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New Firm Formation by Industry over Space and Time: A Multi-Level Analysis

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Contents

Abstract

We apply a multi-level approach to analyze simultaneously the effects of three groups of determinants on new firm formation: industry, location and change over time. The data is for West Germany and covers the 1983-97 period. Our analysis indicates that innovation activities and the technological regime play a significant role in new firm formation processes. There are some differences with regard to the impact of a number of variables on start-ups in manufacturing and the service sector. Changes in demand are conducive to new firm formation while a high level of unemployment in a region obviously creates a relatively uncomfortable environment for setting up new businesses.

JEL classification: D21, L10, R10

Keywords: New firm formation, industrial economics, regional economics, entrepreneurship.

Zusammenfassung

"Neue Betriebe über Industrien, Raum und Zeit: Eine Mehr-Ebenen-Analyse"

Wir untersuchen den Einfluss von Branchenmerkmalen, Standort und Veränderungen im Zeitablauf auf Neugründungen von Betrieben mit einem Mehr-Ebenen-Ansatz. Die Analyse bezieht sich auf Westdeutschland im Zeitraum 1983-1997. Innovationsaktivitäten und die Ausprägung des technologischen Regimes haben offenbar einen wesentlichen Einfluss auf Gründungsaktivitäten. Es bestehen erhebliche Unterschiede zwischen dem Industrie- und dem Dienstleistungssektor hinsichtlich der Bedeutung der verschiedenen Faktoren für das Gründungsgeschehen. Expandierende Nachfrage stimuliert Gründungsaktivitäten während sich ein hohes Niveau an regionaler Arbeitslosigkeit offenbar ungünstig auswirkt.

JEL-Klassifikation: D21, L10, R30

Schlagworte: Neugründungen, Industrieökonomik, Regionalökonomik, Entrepreneurship.

1. Introduction*

There is little doubt that new firm formation plays an important role in the process of economic development. Each new firm or new market entry represents a challenge to the incumbents and, in doing so, may generate significant incentives for improvements. The determinants of new firm formation have been investigated theoretically and empirically in a number of ways.[1] Most empirical studies in this field are cross-section analyses of different industries or regions.[2] Longitudinal analyses of new firm formation processes are rather rare.[3] A severe shortcoming of these analyses is that most of them concentrate on only one category of influence and tend to neglect other factors. The types of influences that are accounted for is mainly due to the approach chosen. For example, cross-sectional analyses limited to the industry level can only investigate the role of industry characteristics (e.g., minimum efficient size, capital intensity) but not such regional determinants as population density or workforce qualifications. Without accounting for the regional dimension, however, in the case of such industry-level studies, reliable results can not be attained if the importance of a certain factor, say innovation conditions, varies significantly across regions. And if certain regional conditions stimulate new firm formation in some industries but deter start-ups in other industries, the effect of location on the formation of new firms cannot be adequately assessed by means of an interregional approach that does not account for different industries. Moreover, empirical analyses should include multiple years to control for the possibility that the effect of the different determinants

* The research reported here is based on the project "Gründungsdaten und Analysen des Gründungsgeschehens" (Data on New Firms and Analyses of New Firm Formation) funded by the German Science Foundation. We are indebted to Udo Brixy (Institute for Employment Research, Nuremberg) for providing large parts of the data used here. Comments by Olav Sorenson and Joachim Wagner on an earlier version helped us to improve the paper.

[1] For a brief overview of theoretical concepts see Audretsch (1995, 45-55) and Storey (1994, 60).

[2] For an overview of cross-section studies of industries see Evans and Siegfried (1994) and Geroski (1995). The evidence of interregional analyses is summarized in Reynolds, Storey and Westhead (1994).

[3] The only longitudinal analyses of new firm formation that we are aware of are Keeble, Walker and Robson (1993), Johnson and Parker (1996) and Sutaria (2001).

changes over time, and more particularly to account for the impact of factors that mainly have an effect on the macro or the national level, such as wage variation, capital user cost and overall demand.

As far as we know, such a comprehensive approach, which analyzes the influence of industry, location and time on new firm formation processes simultaneously, has not yet been conducted, presumably because of limitations in the available data. The available time-series are rather short, differentiation by industry is often rudimentary and there is hardly any data supporting meaningful spatial categories. This shortcoming may be the cause of the mixed and partly contradictory results that have been found particularly in studies across industries (cf. Evans and Siegfried, 1994; Geroski, 1995). Based on a unique data set, which was compiled from German Social Insurance Statistics (see Brixy and Fritsch, 2002 for details), we use a multi-level approach to analyze the effects of the three groups of determinants – industry, location and time – simultaneously. The data covers the 1983-97 period and provides information on the number of new firms in each year within 52 private sector industries and 74 regions. The estimates enable us to assess the relative importance of the three types of determinants for new firm formation processes. The results should be much more reliable than those found through analyzing only one or two categories of factors.

We start with a brief outline of the main hypotheses. Next, we discuss empirical findings about the determining factors in the decision to set up a business in a certain industry and region (section 2). This is followed by an overview of new firm formation in West Germany during the period under review (section 3). Section 4 introduces the basic analytical approach and compares the variation of the number of start-ups over the three analytical dimensions, industry, space and time. The analysis of causal relationships is reported in section 5. Finally, we draw some conclusions from the analysis, particularly with regard to the merits of the type of multi-level approach applied here (section 6).

2. Hypotheses and main empirical findings

In analyzing new firm formation processes, we assume the perspective of a potential founder. According to this ‘labor market’ approach (Audretsch, 1995, 47-50; Storey, 1994, 60), every member of the workforce is faced with the question of whether to remain in dependent employment (or unemployment) or to start a business. In this view, the start-up decision is determined by a person's subjective evaluation of the costs and benefits related to these alternatives. One group of factors that may be relevant for this decision are the personal characteristics of the potential entrepreneur. Individual characteristics which may be conducive to starting a business are an entrepreneurial attitude (the pursuit of economic success, independence and self-realization; the capability to bear risk), an appropriate qualification (expertise, management abilities) as well as the opportunity costs of becoming an entrepreneur, such as the income and the career prospects provided by the current position (c.f. Chell, Haworth and Brearley, 1991). Because unemployment implies relatively low opportunity costs, one should expect a positive relationship between the level of unemployment and the level of new firm formation activity.

