product mar-

Levinthal, 1990.

ket. Another mechanism involves the increased diversity in a region contributed by entrepreneurship. Glaeser *et al.* (1992) argue and support the theory that an increased amount of diversity in a region is conducive to a superior economic performance. Thus, entrepreneurship capital has a threefold impact: it facilitates knowledge spillovers, an increase in competition, and increased diversity in a region, all of which contribute to economic growth.

The purpose of this paper is to investigate this relationship i.e. to link entrepreneurship to economic performance. To remain consistent with and to connect to the above literature, we define the notion of *entrepreneurship capital* of an economy, a region or a society as being a regional milieu of agents and institutions that is conducive to the creation of new firms. This involves a number of aspects such as social acceptance of entrepreneurial behavior but of course also individuals who are willing to deal with the risk of creating new firms[2] and the activity of bankers and venture capital agents that are willing to share risks and benefits involved. Hence entrepreneurship capital reflects a number of different legal, institutional and social factors and forces.[3] Regions with a high degree of entrepreneurship capital facilitate the startup of new firms based on uncertain and asymmetric ideas. On the other hand, regions with a low degree of entrepreneurship capital impede the ability of individuals to start new firms. Entrepreneurship capital promotes the spillover of knowledge by facilitating the startup of new firms.

Above, we argued that a high endowment of a region with entrepreneurship capital can be expected to increase that region's economic performance. However, the opposite relationship can be expected to hold as well: A strong economic performance of a region will increase that region's entrepreneurship capital since it implies a higher level of entrepreneurial opportunities. Then a unidirectional analysis would lead to biased results. Therefore, in this paper we consider simultaneously the impact of entrepreneurship capital on regional economic performance and vice versa. However, the virtue of this approach is not only in the correction of the statistical bias. While the emergence of a statistical link between economic performance and entrepreneurial activity is of considerable interest to both scholars and policy makers alike, it considers the amount of entrepreneurial activity specific to a region as an exogenous endowment. By explicitly instrumenting entrepreneur-

[2] 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."

[3] In that respect the notion of entrepreneurship capital is close to the one of social capital (e.g. Putnam, 1993), though not identical. See Audretsch and Keilbach (2004a) for an in-depth discussion of this issue.

ship capital in a second equation, we are able to analyze how policy could actually influence economic performance by generating more entrepreneurial activity.

With this approach, we implicitly link to disparate literatures. On the one hand is a series of studies, dating back at least to Carlton (1983) and Bartik (1989) and more recently Reynolds, Storey and Westhead (1994), which have tried to identify characteristics specific to particular regions that account for inter-spatial variations in entrepreneurship. On the other hand is a literature that has examined the impact of entrepreneurship on the economic performance of that region. Most recently this has generated a series of studies suggesting that economic growth is systematically and positively related to the degree of entrepreneurial activity across geographic space (see Acs and Storey, 2004 and the subsequent articles in that volume).

In the following section, we estimate this relationship using a production function framework. When combined with the more traditional factors of production – labor and physical capital – we expect entrepreneurship capital to have a positive impact on economic performance. There we discuss issues involving the measurement of entrepreneurship capital, as well as the more traditional factors. A three-stage regression model estimating, first, entrepreneurial activity, and then economic performance is presented in the fourth section. Finally, in the last section a summary and conclusion are provided. In particular, the empirical evidence suggests that the degree of spatially specific entrepreneurship capital is shaped by regional-specific factors that vary significantly between technology-oriented entrepreneurship and more general or non-technological ("low-tech") entrepreneurship. In turn, the extent of entrepreneurship capital has a positive impact on regional economic performance.

3 Modeling Impact and Determinants of Entrepreneurship Capital

3.1 Theoretical Underpinning

Consider the Romer (1990) growth model. The production function is

$$Y = K^{\alpha} \left(A L_Y \right)^{(1-\alpha)} \tag{1}$$

with the capital accumulation equation

$$\dot{K} = s_K Y - \Delta K \tag{2}$$

and the R&D-sector

$$\dot{A} = \bar{\delta} L_A . \tag{3}$$

$\bar{\delta}$ is the *discovery rate* of new ideas with

$$\bar{\delta} = \delta L_A^{\lambda-1} A^{\phi}, \tag{4}$$

where λ denotes returns to scale in R&D and ϕ is a parameter that expresses the intensity of *knowledge spillovers*. Inserting (4) into (3) we obtain the rate of creation of new knowledge (the rate of endogenous technical change) is

$$\dot{A} = \delta L_A^{\lambda} A^{\phi} \tag{5}$$

New knowledge $\dot{A}$ is uncertain and therefore only a share $\theta \in [0, 1]$ will be transferred into viable new products within incumbent firms *in*. We denote θ as *knowledge filter*. Hence we have

$$\dot{A}_{in} = \theta \cdot \delta L_A^{\lambda} A^{\phi} \tag{6}$$

The remaining "untapped" part $(1 - \theta)$ are opportunities op that can be taken on by new firms. We denote this part *entrepreneurial opportunities*. Hence we have

$$\dot{A}_{op} = (1 - \theta) \cdot \delta L_A^{\lambda} A^{\phi} \tag{7}$$

From this simple extension of the Romer model we can derive a number of hypotheses.

