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Determinants and Impact**

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Entrepreneurship Capital: Determinants and Impact

David B. Audretsch^{a b} and Max Keilbach^a

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Abstract

The literature focusing on the geography of entrepreneurship has developed something of a schizophrenic approach. On the one hand is a series of studies, 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. 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. Thus, little guidance is provided as to how policy could actually influence economic performance by generating more entrepreneurial activity.

The purpose of this paper is explicitly link these two disparate literatures by suggesting that entrepreneurial activity is not exogenous, as this second strand of literature implies, but rather, as the earlier studies indicated, shaped by a number of factors specific to the particular location. Moreover, if entrepreneurship capital cannot be assumed to be exogenous, a single equation estimation would lead to biased results. We therefore estimate both equations simultaneously using three stage least square estimation.

The empirical evidence suggests that the degree of spatially specific entrepreneurship capital is shaped by regional-specific factors reflecting both entrepreneurial opportunities and the entrepreneurial capabilities. In turn, the extent of entrepreneurship capital has a positive impact on regional economic performance.

JEL-Codes: M13, O32, O47

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

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1. Introduction

In proposing a new theory of economic geography (Krugman, 1991, p. 5) asked, “What is the most striking feature of the geography of economic activity? The short answer is surely concentration...economic activity is remarkably concentrated in space.” What explains such an asymmetric distribution of economic activity? Here Krugman (1991), along with Romer (1986), is unequivocal – the existence of increasing returns to scale in production. By increasing returns, however, Krugman and Romer do not necessarily mean 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 region or area. In fact, it is assumed that externalities across firms and even industries that yield convexities in economic activity.

While neither Krugman (1991) nor Romer (1986) included entrepreneurship in their models, it has long been observed that entrepreneurial activity, defined as the process by which new enterprises are founded and become viable, also exhibits a high propensity to vary across geographic space and be spatially concentrated in specific regions. However, the literature focusing on the geography of entrepreneurship has developed something of a schizophrenic approach. On the one hand is a series of studies, dating back at least to Carlton (198?) and Bartik (198) and more recently Reynolds, Storey and Westhead (1993), 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 en-

entrepreneurial activity across geographic space. 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. Thus, little guidance is provided as to how policy could actually influence economic performance by generating more entrepreneurial activity.

The purpose of this paper is explicitly link these two disparate literatures by suggesting that entrepreneurial activity is not exogenous, as this second strand of literature implies, but rather, as the earlier studies indicated, shaped by a number of factors specific to the particular location. In the second section of this paper, we suggest that such spatially specific factors shaping the entrepreneurial capacity of a region constitute that region's endowment of entrepreneurship capital. When combined with the more traditional factors of production – labor, physical capital, and knowledge capital – entrepreneurship capital should have a positive impact on economic performance. In the third section, issues involving the measurement of entrepreneurship capital, as well as the more traditional factors are discussed. 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 somewhat between technology oriented entrepreneurship and more general entrepreneurship. In turn, the extent of entrepreneurship capital has a positive impact on regional economic performance.

2. Entrepreneurship Capital and its Impact

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 involves the creation of a new enterprise to appropriate the economic value of that knowledge.

Theories and empirical validation have found that entrepreneurship is not neutral with respect to geographic space. That entrepreneurial activity varies across geographic space has long been observed. Efforts to systematically link spatial variations in entrepreneurship with locational specific characteristics showed that such spatial activity is not at all random but rather shaped by factors associated with particular regions (Reynolds, Storey and Westhead, 1993).

Such entrepreneurial activity could be considered to reflect the underlying stock of entrepreneurship capital. By entrepreneurship capital we mean the capacity for geographically relevant spatial units of observation to generate the startup of new enterprises. A large and robust literature has emerged trying to link social capital to entrepreneurship. But social capital and entrepreneurship capital are distinctive concepts that should not be confused. According to Putnam (2000, p. 19), “Social capital refers to connections among individuals – social networks and the norms of reciprocity and trustworthiness that arise from them. In that sense social capital is closely related to what some have called ‘civic virtue.’ ...Social capital calls attention to the fact that civic virtue is most powerful when embedded in a sense network of reciprocal social relations...Social capital refers to features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefits.”