Another group of factors that will probably affect an individual’s start-up decision are market-specific barriers to entry, such as minimum efficient size, capital intensity, as well as certain industry-specific characteristics of innovation processes that are described by the concept of a "technological regime" (cf. Audretsch, 1995, 39-64; Winter, 1984; Marsili, 2002). Region-specific factors that may be important for the formation of new firms comprise the level and the development of local demand, availability and price of necessary resources like workforce, floor space and venture capital[4], spatial proximity to customers and to other establishments in the same industry as well as the regional knowledge stock and the level and the nature of regional innovation activity. Other influences that

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[4] Sorenson and Stuart (2001) show that spatial proximity between actors matters for establishing and maintaining a venture-capital relationship. Accordingly, venture capital is not evenly available in all regions.

may be relevant are legal conditions for entrepreneurship, the expected development of demand in the particular market, the overall economic conditions (e.g., level and development of wages and capital user cost) as well as a person's access to support networks (e.g., family, ethnic groups, social and professional organizations; see Aldrich and Zimmer, 1986; Birley, 1985; Saxenian, 1994).

As already mentioned, the empirical evidence for the impact of many of these factors is quite mixed and partly contradictory. Regard the qualifications of the potential entrepreneur, many studies find a positive relationship between the education level and the propensity to start a business. However, work experience also seems to play an important role. A stylized fact of interregional studies of new firm formation is that the share of employment in small firms is conducive to start-up activity (cf. Reynolds, Storey and Westhead, 1994). The standard explanation for this result is that working in a small firm stimulates the emergence of an entrepreneurial attitude, thus increasing the likelihood that the firm's employees will consider starting their own businesses (Beesley and Hamilton, 1984; Sorenson and Audia, 2000). This interpretation is based on the notion that smaller firms have a less extensive division of labor than do larger firms, so that employees of these firms are likely to gain exposure to a relatively big portion of the often tacit knowledge that is necessary for running a firm. This view is supported by evidence from empirical studies showing that many founders worked in small firms before setting up their own enterprises (Johnson and Cathcart, 1979a and b). Moreover, a high level of employment in small firms in a region is probably associated with a relatively pronounced tradition of entrepreneurship, thus increasing the confidence of potential entrepreneurs in their ability to open a new venture (Sorenson and Audia, 2000, 442f.).[5] This is also the reason why these factors may be somewhat overestimated by the percentage of small firm employment because it reflects to some degree the historical levels of regional entrepreneurship since most firms start small. The relevance of firm size structure in a given region in

[5] "Through direct contact with successful entrepreneurs, people gain opportunities to gather more information about transition from worker to entrepreneur and to conduct a more accurate personal assessment of their ability to succeed", Sorenson and Audia, 2000, 443).

relation to new firm formation processes could result from the fact that most founders locate their businesses close to their home (Johnson and Cathcart, 1979b; Mueller and Morgan, 1962; Cooper and Dunkelberg, 1987). However, the share of employment in small establishments also may well be regarded as a proxy for an industry's minimum efficient establishment size. The smaller an industry's minimum efficient establishment size is, the fewer are the resources that are needed to successfully enter the market, which makes it more likely that new firms will emerge in that industry.

An issue related to qualification and minimum efficient size is the technological regime that holds sway in an industry. The concept of technological regime characterizes the nature of innovation activity in an industry, particularly the role of small and large firms (Audretsch, 1995, 39-64; Winter, 1984). A technological regime is called "entrepreneurial" if small firms have a high share of innovation activity so that entrants have a relatively good chance to compete successfully. In a "routinized" regime, the incumbent large firms have the innovative advantage and small firms play only a minor role. Therefore, the survival chances of firms entering such a market can be assumed to be comparatively small. Lower levels of capital intensity in an industry, mean that less investment is needed to enter the market, which has a salutary effect on start-up activity. Likewise, a high level of new firm formation can also be expected in industries with low labor unit-costs. Lower levels of capital intensity and relatively high labor unit-costs may also indicate industries in which a higher proportion of relevant resources reside in skilled labor rather than being incorporated in equipment. In such industries, highly-skilled employees may face relatively high incentives to exit a firm and start their own businesses because they want to appropriate the full value of their skills, which employers tend to undervalue as a result of information asymmetry. A low level of capital user costs indicates low barriers to entry and should be associated with high start-up rates.

Another stylized fact of cross-regional analyses is a positive relationship between the level of new firm formation and population density.[6] The reason for this result is largely unclear because regional density may serve as a proxy for all kinds of regional influences, such as the cost of needed resources (e.g., floor space and wages), large and differentiated labor markets, the availability of specialized services, spatial proximity to customers and to other firms in the industry, knowledge spillovers (cf. Krugman, 1991), quality of life (Pennings, 1982), etc. Density may also be regarded an indicator of innovativeness if agglomerations are characterized by a high level of innovation activity, as is frequently stated in the literature (for an overview see Fritsch, 2000). In this interpretation, a positive relationship between density and start-up activity implies that a high level of innovativeness is conducive to new firm formation processes.

The empirical results concerning the impact of unemployment on new firm formation is rather contradictory and unclear. On the one hand, it could be argued that unemployed workers face rather low opportunity costs when starting their own firms, so that a high level of unemployment may lead to relatively large numbers of start-ups. On the other hand, high unemployment may indicate relatively low demand and correspondingly bad prospects for a successful start-up. In most of the empirical studies, the impact of the unemployment rate on new firm formation was found to be almost insignificant (cf. Reynolds, Storey and Westhead, 1994; Evans and Siegfried, 1994; Geroski, 1995). A few analyses have found that the percentage change in the number of unemployed had a negative impact on new firm formation activity (cf. Reynolds, Storey and Westhead, 1994; Sutaria, 2001). There is little doubt that growing demand should be stimulating for start-ups. But it is not quite clear, however, whether the demand for the produce of the specific industry or the overall demand is more important in this respect.

[6] Cf. Reynolds, Storey and Westhead (1994); Fotopoulos and Spence (1999), Armington and Acs (2002).

3. Overview of new firm formation in Germany 1983-97

Our information on start-ups is generated from the German Social Insurance Statistics (see Brixy and Fritsch, 2002, for a description of this data source). The data is comprised of the yearly number of new enterprises in the 74 (West) German planning regions for 52 private-sector industries in the 1983-97 period. Because the data covers only establishments with at least one employee other than the founder, start-ups of firms that remain very small without any employees are not included. Planning regions are functional spatial units somewhat larger than labor-market areas consisting of at least one city and the surrounding area.[7]

According to our data, there were about 126 thousand private sector start-ups per year in the period under examination. Over the years, the number of start-ups increased slightly with a relatively distinct rise between 1990 and 1991. The difference between the average start-up rate in the 1983-89 and the 1990-97 period was about 14%. The majority of the new firms, about 92.5 thousand per year (73.4% of all start-ups), were in the service sector compared to about 14.4 thousand new establishments per year (11.5%) in manufacturing.[8] There was an overall trend towards an increasing share of start-ups in the service sector and a corresponding decreasing share in manufacturing (Figure 1). In the service sector, the largest number of new establishments was set up in wholesale and resale trade, hotels and inns, and the non-specified "other" services. In manufacturing, most start-ups were in steel processing, motor vehicles, electrical engineering, furniture and food (Table 1).