Endogenous Entrepreneurship Hypothesis: Entrepreneurship opportunities will be greater in the presence of higher investments in new knowledge ceteris paribus.

Investments in new knowledge are denoted L_A within the model. Deriving (7) we obtain

$$\partial \dot{A}_{op} / \partial L_A = (1 - \theta) \cdot \delta \lambda L_A^{\lambda-1} A^{\phi}$$

which is greater than 0 for all L_A. □

Business Performance Hypothesis: Opportunities for knowledge based entrepreneurship and therefore performance of knowledge based startups is superior when they are able to access knowledge spillovers through geographic proximity to knowledge sources such as universities, when compared to their counterparts without a close geographic proximity to a knowledge source

Deriving $\dot{A}_{op}$ with respect to A^{ϕ} we obtain

$$\partial \dot{A}_{op} / \partial A^{\phi} = (1 - \theta) \cdot \delta L_A^{\lambda}$$

which is greater than 0 for all L_A. □

Economic Performance Hypothesis: Entrepreneurial activity will increase the level of economic output since entrepreneurship serves as a mechanism facilitating the spillover and commercialization of knowledge.

On the basis of the arguments given above, we state production function (1) as

$$Y = K^{\alpha}(\theta_r A)^{(1-\alpha)} L_Y^{(1-\alpha)}$$

denoting θ_r the *actual level* of the knowledge filter, i.e. that level that includes the part of $(1-\theta)$ that has been taken on by start up firms. Hence we have $\theta \leq \theta_r \leq 1$. An increase in entrepreneurial activity increases θ_r and therefore the distance between θ and θ_r. Deriving

$$\partial Y / \partial \theta_r = (1-\alpha)\theta_r^{-\alpha} K^{\alpha} A^{(1-\alpha)} L_Y^{(1-\alpha)} = \frac{(1-\alpha)}{\theta_r} Y$$

which is greater than 0 for all Y, hence GDP increases with entrepreneurial activity. $\square$

3.2 Empirical Test

To test these hypotheses empirically we set up an augmented production function that includes entrepreneurship capital explicitly. On this basis we are able to test the impact of entrepreneurship on one hand and what drives the level of entrepreneurship on the other hand. The first equation is a Cobb-Douglas function of the form

$$Y_i = K_i^{\alpha} L_i^{\beta} R_i^{\gamma} E_i^{\delta}, \tag{8}$$

where Y_i is economic performance of region i, measured as GDP, K_i is region's i endowment with capital, L_i is labor, R_i is region i's R&D intensity and E_i represents the region's endowment *entrepreneurship capital*. Hence, this specifies formally that entrepreneurship capital contributes to the economic output of regions. With equation (8) our approach is an extension to the one chosen by Mankiw, Romer and Weil (1992, p.416) who emphasize the impact of regions' human capital while we focus on entrepreneurship capital.

The specification of equation (8) assumes implicitly that entrepreneurship capital is exogenous. However, as argued above, the inverse causal relationship is also at work, i.e. entrepreneurship capital and regional performance are linked recursively. We specify a second equation in order to take this recursive structure explicitly into account. In its general form, this equation takes the form

$$E_i = f(\mathbf{y}_i, \mathbf{x}_i), \tag{9}$$

where $\mathbf{y}_i$ is a vector of measures of region's i economic performance and $\mathbf{x}_i$ is a vector of other variables influencing entrepreneurial activity. These variables are specified in detail in the following section. We estimate this set of equations simultaneously using three stage least square to correct for a simultaneity bias (e.g. Intriligator *et al.*, 1996 or Greene, 2000).

The specification suggested here has also a political dimension. While equation (8) specifies our hypothesis of a positive impact of entrepreneurship capital on economic performance, it does not give any hindsight for policy makers on what actually drives a regions' endowment with this form of capital. Equation (9) will give evidence in this direction.

4 Measurement Issues

4.1 Measuring the impact of entrepreneurship capital

We measure the variables used in equation (8) as follows, all measured being for 2000 where not mentioned otherwise. *Output* is measured as Gross Value Added of the manufacturing industries corrected for purchases of goods and services, VAT and shipping costs. The stock of *Physical 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 investments done in the producing sector in the period 1980 to 2000. For a more detailed description of this procedure see e.g. Audretsch and Keilbach (2004b). Statistics including Output and investment are published every two years on the level of *Kreise* by the Working Group of the Statistical Offices of the German Länder, under "Volkswirtschaftliche Gesamtrechnungen der Länder". *Labor* is expressed as the number of employees in the manufacturing industries. This data is published by the Federal Labor Office, Nürnberg that reports number of employees liable to social insurance on the Level of German counties (Kreise). R_i, the regions' *R&D Intensity*, is measured as the number of non-public R&D-employees in all industries in 1999 relative to our measure of labor. This data has been provided by the Stifterverband für die Deutsche Wissenschaft.