By contrast, entrepreneurship capital is shaped by a broad spectrum of factors, spanning institutions, laws, finance, traditions and policies. Aldrich and Martinez (2003) and Thorton and Flynn (2003), review studies trying to link measures of social capital to entrepreneurship. In fact, Putnam did not directly link social capital to entrepreneurship. Rather, the components of social capital Putnam emphasized the most included associational membership and public trust. While these may be essential for social and economic well being, the connection to entrepreneurship is less obvious. The connection of entrepreneurship to entrepreneurship capital may be more important and relevant than that between entrepreneurship and social capital.

In their 2003 study, Audretsch and Keilbach explain how entrepreneurship capital might influence economic performance. In particular, they identify three mechanisms by which entrepreneurship capital shapes economic performance. The first is that entrepreneurship serves as a conduit for knowledge spillovers. While Romer (1984) and Lucas (1993) emphasized the role that knowledge plays in generating economic growth through knowledge spillovers, entrepreneurship can serve as a mechanism transmitting such knowledge spillovers.

The second 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 market. The third 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 facilitates

knowledge spillovers, an increase in competition, and increased diversity in a region, all of which contribute to economic growth.

3. Entrepreneurship Capital and Regional Economic Performance

3.1 Assessing the Impact of Entrepreneurship Capital

The previous section developed the hypothesis that entrepreneurship capital should contribute to economic performance. In this section empirical evidence is provided for testing this hypothesis. We estimate a regression model where the first equation is a Cobb-Douglas function of the form

$$Y_i = K_i^\alpha L_i^\beta E_i^\gamma, \quad (1)$$

where Y is economic performance of region i , measured as GDP, K is the region's i endowment with capital, L is labor and E represents the region's endowment *entrepreneurship capital*. Hence, this specifies formally that entrepreneurship capital contributes to the economic output of regions.

As already emphasized in the previous section, the concept of entrepreneurship capital is unobservable. However, as an unobservable variable, entrepreneurship capital, is reflected by the number of startups in the respective region. Thus, we use the number of startups as a proxy measure or indicator of entrepreneurship.

3.2 Measurement Issues

The variables used to estimate equation (1) are

Output is measured as Gross Value Added corrected for purchases of goods and services, VAT and shipping costs, measured in year 2000. Statistics are published every two years for *Kreise* by the Working Group of the Statistical Offices of the German Länder, under “Volkswirtschaftliche 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 investments done in the producing sector in the period 1980 to 2000. In the estimates we used a γ -distribution with $p=9$ and a mean age of $q=14$. For a detailed description of this procedure see e.g. Audretsch and Keilbach (2003).

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

Entrepreneurship Capital: Measurement of entrepreneurship capital is no less complicated than is measuring the traditional factors of production. Just as measuring capital and labor invokes numerous assumptions and simplifications, creating a metric for entrepreneurship capital also presents a challenge. Many of the elements that determine entrepreneurship capital in our definition 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, the latter being an unobservable (i.e. latent) variable. *Ceteris paribus*, higher startup rates reflect higher levels of en-

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 shakeout 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.

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 Register, especially for firms with large credit requirements as e.g. high-technology firms.¹ As of 2000, there were 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 from 1998 to 2000.

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 involved in high-technology activity. Therefore, we compute two additional measures of entrepreneurship. The first one restricts entrepreneurship capital to include only startup activity in high-

¹ 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.

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; hence there exists an intersection between these two measures. These two measures will place more emphasis on the aspect of risk involved in our definition of entrepreneurship capital, since R&D-intensive activities are more uncertain in outcome, and since a larger financial commitment is necessary to engage into R&D intensive industries. Therefore, the expected value of the monetary loss is larger.

3.3 Estimation Results

Table 1: The Impact of Entrepreneurship on West German County GDP

	<i>Dependent Variable: GDP of West German Counties</i>		
Constant	-0.8349*** (-4.01)	-0.4680** (-2.09)	-0.7563** (-3.31)
Capital	0.1523*** (5.46)	0.1788*** (6.60)	0.1777*** (6.37)
Labour	0.7980*** (24.86)	0.7463*** (23.70)	0.7622*** (23.67)
General Entrepreneurship	0.2068*** (5.77)		
High Tech Entrepreneurship		0.1481*** (7.06)	
ICT Entrepreneurship			0.1303*** (5.43)
R^2 (adj)	0.9487	0.9510	0.9481

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

Table 1 shows the regression results from estimating equation 1. As the positive and statistically significant coefficients of capital and labor indicate, both of the traditional factors contribute to economic growth. Similarly, the coefficients of the three different measures of en-

entrepreneurship are also positive and statistically significant, suggesting that entrepreneurship capital also contributes to economic performance, at least in the case of German regions. Thus, taking entrepreneurship capital as exogenous, the results from Table 1 suggest that not only do the traditional factors of production positively influence economic growth, but entrepreneurship capital also has a positive impact on economic performance as well.