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7 The definition of the planning regions developed in the 1980s was used for the whole period for reasons of consistency. For this definition of the planning regions see Bundesforschungsanstalt für Landeskunde und Raumordnung (1987, 7-10). The Berlin region was excluded due to changes in the definition of the region in the time period under inspection. One might suppose that German unification in 1990 would have had an effect on start-up activity in regions along the former border with East Germany. However, closer inspection shows that such effects, if they exist at all, tend to be rather small and are in any case not significant enough to justify the exclusion of these regions.

8 The "other private sectors" are agriculture and forestry, fishery, energy and water supply, mining and construction.

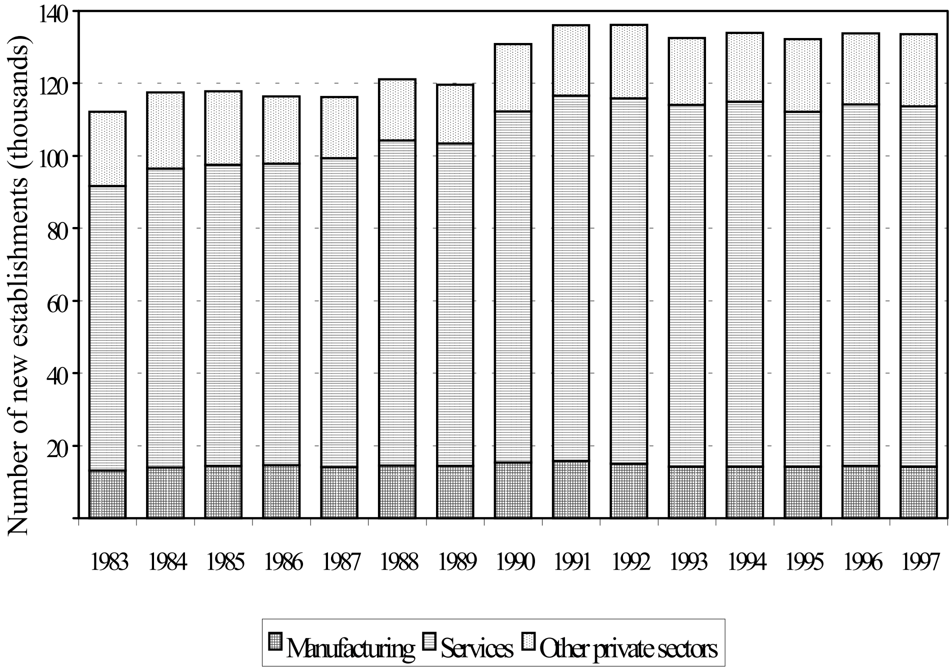

Figure 1: Number of start-ups in West Germany per year 1983-97

Because industries and regions differ considerably in their economic potential, the absolute number of new establishments may not be a meaningful indicator for comparisons of new firm formation processes. To account for such differences in economic potential, it is a common practice to analyze start-up rates. For calculating start-up rates we apply the 'labor market' approach here (cf. Audretsch and Fritsch, 1994), i.e., we divide the number of start-ups by the number of employees in a certain industry and region. To the degree that new establishments are set up in the industry in which the founder is employed and are located near the founder's residence, the number of employees in an industry and region can be viewed as a measure of the number of potential entrepreneurs.[9] In this case, the start-up rate represents the probability that an employee in a given industry and region will set up a new establishment during the given period of

9 This interpretation neglects start-ups by unemployed persons. However, there is no plausible way to allocate the unemployed persons to the different industries since information about place of former employment was not available.

Table 1: Average Yearly Number of Start-ups and Start-up Rates in Different Industries 1983-97

Industry	Average no. of start-ups per year (percent share in all start-ups)	Average start-up rate	Industry	Average no. of start-ups per year (percent share in all start-ups)	Average start-up rate
Agriculture	7,716 (6.13)	35.89	Jewelry, musical instruments and toys	230 (0.18)	4.69
Water, energy	85 (0.07)	0.36	Wood (excluding furniture)	111 (0.09)	1.82
Coal mining	4 (0.00)	0.02	Furniture	1,920 (1.53)	5.30
Other mining	19 (0.02)	0.53	Paper-making	12 (0.01)	0.20
Chemicals	177 (0.14)	0.32	Paper processing and board	119 (0.09)	1.21
Mineral oil processing	7 (0.00)	0.24	Printing	775 (0.62)	3.62
Plastics	432 (0.34)	1.56	Textiles	208 (0.17)	0.95
Rubber	45 (0.04)	0.48	Leather	260 (0.21)	3.74
Stone and clay	398 (0.32)	2.15	Apparel	598 (0.48)	3.33
Ceramics	82 (0.07)	1.29	Food	1,572 (1.25)	2.77
Glass	54 (0.04)	0.78	Beverages	68 (0.05)	0.71
Iron and steel	15 (0.01)	0.10	Tobacco	2 (0.00)	0.23
Non-ferrous metals	25 (0.02)	0.42	Construction	6,569 (5.22)	6.47
Foundries	53 (0.04)	0.54	Installation	4,649 (3.69)	7.85
Steel processing	1,176 (0.93)	4.00	Wholesale trade	10,519 (8.36)	8.80
Steel and light metal construction	655 (0.52)	3.48	Resale trade	20,743 (16.48)	12.29
Machinery (non-electrical excluding office)	587 (0.47)	0.96	Shipping	241 (0.19)	4.79
Gears, drive units and other machine parts	360 (0.29)	1.07	Traffic and freight	6,482 (5.15)	10.13
Office machinery	35 (0.03)	2.48	Postal services	457 (0.36)	1.34
Computers	101 (0.08)	1.99	Banking and credits	812 (0.65)	8.49
Motor vehicles	1,844 (1.47)	1.85	Insurance	2,051 (1.63)	1.34
Shipbuilding	37 (0.03)	1.06	Real estate and housing	4,503 (3.58)	27.05
Aerospace	21 (0.02)	0.35	Hotels, inns etc.	16,448 (13.07)	32.16
Electronics	1,222 (0.97)	1.27	Science, publishing, etc.	4,004 (3.18)	14.44
Fine mechanics	714 (0.57)	3.73	Health care	7,273 (5.78)	14.39
Watches and gauges	31 (0.02)	3.00	Other private services	19,296 (15.33)	14.59
Iron and metal goods	493 (0.39)	1.42			

Table 2: Average Yearly Number of Start-ups and Start-up Rates in Different Sectors 1983-97 by Type of Region[a]