Measurement of *Entrepreneurship Capital* presents a challenge since many of the elements that determine entrepreneurship capital in our definition defy quantification. Hence, just as condensing the heterogeneity of production capital or labor qualifications into a single measure respectively, creating a metric for entrepreneurship capital invokes numerous assumptions and simplifications. 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, the latter being an unobservable (i.e. latent) variable. *Ceteris paribus*, higher startup rates reflect higher levels of entrepreneurship capital. We compute entrepreneurship capital 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. From the background of our definition of entrepreneurship capital, alternative measures would be possible. A number of aspects of this definition being difficult to quantify, a natural candidate would be a region's stock of young firms. However, this measure would implicitly reflect exit and shake-out dynamics. Hence a measure along these lines would inevitably be influenced by factors external to entrepreneurship capital such as quality of management or business ideas and thus be biased. We therefore consider the number of startups as being the most appropriate measure of entrepreneurship capital.

While opportunity recognition is probably inherent in entrepreneurial activities of all industries, the aspects of knowledge discussed above are more implicit in knowledge-based entrepreneurship. To grasp this difference, we consider four different measures of entrepreneurship capital. The first one considers simply start-ups in *all* industries. More than 50 percent of these start-ups are in the retail and catering sectors, i.e. shops and restaurants. Figure 1 depicts the spatial distribution of this measure.

We then consider two knowledge based measures of entrepreneurship capital, the first being start-ups in the high-tech industries, i.e. industries with an average R&D-intensity of more than 2.5%.[4] Start-ups in these industries account for 7.5% of all start-ups in average, ranging from 1.6% to 17.9% within German counties (Kreise). A second measure of knowledge based entrepreneurship capital is start-ups in the ICT-industries. This sub aggregate represents a mix of startups in ICT oriented manufacturing and service industries. Our observation period has been very dynamic in terms of startup activities in these industries and 7.7 percent of all startups have been made in these industries, ranging from 1.5% to 19.0% over the regions. As a "counterfactual" we consider the aggregate of the remaining industries, which we denote "low-tech" entrepreneurship capital. 63 to 95 % of all start-ups are in these industries (85% in average of all counties). The notion "low-tech" refers to the average R&D intensity of the industry and not to the actual R&D intensities of the firm, this is due to unavailability of corresponding data.

The data on startups is taken from the ZEW foundation panels that are 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 Reg-

[4]Here, we follow the classifiation used in the reports to the Federal Ministry of Education and Research. See e.g. Grupp and Legler (2000).