4. Endogenizing Entrepreneurship Capital

4.1 On The Determinants of Entrepreneurship Capital

An important qualification of the results from the previous section is that the measure of entrepreneurship is assumed to be exogenous. Thus, while the empirical results from Table 1 provide evidence that entrepreneurship capital has a positive impact on regional economic performance, there are no insights as to how policy could influence entrepreneurship capital. This assumption that entrepreneurship capital is exogenous is particularly bothersome given the earlier literature (Reynolds, Storey and Westhead, 1994), suggesting the entrepreneurship is influenced by regional specific characteristics. For example, Reynolds, Storey and Westhead (1994), along with the survey by Storey (1991), suggest that the empirical evidence has been generally unambiguous with respect to the findings for population density (a positive impact on startup rates), population growth (positive impact on startup rates), skill and human capital levels of the labor force (positive impact), and mean establishment size (negative impact on startup rates) We therefore specify a second equation in order to take this recursive structure explicitly into account. In its general form, this equation takes the form

$$E_i = f(\mathbf{Y}_i, \mathbf{X}_i), \quad (2)$$

where \mathbf{Y}_i is a matrix of measures of region's i economic performance and \mathbf{X}_i is a matrix of other variables influencing entrepreneurial activity. These specific measures are specified in detail in the following section.

If a simultaneous set of equations specifies variables are used as exogenous in one equation and as endogenous in the other equation, an estimation will not be consistent, leading estimates to be biased (e.g. Intriligator et al., 1992 or Greene, 2000). Therefore, we estimate this system of equations using three stage least squared estimations.

The extent of entrepreneurship capital is shaped by (1st) the generation of regional specific opportunities for entrepreneurial activity, and (2nd) the ability of individuals to actualize those opportunities through entrepreneurship. Entrepreneurial opportunities will be generated in regions experiencing growth, but where the realization of those opportunities is less obtainable through traditional (capital) investments in incumbent firms. High levels of unemployment, by contrast, do not reflect an abundance of opportunities, but rather a lack of opportunities. Unemployment also does not suggest a population endowment with the requisite abilities to exploit any existing opportunities.

Regions with a high endowment of knowledge workers should also have a greater degree of entrepreneurship capital for two reasons. First, entrepreneurial opportunities are generated by new knowledge. Arrow's (1962) fundamental insight that knowledge can be used by multiple parties, and that it "spills over" has been frequently observed and cited (Romer, 1986). What has been sometimes overlooked, is Arrow's equally important insight that knowledge differs from the traditional factors of production in that it is characterized by greater uncertainty and asymmetries across economic agents in general, and decision makers

in general. Such knowledge uncertainties and asymmetries create the conditions for entrepreneurship as a mechanism for economic agents to appropriate the value of their endowment of knowledge.

Entrepreneurship capital may also be influenced by the demographic composition of the region. Demographic elements that can be classified as being marginal or outsiders to the main social groups may not possess the requisite social capital for their knowledge to be applicable in and compatible with incumbent organizations. This would suggest that such marginal groups will have a higher propensity to resort to entrepreneurship to appropriate the expected value of their ideas. In particular, immigrants as well as young people have been found to have a greater propensity to start new businesses. A third demographic characteristic influencing economic growth is the degree of diversity in the workforce. Jacobs (1969) argued that the degree of diversity in the workforce is an important source of knowledge spillovers. According to Jacobs (1967), 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 heterogeneity of people within a geographic region promotes knowledge externalities and ultimately innovative activity and economic growth. Thus, entrepreneurial opportunities should be greater in regions with a more diverse population, since more new ideas would be expected to be generated as a result of social diversity.

Public policy can also influence both entrepreneurial opportunities and the ability of economic agents to take advantage of them. The public sector may create economic opportunities at a rate that is considerably below that created by the private sector. But many of the opportunities created by the private sector can be appropriated within existing private enterprises, that is without entrepreneurship. By contrast, economic opportunities created by the

public sector cannot be appropriated by the public sector, and therefore may generate greater opportunities for entrepreneurs to commercialize those opportunities which otherwise would go uncommercialized.