Average yearly number of start-ups	Agglomerations	Moderately congested	Rural areas	All regions
All private sectors	66,253 (52.6 / 100)	40,612 (32.3 / 100)	18,999 (15.1 / 100)	125,854 (100 / 100)
Manufacturing	7,169 (49.6 / 10.8)	4,972 (34.4 / 12.2)	2,309 (16.0 / 12.1)	14,450 (100 / 11.4)
Services	50,615 (54.8 / 76.4)	28,942 (31.3 / 71.3)	12,816 (13.9 / 67.5)	92,373 (100 / 73.4)
Other industries	8,469 (44.5 / 12.8)	6,698 (35.2 / 16.5)	3,864 (20.3 / 20.3)	19,031 (100 / 15.1)
Start-up rate (number of start-ups per 1,000 employees)				
All private sectors	7.06	7.29	7.81	7.24
Manufacturing	1.84	1.95	1.89	1.89
Services	9.41	12.82	14.89	10.87
Other industries	7.68	8.70	11.00	8.53

a: First value in parentheses is row percent, second value is column percent.

time. The average yearly start-up rate (number of new establishments per 1,000 employees) of 7.24 (Table 2) means that per year about every 138th employee started a new business. There is considerable variation in start-up rates across industries indicating widely varying conditions for entrepreneurship. Generally, start-up rates tend to be higher in the service sector than in manufacturing. That we find the highest start-up rate in agriculture is to a certain extent due to the fact that many potential founders in this sector work in establishments that do not appear in our statistics because they are more or less completely family-run and, therefore, are exempt from social insurance payments.

Not surprisingly, most of the start-ups (52.6 percent) were located in the agglomerations, while only 15.1 percent were in rural areas (Table 2). The share of new firms in the service sector was relatively high in agglomerations (76.4 percent) and lowest in rural regions (67.5 percent). Taking the private sector as a whole, we find the lowest start-up rates in the agglomerations. While for manufacturing, the highest start-up rate is in the moderately congested regions, the rural areas show the highest rates for services and other industries.

4. Variation of new firm formation over industry, space, and time

Multilevel analysis allows different categories or dimensions of influences to be examined simultaneously.[10] In our approach, these dimensions are industry, space, and time. We analyze to what extent the number of start-ups that took place in a certain industry and region during a certain year is determined by factors that are specific to the respective industries, regions or years. In doing so, we particularly try to account for interregional differences in industry-specific factors. In a first analysis step, we break down the total variance of start-up activity into three dimensions: industry, region, and time. We estimate

(1) $y_{ijk} = \beta_0 + e_{ijk} + u_{jk} + v_k$, with

yijk is the number of start-ups in an industry, region and year. The subscripts *i*, *j* and *k* represent the three levels or dimensions of analysis. In our model, level *i* is time (1983-1997), level *j* is industry (52 industries) and level *k* is space (74 West German regions). If an item has all three subscripts *ijk,* it varies across all three levels; If an item has two subscripts, it varies across two levels, and so on. *eijk, ujk* and *vk* represent the random variables at the three levels, which follow a normal distribution with *E (eijk) = E (ujk) = E (vk) = 0* and *var (eijk) = σ2e, var (ujk) = σ²u, var (vk) = σ²u.*

The estimation procedure used was generalized least squares.[11] When using the number of start-ups as dependent variable, we obtain a value of 33.20 for the

10 For a more detailed description of the estimation method see Goldstein (1995), Bryk and Raudenbush (1992) as well as Snijders and Bosker (1999).

[11] The estimations have been made on the basis of STATA 7.0.

constant term (β_0) in the estimation for all private sectors (Table 3). This gives us the average number of start-ups in an average industry and region during an average year. Restricting these estimations to manufacturing or services resulted in an average number of 5.58 start-ups in manufacturing and 104.17 new establishments in the service sector. We found the highest variance for the random variable u_{jk}, indicating that the largest part of variation in the number of new establishments is found across industries (σ^2_{ujk}). Considerably less variation could be attributed to region (σ^2_{vk}), and the smallest share of variation in start-up activity was found over time (σ^2_{eijk}).

Table 3: Average Number of Start-ups, Start-up Rate and Estimated Variance by Industry, Region and Over Time[a]

		Variance by		
Number of start-ups	Average	time (σ^2_{eijk})	industry (σ^2_{ujk})	region (σ^2_{vk})
All private sectors	33.20 (2.94)	182.65 (1.10)	7,109.98 (162.37)	503.64 (104.92)
Manufacturing	5.58 (0.44)	8.05 (0.06)	83.48 (2.37)	12.07 (2.38)
Services	104.17 (10.30)	556.52 (7.06)	17,764.38 (882.40)	6,372.82 (1,293.69)
Start-up rate (number of start-ups per 1,000 employees)				
All private sectors	12.93 (0.62)	1,542.03 (9.62)	1,287.85 (32.43)	1.07 (4.72)
Manufacturing	10.08 (0.70)	2,031.87 (15.59)	1,077.06 (34.39)	0.00 (0.00)
Services	18.44 (0.99)	592.43 (7.58)	802.93 (41.83)	1.77 (12.40)

a: Standard deviation in parentheses.

Because the high variation in numbers of start-up between industries is to some degree the result of differences in their economic potential, we carried out the same procedure for start-up rates that account for industry size. In this case, the smallest amount of variation was found across regions (Table 3). In manufacturing as well as in the estimates for all private industries, the highest share of variance could be attributed to time. Estimates limited to the service sector showed that industry affiliation was responsible for most of the variation. Obviously, differences in market dynamics play a relatively pronounced role for start-up activity in service industries. A comparison of the results for the two indicators of start-up activity, i.e., the number of new establishments and the start-up rate, highlights the impact of employment changes on the start-up rate. The higher variance of start-up rates across industry in estimates limited to manufacturing indicates that manufacturing industries differ more with regard to employment change than with regard to the number of start-ups. The opposite seems to be the case for the service industries. For all three sector definitions, the variance across regions is much smaller for start-up rates than it is for the number of start-ups. Variation over time is much higher for start-up rates than it is for the number of start-ups. This reflects a considerable impact of changes in employment, the denominator of the start-up rate.

5. Multivariate analysis

5.1 Variables and estimation procedure

The analysis of the variation of new firm formation across the different dimensions showed that the start-up rate was significantly shaped by employment change in the respective industry and region (cf. Table 3). This is one reason why this rate is a questionable indicator in analyses of new firm formation and entrepreneurship over time. Another argument against using the start-up rate in longitudinal analyses is that independent variables with the number of employees as the denominator are affected by employment changes. As a consequence, the estimates for such independent variables may suffer from a positive pseudo-correlation with the start-up rate. In our analysis, this is particularly relevant for the share of employees in small establishments, labor unit costs and the unemployment rate. For these reasons, we used the number of start-ups instead of the start-up rate as dependent variable in our analyses of the causal factors determining new firm formation.