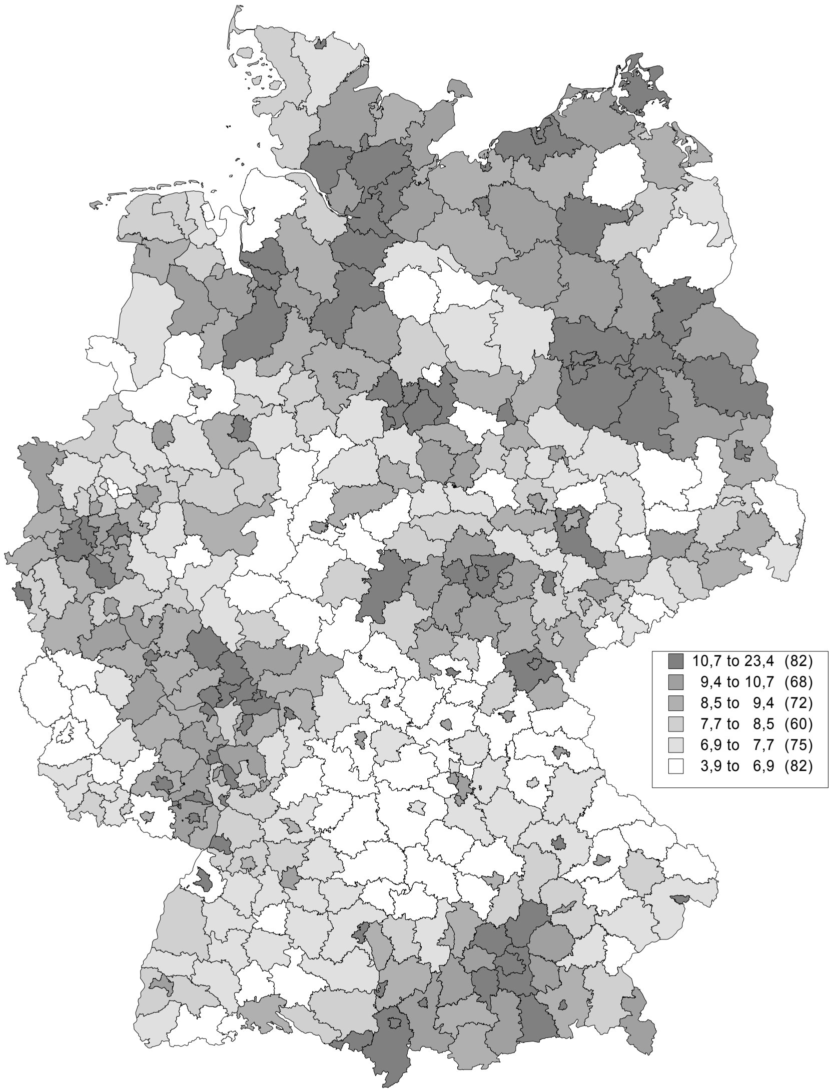

Figure 1: Entrepreneurship Capital in German counties expressed as startups of new firms in all industries 1998 to 2000 relative to the counties' population

Table 1: Correlations between different measures of Entrepreneurship Capital and between Population Density

	PopDens	General	High-Tech	ICT
General	0.3419			
	(0.000)			
High-Tech	0.4325	0.6515		
	(0.000)	(0.000)		
ICT	0.4147	0.6063	0.8411	
	(0.000)	(0.000)	(0.000)	
"Low-Tech"	0.2638	0.9714	0.4667	0.4110
	(0.000)	(0.000)	(0.000)	(0.000)

p-values of a t-test of correlations to be stochastically different from zero in brackets ister, especially for firms with large credit requirements as e.g. high-technology firms.[5] As of 2000, there were roughly 5 million entries for Germany, covering the period 1989 to 2000. 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 from 1998 to 2000 (covering 780,000 startups).

Table 1 shows correlations between these measures of entrepreneurship capital as well as between these measures and population density. This table shows that both knowledge-based variables are strongly correlated while the correlation between these and the "low-tech" measure is much weaker. On the other hand, our general measure of entrepreneurship capital and the "low-tech" measure are strongly correlated. This is probably simply due to the large proportion of "low-tech". It is also noteworthy, that all variables are significantly correlated with population density of regions, however the correlation of the knowledge based measures is stronger.

4.2 Assessing the Determinants of Entrepreneurship Capital

A priori, there are two groups of factors that shape the extent of entrepreneurship capital: (1^{st}) the generation of regional specific opportunities for entrepreneurial activity and (2^{nd}) a favorable general economic situation. Simply spoken, while the first set of factors increases entrepreneurial opportunities through the creation and adoption of new knowledge, the second set of factors is responsible for the creation of a fertile environment i.e. an absence would impede the creation of new firms (i.e. reduce the entrepreneurship capital) even if opportunities were abundant.

4.2.1 Factors creating or stimulating entrepreneurial opportunities

Economic Output. Above we argued that while entrepreneurship capital can be expected to drive economic output, the inverse relationship might hold as well. Large economic output implies a large market size, hence a high intensity in economic exchange and therefore a high level of entrepreneurial opportunities. Including the regions' level of Gross Value Added of the Manufacturing Industries we proxy the level of this opportunities in a very general sense. With this variable, we include the dependent variable of equation (8) as explanatory variable in equation (9) in log form.

[5] 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.

Strong economic *GDP Growth* of a region implies increasing wealth, increasing market size, increasing intensity in economic exchange and consequently increasing general opportunities for new businesses. Since it measures the increase in the general economic activity, this variable proxies again general entrepreneurial opportunities. We compute this variable as $g_Y = \ln(Y_{t_1} - Y_{t_0})/(t_1 - t_0)$, with $t_0 = 1992$ and $t_1 = 2000$, measuring a region's average growth rate between years 1992 and 2000. Rather than the stock measure of GDP, GDP growth is a measure of the regions' past economic performance. We assume that nascent entrepreneurs derive their expectations about the future regional evolution from this past performance.

With *R&D Intensity*, we describe the regions' potential of creating new knowledge. We assume that a high regional R&D activity increases regional opportunities to start-up new knowledge-based businesses by the mechanisms described in section 2. This variable is more specific as compared to mere GDP growth and we therefore expect a positive impact of this variable on a region's level of knowledge-based entrepreneurship capital.

Table 1 indicates that entrepreneurship capital is positively correlated with *Population Density*. Glaeser *et al.* (1992) and Ciccone and Hall (1996) argue that spatial density, hence proximity, increases labor productivity. Similarly, we expect that in densely populated regions, ideas and knowledge flow faster and the provision of ancillary services and inputs is also greater; therefore entrepreneurial opportunities are generated faster and can be appropriated more easily by economic agents. Hence, entrepreneurship capital should be higher in more densely populated regions than in less densely populated regions.