Both entrepreneurial opportunities and the ability of economic agents to appropriate those opportunities through entrepreneurship should be greater in more highly agglomerated regions where knowledge spillovers are greater and the provision of ancillary services and inputs is also greater.

4.2 Measurement Issues

Measures of the variables used to estimate equation (2) are based on “Statistik Regional” the CD-Rom that is published by the German Regional Statistical Offices. These measures are all published on the level of *Kreise* (i.e. German counties). From these measures we compute the following variables:

GDP Growth: This variable is computed as simple growth statistic $g_y = \ln(y_{t1} - y_{t0})$, taking periods 1992 and 2000. Hence this variable measures each region’s growth dynamics between years 1992 and 2000. The aim of this variable is to investigate, whether general economic growth increases the propensity of starting up new businesses. We expect that this is the case since a strong economic performance of a region might increase the trust of entrepreneurs in the economic future of the region, hence increase the belief that their firm will equally perform well.

Investment. 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). On the one hand, investments are driving of course GDP growth (although our measure of

investment is uncorrelated with our measure of GDP growth). There are two mechanisms to be expected in relation with this variable. One 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. On the other hand, investment as measured here, represents pursuing economic opportunities within existing enterprises 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.

Unemployment. Unemployment reflects both lower entrepreneurial opportunities and lower ability of economic agents to appropriate existing opportunities through entrepreneurship. Thus, it should be inversely related to entrepreneurship capital. We measure this variable as unemployment rate and include it to test which of these hypotheses is more appropriate for Germany in the observed period.

Knowledge Workers. This measure captures the share of employees with high school and/or college degree. Here, we test the hypothesis that education increases a region's entrepreneurship capital, by both enhancing entrepreneurial opportunities along with the ability of economic agents to appropriate those opportunities.

Immigrant Workers. This measure captures the share of employees with foreign nationality. Foreign workers may have a positive impact on entrepreneurship capital because their ability to appropriate the value of their ideas tends to be more limited within the context of existing organizations and businesses.

Youth. A region with a greater share of young workers should also have a greater endowment of entrepreneurship capital. The variable "youth" measures the share of population of age 25 to 45.

Entrepreneurial Support. One important way that the ability of economic agents to engage in entrepreneurial activity is through the provision of social and family services that facilitate new startups. We measure this variable with the number of kindergarten places relative to the regional population.

Agglomeration. This variable is measured by population density and should influence the degree to which entrepreneurial opportunities are generated and also the ability of economic agents to appropriate those ideas through entrepreneurship. Entrepreneurship capital should be higher in more densely populated regions than in less densely populated regions.

Locational Attractiveness. It has often been argued that one of the factors that made Silicon Valley happen was the attractiveness of the place. We measure locational attractiveness by the number of a county's hotel beds relative to its surface, assuming that this measure indicates this attractiveness.

Social Diversity. Social diversity promotes the generation of entrepreneurial opportunities 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.

Public Employment. We measure public employment as a county's number of public employees relative to its population. As suggested above, a higher share of employment in the public sector may reflect opportunities generated that will not automatically be appropriated by incumbent enterprises, thus creating entrepreneurial opportunities.

4.3 Estimation Results

Table 2: Estimating Entrepreneurship and Economic Performance

	<i>Dependent Variable: GDP of West German Counties</i>		
Constant	0.9693** (2.97)	0.4901* (1.78)	0.7418** (2.49)
Capital	0.1762*** (6.01)	0.1777*** (6.55)	0.1814*** (6.59)
Labour	0.7684*** (22.79)	0.7375*** (23.40)	0.7464*** (23.60)
General Entrepreneurship	0.5696*** (8.48)		
High Tech Entrepreneurship		0.2667*** (9.27)	
ICT Entrepreneurship			0.3226*** (8.92)
R^2	0.9357	0.9504	0.9436
	<i>Dependent Variable:</i>		
	<i>General Entr.</i>	<i>High Tech Entr.</i>	<i>ICT Entr.</i>
Constant	-4.6389*** -13.37	-7.7001*** (-15.07)	-7.1315*** (-14.95)
GDP Growth	0.5402** (3.24)	1.1314*** (4.59)	0.9281*** (4.04)
Investment	-0.0036*** (-4.84)	-0.00466*** (-4.36)	-0.0042*** (-4.20)
Unemployment	-0.0087 (-1.47)	-0.04430*** (-5.06)	-0.0393*** (-4.78)
Knowledge Workers	1.3661** (2.08)	5.0764*** (5.26)	3.5454*** (3.929)
Immigrant Workers	0.6874 (1.36)	2.2537** (3.04)	1.2395* (1.79)
Youth	-1.0341 (-1.06)	-2.1007 (-1.46)	-0.8593 (-0.64)
Entrepreneurial Support	-15.9864*** (-4.95)	-13.4486** (-2.90)	-17.2806*** (-3.97)
Agglomeration	0.0001* (1.86)	0.0001** (3.43)	0.0001** (2.79)
Locational Attractiveness	0.1552 (1.45)	-0.1356 (-0.86)	0.1259* (0.86)
Social Diversity	0.4866** (2.44)	0.9521** (3.25)	0.4933** (1.819)
Public Employment	0.8758 (1.32)	2.2307** (2.28)	2.6633*** (2.90)
R^2	0.2959	0.5633	0.4474