We applied two alternative estimation procedures. The first method was ordinary least squares (OLS). In keeping with the count data character of the number of start-ups as dependent variable, we also used negative-binomial (negbin) regression. This method is based on the assumption that the counts result from a stochastic poisson-type process. An ordinary negbin regression would, however, lead to the problem of having 'too many' zero values, which implies a violation of underlying distribution assumptions (see Greene, 1997, 931-939). Given the high degree of regional and industrial disaggregation in our data, such zero-value observations represent a considerable share of all cases. For an analysis across all private sectors, this share amounts to 29.7 percent. In manufacturing it is 35.2 percent and in services the proportion of cases with no start-up in a given industry, region and year is 9.9 percent. One solution to this problem would be to apply a 'truncated' negbin-approach, i.e., to exclude those cases that had no start-ups in a given year. However, because observations with zero start-ups are most likely to occur in industries and regions with a relatively low level of new firm formation activity, omission of these cases would lead to a sample that is biased towards large industries and regions with many new establishments. To avoid this problem, we applied a zero inflated negbin approach. This type of model assumes that zero values may result from two different kinds of regime. Under the first regime, the probability of a positive count (i.e., start-up) in an industry in a certain region is about zero. In this case, a zero observation can, therefore, not be regarded a result of a stochastic poisson process. Under the second regime, the zero observations are assumed to be an outcome of such a poisson process with some positive probability that a start-up in the respective industry and region will occur. The zero inflated negbin approach tries to exclude those zero counts that can not be regarded to result from a poisson process. This is in our case done using a logit model with the number of employees (ln) in each industry and region as exogenous variable (cf. Long, 1997, Chapter 8 and Greene, 1997, Chapter 19.9). In our analysis, we found that the estimates of truncated and zero inflated negbin models were very similar so that using one approach instead of the other does not seem to have a significant impact on the results. However, missing values in some of the exogenous variables led to some unavoidable sample bias.[12]

Because industries and regions with a relatively high number of start-ups in a certain year will tend to have correspondingly high numbers of start-ups in other years, there may be considerably autocorrelation over time, leading to biased estimates of the coefficients. Moreover, an industry population in a region that is characterized by high numbers of start-ups is also quite likely to show comparatively high levels of change in the number of start-ups over time. Such an effect would imply heteroscedasticity resulting in biased estimates of variance and, therefore, unreliable test statistics. To avoid these problems, we apply the correction procedure developed by Huber (1967) and White (1980) which provides estimates that are robust with regard to this type of heteroscedasticity and autocorrelation over time. Because this procedure relates each observation to the average value of the industry in the respective region (= cluster), it also accounts for unobserved region- and industry-specific effects.

In our analysis, we use the following indicators to assess the importance of the different factors on the number of new businesses in a certain industry, region and year:

- *Employment:* The number (ln) of employees in a given industry, region and year as an indicator for the pool of potential entrepreneurs. Including only the employees in the same industry implies that the new firm are set up in the industry in which the founder has been employed before. In order to explore the impact of new firms set up by employees of other industries, we also tested the number (ln) of employees in all industries in the respective region and year (source: Social Insurance Statistics).

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[12] Missing values may occur with regards to the share of small firm employment or the entrepreneurial character of the technological regime if there is no employee or no R&D employee present in an industry and region. In our sample, this refers 28.7 percent of all cases. In manufacturing

- *Unemployment:* The number of unemployed persons (ln) in a given region and year indicates to what extent new firms are set up by unemployed persons. In some models we included the number (ln) of short-term unemployed in a given region and year. The group included those who were unemployed for less than one year. Our assumption was that the short-term unemployed would be more likely to start a business than those who were unemployed for longer than a year. In an alternative version of the model, we included the regional unemployment rate. In such an approach, the unemployed do not represent a potential pool of entrepreneurs. However, they are an important aspect of the economic environment (source: Federal Employment Services).

- *Minimum efficient size*: the 75th percentile of establishment size when establishments are ordered by size as measured by the number of employees[13] (source: Social Insurance Statistics).

- *Small firm presence*: Share of employees in establishments with less than 50 employees in a given region, industry and year (source: Social Insurance Statistics).

- *Technological regime:* The proportion of R&D employees in establishments with less than 50 employees over the share of R&D employment in total employment in the same region, industry and year (source: Social Insurance Statistics). We used the number of engineers and employees with a degree in natural sciences as a proxy for R&D employment. This quotient measures the importance of small establishments for R&D activity.[14] Note that we calculate the technological regime indicator for each industry in each region separately

industries, the share of observations with no startup-up in a certain region and year amounts to 35,2 percent and in the service industries it is 9.9 percent.

[13] For this indicator see Audretsch (1995, 59) as well as Comanor and Wilson (1967, 428f.).

[14] This indicator corresponds to the “small-firm innovation rate / total innovation rate” used by Audretsch (1995) as a measure of the entrepreneurial character of an industry. In contrast to Audretsch's indicator, which is based on the number of innovations introduced, our measure refers to R&D input.

so that the character of the technological regime in that industry may differ across regions as is suggested by some authors (Saxenian, 1994). We find that the indicator for the technological regime correlates highly with indicators that measure the qualification level of the workforce in the industry and region, such as the share of employees with a university degree. Because the propensity of individuals to set up a new business rises as their level of qualification increases, one can expect a positive relationship between the qualification variable and the level of start-up activity (Bates, 1990). In our analyses, estimates with the indicator for the technological regime lead to a better fit than those based on measures of the qualification level, so that we omitted the variables for shares of a certain qualification.

- *Capital intensity:* Gross capital assets expressed in terms of 10,000 German marks (source: Federal Statistical Office, Fachserie18, various volumes) over the number of employees (source: Social Insurance Statistics) by industry and year.

- *Labor unit cost:* Gross income from dependent work per employee over gross value added per employee (source: Federal Statistical Office, Fachserie 18, various volumes) by industry over time.

- *Capital user cost:* Nominal interest rate of ten-year government bonds minus the rate of inflation (source: German Federal Bank, various volumes) plus the average yearly depreciation rate of gross capital assets (based on Federal Statistical Office, Fachserie18, various volumes) within an industry over time.

- *Regional innovativeness*: Number of patents per 1,000 employees in a region in the 1992-94 period (source: German Federal Patent Office taken from Greif, 1998).

- *Change of demand:* Our main indicator of demand is the percent change of gross domestic product in the preceding year (source: Federal Statistical Office, various volumes). This variable had a much stronger impact on new firm formation activity than the percent change of gross value added in a given industry. In one version of the model (model III) we included percent change in regional population in the preceding year as indicator for development of overall demand in the region (source: Federal Statistical Office).