4.2.2 Factors influencing the general economic situation

Investment in Manufacturing Ind. This variable measures the investment in physical capital in the producing sector without the mining industry of firms with more than 20 employees (measured in 1999). There are three mechanisms to be expected in relation with this variable. The first is that, just as GDP growth, investment reflects trust in the economic future of the region. Hence we would expect a positive correlation between a region's level of investment and its entrepreneurship capital. The second effect is a "crowding out" effect: Investment as measured here, represent pursuing economic opportunities within incumbent firms rather than in startups. If this effect dominates, we would expect a negative correlation between a region's level of investment and its entrepreneurship capital. The third effect is a structural effect: Investments in the manufacturing industry are strong where the manufacturing industry is strong. If there is a spatial path dependent process in the sense that start-ups in these industries are stronger where incumbents of the same firm are located, we would expect a positive sign for the high-tech manufacturing start-ups.

Regional and national authorities use different subsidy schemes as instruments to achieve economic policy goals. Our variable *Subsidies per person* measures the sum of all subsidies that were spent in the respective region, relative to the region's population. Start-up funding is only one among a large number of schemes. With this variable, we aim to describe the economic situation of each region and not to investigate the effectiveness of start-up funding, this would require other methodologies.[6]

Unemployment Rate. That unemployment is linked to entrepreneurship dates back at least to Oxenfeldt (1943), who pointed out that individuals confronted with unemployment and low prospects for wage employment turn to self-employment as a viable alternative. This was an extension of Knight's (1921) view that individuals make a decision among three states – unemployment, self-employment and employment. The actual decision is shaped by the relative prices of these three activities but there was a clear prediction that entrepreneurship would be positively related to unemployment. However, as Storey (1991) documents, the empirical evidence linking unemployment to entrepreneurship is fraught with ambiguities. While some studies find that greater unemployment serves as a catalyst for startup activity (Evans and Jovanovic, 1989; Yamawaki, 1990; Evans and Leighton, 1990; Reynolds *et al.*, 1994; Reynolds, Miller and Maki, 1995), still others have found that unemployment reduces the amount of entrepreneurial activity (Audretsch and Fritsch, 1994; Audretsch, 1995). We test this relationship for our data including the regional unemployment rate in our regressions.

We also aim to investigate whether a high tax-burden reduces the propensity to start up a new business hence the regions' entrepreneurship capital. Generally, the German tax system does not make regional distinctions with the exception of Business Tax, whose multiplier, hence level, is fixed by regional authorities. With these taxes, regional authorities finance their local budget. Consequently, there are two points in relation with the regional business tax. While one side argues that a high business tax prevents firms to settle in the high tax multiplier, rather settling in other regions, the other side argues that the corresponding services attract the firms. We test these arguments by including the *regional business tax multiplier* in the regressions.

Florida (2002) has argued that *social diversity* in a society is a proxy for the open-

[6] The impact of funding schemes can e.g. be measured using microeconometric evaluation procedures, e.g. Arvanitis and Keilbach (2002).

ness of this society with respect to new ideas. Such openness is important in an environment where new ideas are transformed into business ideas and ultimately to new firm startups. Thus, openness contributes to the entrepreneurship capital of that society by enhancing new ideas and the spillover of knowledge. We measure social diversity with an entropy index of the voting behavior on the occasion of the last parliament vote (1998). The measure takes into account all major political parties but also smaller ones. We transform the entropy index to [0,1] such that 0 indicates maximum and 1 indicates no variety.

Industrial Diversity. In the 1990ies there was a debate on what type of spatial industry concentration serves as the stronger 'engine to growth': strong concentration of industries (leading to 'Marshall-Arrow-Romer' type of externalities) or strong variety of industries (leading to 'Jacobs' type of externalities).[7] The empirical literature[8] did not come to an unanimous conclusion, suggesting that both effects are important depending e.g. on the life cycle of the industry. These two types of externalities describe two different concepts on how generally available new economic knowledge is transformed into viable products. Both concepts are then important in the entrepreneurial process described above. We test which one of both effects dominates by including a Herfindahl index of Industrial Diversity in the regressions.

Let us finally consider the impact of *Locational Attractiveness*. It has often been argued (e.g. Saxenian, 1994) that one of the factors that made Silicon Valley happen was the attractiveness of the place. We investigate if a similar process can be observed for our measures of entrepreneurship, by including a proxy for locational attractiveness: the number of a county's hotel beds relative to its surface.

5 Estimation Results

The top part of Table 2 shows the regression results of equation (8), the bottom part those of equation (9), both estimated simultaneously using three stage least squares. The four columns represent estimates including one out of the four measures of entrepreneurship capital respectively.

[7] This description is very simplified. See e.g. the literature in the following footnote for more detailed descriptions of the underlying processes. Keilbach (2000) gives a summary of this discussion.