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 results from estimating the three measures of entrepreneurship endogenously are presented in the bottom part of Table 2.² As the positive and statistically significant coefficients of GDP growth suggest, economic growth is conducive to entrepreneurship. This presumably reflects a greater degree of entrepreneurial opportunities in regions experiencing higher growth. By contrast, as the negative and statistically significant coefficient of capital investment indicates, investment in capital is a substitute for entrepreneurial opportunities. The negative coefficients of unemployment reflect both lower entrepreneurial opportunities and capabilities in regions characterized by higher unemployment. The presence of knowledge workers in a region has a positive impact on entrepreneurship. We interpret this as indicating both an increase in entrepreneurial opportunities as well as capabilities emanating from knowledge workers.

Demographic composition apparently influences entrepreneurship. Regions with a greater share of foreigners exhibit higher rates of entrepreneurship. Social diversity also contributes to entrepreneurship, which is consistent with the hypothesis that workforce diversity promotes entrepreneurial opportunities. However, the age composition of the region has no statistically significant impact on entrepreneurship. By contrast, the degree to which entrepreneurship is supported by the provisions of kindergartens has a negative impact on entrepreneurial activity.

As the positive and statistically coefficient of agglomeration suggests, entrepreneurship is also promoted in regions with a high population density. Similarly, those regions with a high share of employment in the public sector exhibit a greater degree of entrepreneurship. As we suggested above, this may reflect the creation of opportunities that cannot be appropri-

² Similar results including the East German counties are included in the appendix. Because the data for East Germany is of questionable reliability, the results are presented only for very qualified interpretation.

ated by the organization creating them (the public sector), and hence generate opportunities for entrepreneurship.

These different factors promoting entrepreneurship are somewhat sensitive to the type of entrepreneurship. For example, the impact of both growth and knowledge workers is considerably greater on high technology entrepreneurship and ICT entrepreneurship than on general entrepreneurship. Similarly, while unemployment has no significant impact on general entrepreneurship, it has a statistically significant negative impact on high technology and ICT entrepreneurship.

In the top part of Table two these three measures of entrepreneurship, endogenously estimated, are included in the estimation of GDP in West German counties. The estimated coefficients of capital and labor are virtually the same in Tables 1 and 2. Still, there are some important differences emerging from the three-stage estimation in Table 2, when compared to the single equation estimation presented in Table 1. The estimated coefficients of the entrepreneurship variables are all considerably higher in Table 2, as a result of the endogenous estimation, when compared to the single equation estimation. Thus, the impact of entrepreneurship capital on economic performance is even greater, when entrepreneurship is estimated endogenously in Equation 2, instead of assumed to be exogenous, as in Equation (1).

5. Summary and Conclusions

Two important questions have emerged in the literature linking entrepreneurship to geographic location – *What explains the spatial distribution of entrepreneurial activity?* and *How does entrepreneurship impact regional economic performance?* While each of these questions has generated a lively set of papers, each question has been considered separately

and in isolation from the other question. These disparate research trajectories have resulted in something of a dichotomous literature concerning the geography of entrepreneurship.

This paper has attempted to link these two research questions, which are strikingly interrelated. 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 might 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 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*) this paper has provided empirical evidence suggesting that entrepreneurship capital exerts a significant and strongly positive impact on regional economic performance. On the other hand, entrepreneurship capital is greater in regions exhibiting a stronger economic performance. Regions with large investments and a high unemployment rate tend to have lower levels of entrepreneurship capital. A large share of knowledge workers or immigrant workers increases the regions' entrepreneurship capital. Also, entrepreneurship capital is higher in regions with higher population density (i.e. cities) and in regions with higher social diversity. Overall, our findings suggest that an important mechanism for improving the economic performance of regions is increasing the entrepreneurship capital of that region.