- *Population density:* Number of inhabitants per square kilometer (source: Federal Statistical Office).

We find a considerable degree of spatial autocorrelation in our data, i.e., new firm formation processes in adjacent regions are not independent but related in some way. There are two possible explanations for this high degree of spatial autocorrelation. One is that a significant number of entrepreneurs set up a business in an adjacent region. However, this seems quite unlikely, given the considerable size of the planning regions and the fact that founders of new firms tend to locate their businesses in close proximity to their homes (Johnson and Cathcart, 1979b; Mueller and Morgan, 1962; Cooper and Dunkelberg, 1987). We accounted for this type of spatial autocorrelation by including a *weighted average of the number (ln) of start-ups in the respective industry that took place in adjacent regions*. A more likely explanation for this spatial autocorrelation is that an entrepreneurial attitude or technological regime influences geographical entities that are larger than planning regions. In fact, Audretsch and Fritsch (2002) found that a certain type of growth regime tends to apply to a geographical area that is larger than a single planning region. We accounted for this type of spatial autocorrelation by including a *weighted average of the residuals in the adjacent regions* in the models.

5.2 Results

Table 4 displays the results of ordinary least squares and zero-inflated negbin models for all private sectors. Estimates limited to manufacturing or to the service industries are shown in Table 5 and 6. The strong impact of employment in each industry and region on the number of newly-founded firms clearly indicates that new firms are set up by people. Substituting this variable by overall regional employment leads to a slightly higher value of the coefficient, suggesting that some of the founders come from other industries. However, statistical significance of this variable and statistical fit of the model is somewhat weaker. Another reason for including regional employment in the same industry in our models is that we find a much lower correlation between industry employment and the number of unemployed and, therefore, less multicollinearity than would have been the case had we included overall regional employment. The statistically significant impact of the number of unemployed persons indicates that also those who are unemployed set up new firms. This coefficient is higher for those who are unemployed for less than one year than it is for those who are unemployed for a longer period of time. Nonetheless, the value of this coefficient for both categories of unemployed workers is much smaller than it is for those who have jobs. Obviously, the propensity for unemployed persons to found a firm is relatively low, which explains the negative impact on the number of start-ups that we find for the unemployment rate (model III). A change in the number of unemployed persons or of the unemployment rate had no significant influence on the number of start-ups.

Our indicator for small firm presence (share of employees in small establishments with less than 50 employees) was highly correlated with the measure of minimum efficient size (number of employees representing the 75th percentile of establishments in the industry). The indicator of minimum efficient size (models I and III) had a stronger impact on new firm formation than the measure for small firm presence (model II). This suggests that the positive relationship between small firm employment and start-up activity that has been found in cross-regional analyses may be largely due to a regional concentration of industries with low minimum efficient size. Our indicator for the technological regime in an industry in a certain location had a considerable impact. It had particular significance in the estimates for manufacturing industries (Table 5). The positive sign of the respective coefficients clearly indicates that an entrepreneurial character of an industry is conducive to start-up activity. This confirms the results attained by Audretsch (1995) in analyses of a cross-section of industries. Variables reflecting the formal

Table 4: Results of Multi-level Analyses of New Firm Formation for All Private Sectors

	I		II		III	
	OLS[a]	zero-inflated negbin[b]	OLS[a]	zero-inflated negbin[b]	OLS[a]	zero-inflated negbin[b]
Constant	-3.9064** (27.07)	-5.1690** (28.89)	-4.1706** (27.10)	-5.5042** (25.32)	2.0453** (14.45)	1.6091** (7.19)
Number (ln) of employees in each industry (ijk)	0.4551** (38.84)	0.6340** (48.47)	0.4884** (38.14)	0.6255** (40.51)	-	-
Number (ln) of unemployed persons (ik)	0.2459** (18.24)	0.2530** (16.29)	0.2153** (15.47)	0.2271** (12.80)	-	-
Regional unemployment rate (ik)	-	-	-	-	-0.0093* (2.07)	-0.0319** (5.46)
Minimum efficient size (ij)	-0.0022** (18.44)	-0.0059** (18.36)	-	-	-0.0026** (14.89)	-0.0044** (10.95)
Small firm employment (ijk)	-	-	0.2553** (5.17)	0.1469* (1.99)	-	-
Entrepreneurial technological regime (ijk)	0.0006** (7.82)	0.0006** (7.08)	0.0007** (8.02)	0.0007** (6.77)	0.0002** (2.75)	0.0000 (0.17)
Capital intensity (ij)	-0.0002** (4.80)	-0.0002** (3.72)	-0.0004** (6.13)	-0.0004** (5.07)	-0.0005** (6.51)	-0.0004* (2.72)
Labor unit costs (ij)	-0.0086** (14.95)	-0.0073** (10.60)	-0.0109** (17.71)	-0.0125** (15.72)	-0.0096** (12.34)	-0.008** (6.49)
Capital user costs (ij)	-0.0440** (9.27)	-0.0560** (10.97)	-0.0443** (9.01)	-0.0459** (7.91)	-0.0571** (9.72)	-0.0441** (5.04)
Patents per 1,000 employees (k)	0.1240** (7.71)	0.1176** (6.19)	0.1296** (7.82)	0.1389** (6.45)	0.2335** (8.49)	0.2214** (5.48)
GDP growth rate (i)	0.0222** (11.05)	0.0331** (15.92)	0.0113** (5.56)	0.0152** (6.49)	-	-
Regional population change (ik)	-	-	-	-	0.0350** (6.55)	0.0375** (5.83)
Population density (ik)	-	-	-	-	0.0001** (2.71)	0.0003** (4.26)
Number (ln) of start-ups in the same industry in adjacent regions (ijk)	0.2818** (24.97)	0.2616** (16.08)	0.3276** (28.85)	0.3720** (21.30)	0.3806** (18.27)	0.5538** (16.40)
Residuals in adjacent regions (ijk)	0.7035** (30.11)	0.6383** (19.95)	0.6407** (26.81)	0.6307** (17.01)	0.5402** (16.36)	0.3815** (7.99)
Number of cases	29,696	29,696 + 3,991 zero obs.	29,696	29,696 + 3,991 zero obs.	34,646	34,646 + 4,668 zero obs.
Adj. R^2 and McFadden's Adj. R^2/ML R^2/Cragg & Uhler's R^2 respectively	0.870	0.267 0.900 0.900	0.865	0.250 0.884 0.884	0.765	0.175 0.779 0.779
F-statistic and Wald chi^2-statistics respectively	2497.98**	28208.95**	2440.29**	21738.81**	1055.39**	6073.56**
F-statistics and chi^2 statistics respectively[c]	2674.06**	1972.98**	3235.96**	3549.82**	3205.53**	2925.90**

a: t-statistics in parentheses. b: z-statistics in parentheses. i : per year. j: values per industry. k: values per region. -: variable not included in the model. **: statistically significant at the 1 percent level. *: statistically significant at the 5 percent level.
c: for H0: coefficient of number (ln) of start-ups in the same industry in adjacent regions = 0 and coefficient of residuals in adjacent regions