[8] See e.g. Glaeser *et al.*, 1992; Henderson *et al.*, 1995; Henderson, 1997 or Ellison and Glaeser, 1997.

Table 2: Estimating Entrepreneurship and Economic Performance

	Dependend Variable: GDP of Counties			
Constant	1.2234*** (0.001)	0.3683 (0.284)	-0.5918* (0.051)	1.3101*** (0.001)
Capital	0.1190*** (0.000)	0.1344*** (0.000)	0.1296*** (0.000)	0.1031*** (0.000)
Labor	0.7892*** (0.000)	0.7338*** (0.000)	0.7462*** (0.000)	0.8228*** (0.000)
R& D Intensity	0.0155*** (0.002)	0.0199*** (0.000)	0.0302*** (0.000)	0.0180*** (0.000)
General Entrepreneurship	0.5511*** (0.000)			
High-Tech Entrepreneurship		0.1848*** (0.000)		
ICT Entrepreneurship			0.0605** (0.047)	
"Low-Tech" Entrepreneurship				0.5842*** (0.000)
Pseudo R^2 p-value	0.931 (0.000)	0.941 (0.000)	0.940 (0.000)	0.928 (0.000)
	Dependend Variable: Entrepreneurship Capital			
	General	*High-Tech*	*ICT*	*Low-Tech*
GDP	-0.0047 (0.803)	0.0296 (0.302)	-0.0153 (0.575)	-0.0114 (0.558)
GDP Growth	0.3209*** (0.000)	0.5009*** (0.000)	0.0460 (0.727)	0.3183*** (0.000)
R&D Intensity	0.7009 (0.391)	5.2692*** (0.000)	5.3511*** (0.000)	-0.2553 (0.760)
Population Density	1.3090*** (0.000)	2.3709*** (0.000)	2.0305*** (0.000)	1.1665*** (0.000)
Investment in Manufacturing Ind.	-0.0010* (0.058)	-0.0009 (0.247)	0.0004 (0.632)	-0.0010* (0.058)
Subsidies per Person	0.0008 (0.771)	-0.0002 (0.971)	-0.0099** (0.015)	0.0014 (0.609)
Unemployment Rate	-0.0011 (0.716)	-0.0446*** (0.000)	-0.0522*** (0.000)	0.0053* (0.096)
Regional Tax Multiplier	-0.1036*** (0.003)	-0.0651 (0.229)	-0.0889* (0.087)	-0.1028*** (0.004)
Social Diversity Index	-0.1192 (0.306)	-1.1235*** (0.000)	-0.1958 (0.258)	-0.0335 (0.777)
Industry Diversity Index	0.8762*** (0.000)	1.1358*** (0.000)	1.2827*** (0.000)	0.8474*** (0.000)
Locational Attractiveness	0.0794 (0.443)	-0.0647 (0.687)	0.2487 (0.106)	0.0675 (0.521)
Constant	-5.5907*** (0.000)	-7.8634*** (0.000)	-8.0643*** (0.000)	-5.8014*** (0.000)
Pseudo R^2 p-value	0.258 (0.000)	0.498 (0.000)	0.639 (0.000)	0.230 (0.000)
Number of Obeservations	429	429	429	429

Notes: p-values 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*

5.1 On the Impact of Entrepreneurship Capital on Regional Economic Performance

The regressions of the production function show throughout positive and significant results for the production factors. The estimates for capital and labor are in the usual range, they are close to the one that have been reported by Cobb and Douglas (1928) and numerous production function regressions that followed. The result for R&D intensity is also significant and positive throughout as was expected from the discussion above. The coefficients of entrepreneurship capital are positive and significant. This confirms our hypothesis of entrepreneurship capital creating a positive impact on regions' economic performance.

5.2 On the Variables influencing Entrepreneurship Capital

The regressions of variables on the four different measures of entrepreneurship capital are given in the bottom part of Table 2. Some of the variables show different impact on the different measures of entrepreneurship capital. It is also remarkable that the share of explained variance (expressed through the pseudo R^2) is more than twice as large for the knowledge-based measures of entrepreneurship capital. Apparently, the chosen model is more appropriate for knowledge based start-up processes. Since the R^2 of the second equation expresses the fit for equation (8) in the second step of the regression, a higher R^2 implies that the 3SLS approach is more appropriate and the results are more reliable (Intriligator *et al.*, 1996, 10.5). Let us discuss the regression results in turn.

The GDP measures show different behavior. While the contemporary stock measure of *GDP* does not show any significant influence on the agents' propensity to start up a new firm (hence on the regions' entrepreneurship capital) *GDP growth* does so. This is even more so, for the high-tech oriented measure. Here, an increase of GDP growth by one percentage point will increase the region's start-up rate by roughly 50%. On the other hand, GDP growth apparently does not have an impact on the regions' ICT startups. We assume that this is due to the fact that ICT startups were especially strong in the late 1990'ies and probably decoupled from macroeconomic trends.