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APPENDIX: Regressions for Eastern Germany and for Germany as a whole

In this appendix, we present regression results for alternative regional settings. In the paper we focused on Western Germany. Here, we present results for Eastern Germany and for Germany as a whole.

A.1 Regression results for Eastern Germany

In October 1990, the German Democratic Republic (Eastern Germany) and the “old” Federal Republic of Germany (Western Germany) were unified to create the “new” Federal Republic of Germany. Eastern Germany consists of 112 *Kreise* plus Berlin, which is treated as one region in our analysis.

Due to the young age of the five new *Bundesländer*, or Eastern Germany as we know it today, data availability are restricted, and a longer time series is either not available or spurious. This important data qualification especially holds for the estimation of the capital stock, since it is based on longer investment time series. We therefore based our estimates on the officially published data on capital stock of the six federal states and used a “reverse imputing process” based on the available investment series on the *Kreise* level to obtain our estimates for the capital stock for each *Kreis*.

The following two tables present the estimation results for Eastern Germany alone. As in the paper, the first Table (Table A.1) presents the results of Equation (1).

Table A.1: The Impact of Entrepreneurship on East German County GDP

	<i>Dependent Variable: GDP of East German Counties</i>		
Constant	1.0937* (1.81)	0.7057 (1.14)	-0.1389 (-0.20)
Capital	0.0229 (0.48)	0.0271 (0.56)	0.0247 (0.489)
Labor	0.7869*** (10.68)	0.7538*** (9.94)	0.7626*** (9.54)
General Entrepreneurship	0.3702** (3.38)		
High Tech Entrepreneurship		0.1470** (2.51)	
ICT Entrepreneurship			0.0407 (0.505)
R^2 (adj)	0.7832	0.7734	0.7611

Table A.2: Results of simultaneous regressions of Equations (1) and (2) for Eastern German counties using 3SLS

	<i>Dependent Variable: GDP of Eastern German Counties</i>		
Constant	3.0182*** (3.09)	1.8370** (2.22)	0.5942 (0.66)
Capital	0.0576 (0.94)	0.0516 (0.85)	0.0584 (0.94)
Labor	0.7539*** (7.97)	0.6992*** (7.79)	0.6969*** (7.50)
General Entrepreneurship	0.7782*** (3.42)		
High Tech Entrepreneurship		0.2610*** (2.78)	
ICT Entrepreneurship			0.0956 (1.03)
R^2	0.7578	0.7710	0.7654
	<i>Dependent Variable:</i>		
	<i>General Entr.</i>	<i>High Tech Entr.</i>	<i>ICT Entr.</i>
Constant	-5.1662*** (-4.57)	-8.4956*** (-4.68)	-6.6132*** (-3.38)
GDP Growth	0.0907 (0.52)	0.4893* (1.74)	0.1189 (0.39)
Investment	0.0001 (0.23)	0.0017* (1.74)	0.0011 (1.06)
Unemployment	-0.0034 (-0.40)	-0.0091 (-0.69)	-0.0192 (-1.35)
Knowledge Workers	-0.5438 (-0.41)	5.3363** (2.51)	1.9229 (0.84)
Immigrant Workers	18.3731* (1.91)	22.0348 (1.45)	49.3295*** (3.00)
Youth	4.2260** (2.17)	4.1430 (1.33)	-0.7678 (-0.23)
Family Support	0.8571 (0.50)	0.5959 (0.22)	-8.0503*** (-2.73)
Population Density	0.0001 (0.60)	0.0002 (1.22)	0.0002 (0.96)
Locational Attractiveness	0.0965 (0.32)	0.1126 (0.23)	0.2579 (0.49)
Social Diversity	-0.6360 (-1.15)	-0.7753 (-0.87)	-0.6910 (-0.72)
Public Employment	1.8178 (1.36)	1.4547 (0.68)	3.2157 (1.40)
R^2	0.295	0.5175	0.5099

The estimates in Table A.1 for labor are roughly in the same region as the results for Western Germany, those for entrepreneurship capital are also positive, though not significant for ICT entrepreneurship. A striking finding is that the estimates for capital are very small and do not

differ significantly from zero. This is very implausible and we take this as evidence that the data for Eastern Germany are at this present state not yet reliable enough to run such estimates. This effect remains in the 3SLS regressions whose results are reported in Table A.2. We present this table for illustrative purposes and take this finding as a stimulus for further research.