Table 5: Results of Multi-level Analyses of New Firm Formation for Manufacturing Industries

	I OLS[a]	I zero-inflated negbin[b]	II OLS[a]	II zero-inflated negbin[b]	III OLS[a]	III zero-inflated negbin[b]
Constant	-4.206** (25.56)	-5.6421 (31.69)	-4.1876** (24.82)	-5.7981** (27.09)	1.584** (11.26)	1.5281** (6.76)
Number (ln) of employees in each industry (ijk)	0.3979** (31.60)	0.5992** (35.44)	0.4293** (30.11)	0.6198** (29.73)	-	-
Number (ln) of unemployed persons (ik)	0.2361** (15.79)	0.2680** (14.80)	0.2100** (14.01)	0.2345** (11.65)	-	-
Regional unemployment rate (ik)	-	-	-	-	-0.0102* (2.01)	-0.0239** (3.34)
Minimum efficient size (ij)	-0.0019** (17.73)	-0.0050** (18.08)	-	-	-0.0024** (14.45)	-0.0043** (11.79)
Small firm employment (ijk)	-	-	0.2501** 4.23)	0.4669* 4.80***	-	-
Entrepreneurial technological regime (ijk)	0.0008** (8.60)	0.0009** (8.66)	0.0010** (8.87)	0.0013** (9.41)	0.0003** (3.17)	0.0002 (1.54)
Capital intensity (ij)	-0.0004** (5.05)	-0.0018** (7.42)	-0.0005** (6.19)	-0.0017** (7.09)	-0.0006** (7.97)	-0.0021** (6.93)
Labor unit costs (ij)	-0.0021** (2.95)	-0.0009 (0.91)	-0.0049** (6.22)	-0.0087** (7.90)	-0.0036** (4.15)	-0.0011 (0.79)
Capital user costs (ij)	-0.0318** (5.54)	-0.0411** (6.57)	-0.0338** (5.83)	-0.0425** (6.25)	-0.0374** (7.04)	-0.0378** (5.04)
Patents per 1,000 employees (k)	0.1147** (6.39)	0.1066** (4.91)	0.1247** (6.82)	0.1387** (5.81)	0.1913** (6.48)	0.1927** (4.44)
GDP growth rate (i)	0.0252** (9.89)	0.0353** (12.16)	0.0139** (5.58)	0.0135** (4.55)	-	-
Regional population change (ik)	-	-	-	-	0.0226** (4.06)	0.0220** (3.26)
Population density (ik)	-	-	-	-	0.0001** (2.90)	0.0003** (4.01)
Number (ln) of start-ups in the same industry in adjacent regions (ijk)	0.2520** (21.33)	0.2229** (13.88)	0.2866** (24.17)	0.3117** (18.66)	0.2953** (15.00)	0.3749** (10.89)
Residuals in adjacent regions (ijk)	0.4233** (15.74)	0.4723** (14.22)	0.4492** (17.78)	0.6211** (19.77)	0.4630** (12.73)	0.4280** (8.07)
Number of cases	19,770	19,770 + 3,339 zero obs.	19,770	19,770 + 3,339 zero obs.	23,063	23,063 + 3,929 zero obs.
Adj. R^2 and McFadden's Adj. R^2/ML R^2/Cragg & Uhler's R^2 respectively	0.707	0.223 0.752 0.753	0.698	0.205 0.722 0.723	0.530	0.124 0.539 0.540
F-statistic and Wald chi²-statistics respectively	667.99**	8465.27**	697.87**	7371.92**	341.05**	1892.02**
F-statistics and chi² statistics respectively[c]	709.86**	673.20**	1013.91**	1755.26**	1075.30**	860.54**

a: t-statistics in parentheses. b: z-statistics in parentheses. i : per year. j: values per industry. k: values per region. -: variable not included in the model. **: statistically significant at the 1 percent level. *: statistically significant at the 5 percent level.

c: for H0: coefficient of number (ln) of start-ups in same industry in adjacent regions = 0 and coefficient of residuals in adjacent regions

Table 6: Results of Multi-level Analyses of New Firm Formation for Service Industries

	I		II		III	
	OLS[a]	zero-inflated negbin[b]	OLS[a]	zero-inflated negbin[b]	OLS[a]	zero-inflated negbin[b]
Constant	-4.3846** (16.39)	3.0918** (4.87)	-4.1804** (13.17)	-4.1836** (12.91)	1.8799** (5.91)	2.0709** (5.96)
Number (ln) of employees in each industry (ijk)	0.5814** (28.66)	0.2374 (1.86)	0.6078** (24.95)	0.6194** (24.84)	-	-
Number (ln) of unemployed persons (ik)	0.2580** (9.61)	0.0371 0.44	0.1924** (6.25)	0.2046** (6.63)	-	-
Regional unemployment rate (ik)	-	-	-	-	-0.0306** (3.08)	-0.0458** (4.28)
Minimum efficient size (ij)	-0.0120** (11.95)	-0.0258** (7.49)	-	-	-0.0132** (9.52)	-0.0185** (8.46)
Small firm employment (ijk)	-	-	0.1495** (6.41)	0.1965** (8.48)	-	-
Entrepreneurial technological regime (ijk)	0.0004** (5.09)	0.0002** (2.56)	0.0001* (2.01)	0.0001 0.60	0.000* (2.48)	0.0004** (4.73)
Capital intensity (ij)	-0.0004** (9.55)	-0.0005** (5.45)	-0.0005** (9.84)	-0.0005** (8.58)	-0.0006** (5.80)	-0.0005** (3.96)
Labor unit costs (ij)	0.0003 0.28	-0.0024 -1.11	-0.0085** (6.85)	-0.0072** (6.06)	-0.0050* (2.25)	0.0034 (1.38)
Capital user costs (ij)	-0.0223* (2.56)	-0.1094** (7.77)	-0.0097 (0.92)	-0.0130 (1.30)	-0.0104 (0.80)	0.0120 (0.89)
Patents per 1,000 employees (k)	0.1455** (5.32)	0.1085 (1.51)	0.1546** (4.77)	0.1630** (4.98)	0.2030** (3.33)	0.1755* (2.41)
GDP growth rate (i)	0.0178** (5.37)	0.0010 (0.23)	0.0094** (2.64)	0.0144** (4.27)	-	-
Regional population change (ik)	-	-	-	-	0.0351** (3.00)	0.0341** (3.06)
Population density (ik)	-	-	-	-	0.0002* (2.03)	0.0004** (3.08)
Number (ln) of start-ups in the same industry in adjacent regions (ijk)	0.1415** (6.25)	0.0649 (1.02)	0.2594** (10.10)	0.2656** (9.62)	0.4326** (9.18)	0.4808** (8.62)
Residuals in adjacent regions (ijk)	0.5550** (10.07)	0.4141** (4.87)	0.5957** (10.68)	0.4801** (9.16)	0.1189 (1.92)	0.0540 (0.88)
Number of cases	7,114	7,114 + 160 zero obs.	7,114	7,114 + 160 zero obs.	8,300	8,300 + 174 zero obs.
Adj. R^2 and McFadden's Adj. R^2/ML R^2/Cragg & Uhler's R^2 respectively	0.889	0.106 0.714 0.714	0.868	0.165 0.860 0.860	0.658	0.080 0.614 0.614
F-statistic and Wald chi²-statistics respectively	557.73**	6041.20**	453.21**	4323.69**	193.02**	1103.26**
F-statistics and chi² statistics respectively[c]	150.91**	32.51**	380.28**	379.35**	157.02**	202.35**