The impact of our more specific measure of economic opportunity, *R&D-intensity*, is positive and significant for the knowledge-based measures of entrepreneurship capital while it is insignificant for the others. Hence R&D creates localized generally available knowledge and thus opportunities for knowledge based entrepreneurship. We see this as evidence for our arguments given in section 1.

Entrepreneurship capital is stronger in regions with high *population density*. Apparently, the propensity to start up a new firm is larger in cities and surrounding areas. This effect is roughly twice as large for the knowledge based measures of entrepreneurship capital. Along with the arguments given in section 1, we take this as evidence that spatial proximity increases the dissemination of publicly available knowledge and thus increases the opportunities for entrepreneurship.

Let us now turn to the class of variables that are responsible for the creation of entrepreneurial opportunities. While dynamic economic growth stimulates the regions' entrepreneurship capital, *capital investment* shows a weakly significant negative impact on "low-tech" entrepreneurship capital and correspondingly on the overall measure. It does not influence the knowledge-based measures of entrepreneurship. The negative sign indicates that the substitution effect dominates the other two effects mentioned above, i.e. strong investment of incumbent firms can be considered as a substitute for entrepreneurial opportunities.

The level of *subsidies* does not have a significant impact on the regions' entrepreneurship capital, for ICT start-ups the impact is even negative. Investigating the statistical basis for this finding we noted that subsidies are negatively correlated with regions gross value added, positively correlated with regional GDP growth and investment and at the same time negatively correlated with population density (i.e. they are relatively larger in weakly populated areas). We therefore assume that the insignificance is due to statistical effects through multicollinearity. Hence we should be careful in interpreting this result as evidence against a positive impact of subsidy schemes. Nevertheless, the fact that subsidies do not show strong positive impact on startups should be investigated further using e.g. microeconometric evaluation methods (e.g. Arvanitis and Keilbach, 2002). We leave this for further research.

An interesting effect occurs when considering the effect of the local *unemployment rate*. While for the general measure of entrepreneurship capital we do not observe a significant impact of unemployment rate, the impact of regional unemployment is significantly negative for the high-tech oriented measures and significantly positive for the "low-tech" measure. We conclude from this finding that the relationship between unemployment and entrepreneurship has actually two faces: Start-ups in the "low-tech" industries have been generated out of unemployment. Apparently this has been chosen as a strategy for self-employment out of a state of unemployment. High-tech start-ups, however, do not follow this strategy. The high qualification that is necessary to start up a firm in a high tech industry simply does not match the knowledge structure of regions with high unemployment. Rather, high regional unemployment reflects a lack of opportunities for knowledge-based start-ups. Therefore a policy measure that aims to encourage knowledge-based start-ups out of unemployment is probably doomed to fail.

The regression results for the *regional business tax multiplier* show a strongly significant negative impact on the startup-intensity (the regional entrepreneurship capital) for our measure of "low-tech" entrepreneurship capital as well as for the general measure. ICT start-up activities are less though still negatively affected, while high-tech start-up activities are insensitive with respect to this tax burden. Obviously, the decision to start-up or where to locate a non high-tech firm is not influenced by the regional tax burden. It is rather influenced by other factors (such as the regional R&D-intensity that has been discussed above). If these factors are present, an entrepreneur will accept higher tax burden. ICT-start-ups show a more intermediate behavior, which is discussed below.

Considering the two diversity measures, *social diversity* does not seem to play a general impact on the regions' entrepreneurship capital. It is insignificant for all but high-tech entrepreneurship capital. For that case, increasing social diversity has s positive and significant impact. We take this as confirmation of the arguments of Florida (2002), i.e. a high level of social tolerance is positively correlated with the acceptance of new ideas and thus increases a region's entrepreneurship capital. The positive and significant sign of *industry diversity* implies that strong industry concentration has a positive impact on the regions' propensity to start up new businesses. Hence we find external effects of the Marshall-Arrow-Romer type as having a positive impact on the regions' entrepreneurship capital.

Let us finally consider the impact of *locational attractiveness*. We do not find significant impact for this variable on the regions' entrepreneurship capital. on to have an influence on the decision to start up a new business. The results are insignificant for all but the ICT-oriented measure of entrepreneurship capital.

5.3 Overall Findings

Overall, a rather heterogeneous picture emerges for the different types of entrepreneurship capital. *"Low-tech" entrepreneurship capital*, covering 85% of all entrepreneurial activity, is larger in regions with strong economic performance. It is strongly positively correlated with the regional unemployment rate. On the other hand, this type of entrepreneurship capital is weaker in regions with a high business tax multiplier, with a high level of investment in the manufacturing industries and with high industry diversity. It is uncorrelated with subsidies, with locational attractiveness and with the regional R&D intensity. Still it has a positive impact on regional economic output.