A.2 Regression results for Germany as a whole

Germany as a whole consists of 440 regions (counties or Kreise), counting Berlin and Hamburg as one region, and the federal State of Bremen as two (Bremen and Bremerhaven). This also treats Hannover and its surrounding region as two separate counties.

Table A.3: The Impact of Entrepreneurship on German County GDP

	<i>Dependent Variable: GDP of German Counties</i>		
Constant	-0.4902** (-2.26)	-0.2988 (-1.28)	-0.7687** (-3.21)
Capital	0.0802** (3.28)	0.1013*** (4.16)	0.1021*** (4.05)
Labor	0.8490*** (28.45)	0.8017*** (26.70)	0.8153*** (26.36)
General Entrepreneurship	0.2526*** (86.79)		
High Tech Entrepreneurship		0.1535*** (7.07)	
ICT Entrepreneurship			0.1097*** (4.50)
East Germany Dummy	0.0686** (0.015)	0.0797*** (2.84)	0.1386*** (4.30)
R^2 (adj)	0.9384	0.9389	0.9349

If a part of a dataset is of questionable quality (as reported above on Eastern Germany) regressions based on this dataset will be contaminated and therefore questionable as well. This is the reason why we based our interpretations of the results in the paper only on the Western German dataset.

Nevertheless, we are presenting the regression results for Germany as a whole here, with the important qualification that the results will be biased. Again, this is for illustrative purposes.

Table A.4: Results of simultaneous regressions of Equations (1) and (2) for German counties using 3SLS

	<i>Dependent Variable: GDP of German Counties</i>		
Constant	1.6622*** (4.49)	0.7722*** (2.61)	0.6224* (1.95)
Capital	0.1227*** (4.38)	0.1235*** (4.67)	0.1280*** (4.67)
Labour	0.7964*** (23.51)	0.7616*** (23.72)	0.7720*** (23.35)
General Entrepreneurship	0.6756*** (8.63)		
High Tech Entrepreneurship		0.2741*** (8.82)	
ICT Entrepreneurship			0.2771*** (7.34)
East Germany Dummy	0.0196 (0.61)	0.0873*** (2.91)	0.2316*** (6.06)
R^2	0.9207	0.9371	0.5869
	<i>Dependent Variable:</i>		
	<i>General Entr.</i>	<i>High Tech Entr.</i>	<i>ICT Entr.</i>
Constant	-5.3442*** (-17.14)	-8.6149*** (-18.90)	-7.7751*** (-17.62)
GDP Growth	0.2853** (2.15)	0.6523*** (3.37)	0.4433** (2.36)
Investment	-0.0021*** (-3.91)	-0.0019** (-2.47)	-0.0018** (-2.43)
Unemployment	0.0033* (0.68)	-0.0289*** (-4.13)	-0.0293*** (-4.30)
Knowledge Workers	1.0617** (1.82)	5.1266*** (6.02)	3.7821*** (4.58)
Immigrant Workers	1.5059*** (3.08)	3.1911*** (4.49)	2.0837*** (3.03)
Youth	1.9643** (2.31)	1.3054 (1.05)	1.8036 (1.50)
Family Support	0.7930 (0.52)	2.8317 (1.26)	-3.5009 (-1.61)
Population Density	0.00003 (1.29)	0.0001** (2.54)	0.0001** (2.04)
Locational Attractiveness	0.1563 (1.49)	-0.0550 (-0.36)	0.2122 (1.43)
Social Diversity	-0.2815* (-1.74)	0.2291 (0.97)	-0.1606 (-0.70)
Public Sector Size	1.4932** (2.45)	2.5706*** (2.89)	3.1307*** (3.63)
East Germany Dummy	0.1135 (1.15)	0.0873*** (2.91)	-0.3604*** (-2.6)
R^2	0.2229	0.5352	0.5869

Table A.3 and A.4 show that now that regression results for capital within Cobb-Douglas equation (1) are significant, however, given the findings of section A.1, (Tables A.1 and A.2) this result is certainly driven by Western Germany, hence we have to consider these results still as spurious. We therefore present these tables without further comment.