a: t-statistics in parentheses. b: z-statistics in parentheses. i : per year. j: values per industry. k: values per region. -: variable not included in the model. **: statistically significant at the 1 percent level. *: statistically significant at the 5 percent level.

c: for H0: coefficient of number (ln) of start-ups in same industry in adjacent regions = 0 and coefficient of residuals in adjacent regions qualifications of the regional workforce (e.g., share of employees with a university degree) were only significant in models that did not include the indicator for the technological regime. We found considerable correlation between these variables, with the technological regime indicator clearly outperforming the qualification measures in models that contained both variables. Remarkably, in analyses of the data that do not account for regional differences, the indicator for the technological regime of the industry was found to have no statistically significant impact on start-up activity. This suggests that there is an important degree of interregional variation with respect to the character of the technological regime in an industry. A case was made for this by Saxenian (1994) in her comparison of the computer industry along Route 128 and in Silicon Valley. Therefore, analyses on the level of industries that do not account for such regional differences may be misleading.

The level of capital intensity, labor unit cost and capital user cost were significant with the expected sign. No significant impact could be found for changes of these factors. The number of patents granted to private firms and other institution (e.g., universities) located in the region represents an overall indicator for the level of regional innovation activity. The results for this measure signify that a relatively high degree of innovativeness in a region is conducive to start-up activity, particularly for start-ups in manufacturing industries where significance of this variable was higher than for start-ups in the service sector. Change in the national gross domestic product (GDP) in the preceding year had a significantly stronger impact than changes in the industry's gross value added, so that the respective indicators are not included in one model. The estimates show that changes in demand are of significant importance for new business set-up in all sectors.[15] Regional population change had some effect on new-firm formation (Version III), more in the case of service industries than in manufacturing.[16] Be-

15 Obviously, this effect is mainly limited to changes in the preceding year because according to our estimates lags for more remote time periods were not found to be statistically significant.

16 GDP change and unemployment rate are not included in the same model due to multicollinearity problems.

cause of high levels of correlation between employment figures, unemployment figures and population density, the impact of density is tested in a model that does not include the employment figures (Model III). Our estimates clearly indicate that population density in a region is conducive to start-up activity. Obviously, there are agglomeration economies at work that stimulate the formation of new firms. This finding is consistent with hypotheses that emphasize the role of spatial proximity and knowledge spillovers for economic development (cf. Krugman, 1991).

Both variables for the influence of start-up activity in adjacent regions are highly significant with a positive sign. Obviously, the two types of spatial autocorrelation are quite relevant for regional new firm formation processes and should be included in any future empirical analyses. Particularly surprising is the strong impact that we find for the number of start-ups in the adjacent regions indicating spatial spillovers of new firm formation activity. Because planning regions, that constitute the spatial units of our analysis are, rather large and founders tend to locate their business in close proximity to their home, this strong impact is hard to explain and deserves further attention. In our analysis, however, inclusion of variables for effects of spatial autocorrelation did not lead to any changes in the basic structure of the other influences on the number of start-ups. The main difference between manufacturing industries and the service sector is the higher importance of the technological regime for start-ups in manufacturing and the stronger impact of local employment change for new firm formation in the service industries. With respect to all other variables tested, the impact seems to be of about the same significance in both sectors.

6. Conclusions

Our multi-level analysis of new firm formation in Germany confirmed a number of results from pure cross-section studies. Although, the more differentiated data and the higher level of sophistication in the analysis did not substantially contradict the results of previous studies, we were able to shed some new light on a number of issues. Above and beyond a confirmation of earlier studies, there are at least three results that seem to us to be particularly interesting. First, we were able to show that a high level of unemployment definitely has a negative effect on new firm formation because unemployed persons are less likely to found a business than are employed persons. Second, the positive influence of small firm presence on new firm formation that has been found in many cross-regional analyses (cf. Reynolds, Storey and Westhead, 1994), may to some extent be related to the minimum efficient size of the industries that are located in the region. And third, we could demonstrate a significant positive relationship between the entrepreneurial character of an industry in a certain location and the number of start-ups. This clearly indicates that the characteristics of the technological regime and, therefore, of innovation processes play an important role in the formation of new establishments. The significant link between innovation activities and a considerable part of new firm formation processes is also underlined by the positive impact that we find for the level of inventions in a region as measured by the number of patents per 1,000 employees. These results clearly indicate that a considerable part of new firm formation is closely related to innovation activity and can be regarded as an important part of the innovation system. We were able to show that the respective relationships not only vary across industries, but also have a pronounced regional dimension.

Our multi-level analysis of new firm formation processes clearly demonstrates that a more disaggregated and differentiated empirical approach may lead to considerable advance in the understanding of reality. Therefore, further research on new firm formation processes should try to apply such a disaggregated approach that simultaneously accounts for differences between industries *and* regions. Moreover, our results suggest at least two topics for further research. One of these issues is the link between start-ups and the level as well as the characteristics of innovation activity in an industry and region. What are the main causal relationships, how pronounced are these relationship, and what does this mean for economic development? Another issue deserving further investigation is the strikingly high level of spatial autocorrelation that we found in our analysis. Obviously, if spatial autocorrelation is that strong, it should be accounted for in any further analysis of new firm formation activity. And we should learn more about the causes for the pronounced neighborhood effects. Investigation of these issues should lead to a further progress in our understanding of new firm formation processes and the process of economic development.

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