High-tech entrepreneurship capital shows a different behavior. While it is positively correlated with GDP growth, it is also strongly positively correlated with R&D intensity and stronger in regions with a large social diversity. On the other hand, this type of entrepreneurship capital is negatively correlated with regional unemployment; it is uncorrelated with investment in the manufacturing industry and with the regional tax multiplier.

Just as high-tech entrepreneurship capital, *ICT oriented entrepreneurship* capital is positively correlated with the regional R&D intensity, hence a strong regional R&D-intensity has a positive impact on knowledge based entrepreneurship capital but no impact on entrepreneurship capital in the other industries. Unlike high-tech however, ICT start-ups are sensitive with respect to the locational attractiveness and insensitive with respect to the general economic situation (GDP growth). Also, it is insensitive with respect to social diversity but stronger in regions with lower level of industry diversity.

6 Summary and Conclusions

In this paper we address two questions: *How does entrepreneurship impact regional economic performance?* and *What explains the spatial distribution of entrepreneurial activity?* Both questions are interrelated and we therefore address them simultaneously. This link implies that entrepreneurship capital is on the one hand an independent variable explaining economic performance. On the other hand, start up activity is driven by a regions' economic performance, hence entrepreneurship capital and economic performance are endogenous variables and a single equation estimation would lead to an endogeneity bias. To correct for this bias, we specified a two equation model that was estimated using three stage least squares error correction. While the first equation explains regional economic performance as a function of the regions' endowment of physical capital, labor, R&D intensity and entrepreneurship capital, the second equation explains the regional level of entrepreneurship capital as a function of regional economic performance and other variables shaping entrepreneurship capital.

Based on a data set consisting of 440 German counties (*Kreise*) we are able to provide empirical evidence suggesting that entrepreneurship capital exerts a significant and strongly positive impact on regional economic performance. We also find that the regional R&D intensity has this same impact.

To explain the level of entrepreneurship capital on the basis of the second equation, we use different measures of entrepreneurship capital: high-tech oriented, ICT-oriented, "low-tech" and a measure that comprises all start-ups, hence a general measure. Regressing these measures on a set of explaining variables returns diverse results for each of them.

In general, entrepreneurship capital is greater in regions exhibiting a stronger economic performance. Regions with large investments in existing firms tend to have lower levels of entrepreneurship capital. Regional unemployment fosters start-ups in "low-tech" industries but decreases the region's propensity to engage into knowledge-based start-ups. The regional level of subsidies does not influence significantly the entrepreneurial behavior, while a high level of business tax is positively correlated with the regions' entrepreneurship capital. The attractiveness of a region does not have a significant impact on the decision to start up a business in an established industry or in "low-tech" industries; it has had a slightly positive effect on the location decision of ICT start-ups.

A strong regional R&D-intensity has a positive impact on knowledge based entrepreneurship capital but no impact on entrepreneurship capital in the other industries. Moreover, a high population density has a positive impact on entrepreneurship capital, which is especially marked for knowledge-based entrepreneurship. Finally, a large social diversity of a region, which we consider as proxy for tolerance, increases the propensity to start-up high tech firms hence the regions' high-tech entrepreneurship capital. On the other hand, entrepreneurship capital is higher in regions with a strong industry concentration, i.e. entrepreneurship capital benefits stronger from Marshall-Arrow-Romer type of localized knowledge spillovers.

From these findings, the following overall picture emerges. The creation of new technological opportunities through R&D increases the regions' economic performance directly but also via the increase of the regions' entrepreneurship capital which in turn also increases the regions' economic performance. This is consistent with our argument that entrepreneurship is a way to transform generally available economic knowledge into new products. We conclude from these findings that entrepreneurship plays an important role in the knowledge spillover process. This spillover process is more marked in densely populated regions and where an industry is strongly concentrated, i.e. where there is stronger exchange of ideas within firms of the same industry. These processes are enforced in a generally strong economic environment i.e. one with strong economic growth and low unemployment rate. In these regions, we cannot find evidence for subsidies to increase regional entrepreneurship capital. Entrepreneurship in "low-tech" industries does not benefit from these processes, this form can rather be considered as a strategy for unemployed to improve their situation. Nevertheless, "low-tech" entrepreneurship capital has a positive impact on regional economic performance.

The policy implications of these findings are straightforward. Generally, a region's capacity to create new firms does have a positive impact on that region's economic performance. This provides an "ex-post rationale" for the declared objectives to increase the start-up activities in the region. In a region with high level of R&D and low level of unemployment this objective should rather be targeted towards knowledge-based entrepreneurship. There, entrepreneurship plays an important role in the creation of new products or technologies from publicly available technological knowledge. In regions with a high level of unemployment and low R&D intensity, policy should rather focus on "low-tech" entrepreneurship; a policy that aims to foster knowledge-based entrepreneurship to strengthen the economic basis in such a region can be expected to fail its objectives.

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