JENA ECONOMIC RESEARCH PAPERS

2007 – 077

Why Does the Effect of New Business Formation Differ Across Regions?

by

Michael Fritsch
Alexandra Schroeter

www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich-Schiller-University and the Max Planck Institute of Economics, Jena, Germany. For editorial correspondence please contact m.pasche@wiwi.uni-jena.de.

Impressum:

Friedrich-Schiller-University Jena
Carl-Zeiß-Str. 3
D-07743 Jena
www.uni-jena.de

Max-Planck-Institute of Economics
Kahlaische Str. 10
D-07745 Jena
www.econ.mpg.de

Jena Economic Research Papers 2007-077

Why Does the Effect of New Business Formation Differ Across Regions?

Michael Fritsch and Alexandra Schroeter

October 2007

Abstract

We investigate regional differences of the effect of new business formation on employment growth in West Germany. We find an inverse 'u'-shaped relationship between the level of start-up activity and employment change. The main variables that shape the employment effects of new businesses in a region are population density, the share of medium level skilled workers, the proportion of Research and Development conducted in small businesses (entrepreneurial technological regime), the unemployment rate as well as the degree of specialization of the regional economy. However, indicators for education and innovation activity in the region proved not to be statistically significant. Conducting our analysis for manufacturing and services separately confirmed the pattern of our previous results only for manufacturing but not for services.

JEL classification: M13, O1, O18, R11

Keywords: Entrepreneurship, new business formation, regional development, entrepreneurship policy

Address for correspondence:

Prof. Dr. Michael Fritsch
Alexandra Schroeter, MA
Friedrich Schiller University Jena
Faculty of Economics and Business Administration
Carl-Zeiss-Str. 3
D-07743 Jena, Germany

m.fritsch@uni-jena.de
alexandra.schroeter@uni-jena.de

1. Aims and scope[1]

Recent empirical research has strongly indicated that the effect of new business formation on economic development is rather long-term[2]. Moreover, it was found that the relationship between new business formation and development is to a considerable degree shaped by the regional conditions. While some regions are able to draw substantial employment growth out of start-ups, the effect may be even negative in other regions. In this paper, we analyze such regional differences of the effect of new business formation on regional development with data for West Germany.

The following section provides an overview on the recent results of empirical research about the regional employment effects of new businesses. We then derive hypotheses about the reasons for the regional differences (section 3). Section 4 introduces the data and the empirical approach. The results of our empirical investigation are presented in section 5. Section 6 concludes.

2. The effects of new business formation on employment

New business formation may affect regional development in many different ways. Start-ups represent an entry of new capacities into the market and are, therefore, an essential element of the market process. The evolution of the newcomers, e.g., given by the number of their employees or by their market share, may be labeled as the *direct effect* of new capacities. This is, however, only a part of the contribution that

[1] We are indebted to Oliver Falk (CES-ifo, Munich) and Antonio Garcia-Tabuenca (University of Alcala, Madrid) for their helpful comments on an earlier version of this paper. Oliver Falck also provided very valuable advice on the econometric issues.

[2] Acs and Mueller (2008), Arauzo-Carod, Liviano-Solis, and Martin-Bofarull (2008), Audretsch and Fritsch (2002), Baptista, Escária, and Madruga (2008), Carree and Thurik (2008), Fritsch and Mueller (2004, 2006, 2008), van Stel and Storey (2004), Mueller, van Stel, and Storey (2008), van Stel and Suddle (2008)

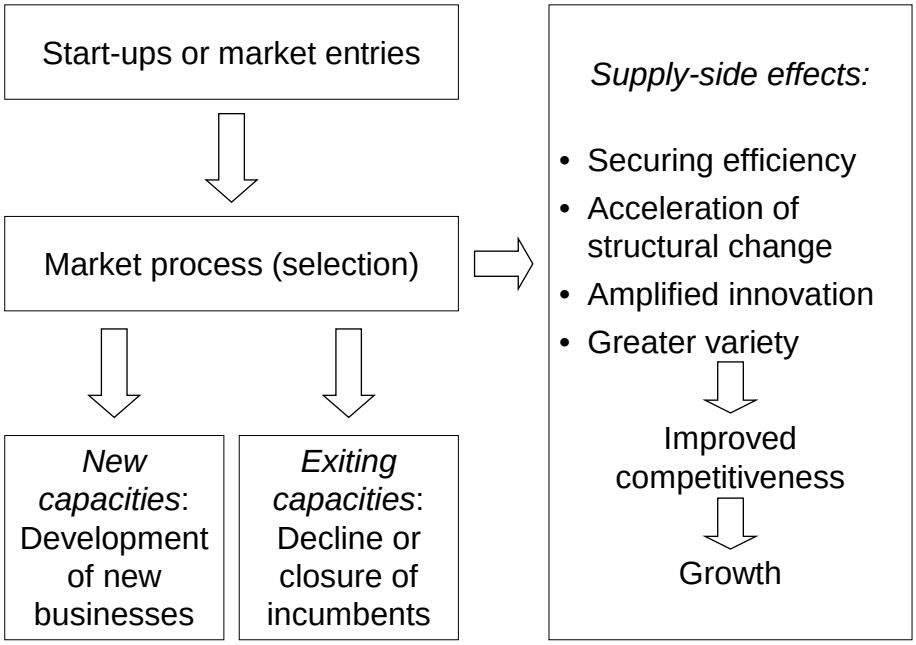

Figure 1: New business formation and the market process

the new businesses make to economic development. Due to competition and market selection, only a fraction of the start-ups survive for a longer period of time (Boeri and Cramer, 1992; Fritsch and Weyh, 2006), and those start-ups that do succeed in establishing themselves in the market may displace incumbents. Therefore, two types of *exiting capacities* may result from the entry of new businesses. Firstly, a considerable part of the new businesses fail to be sufficiently competitive and, thus, have to leave the market after some time. And secondly, the crowding out of incumbents by their new competitors leads to declining market shares or market exit. Given that market selection works according to a survival of the fittest scenario, firms with relatively high productivity will remain in the market while those with low productivity have to reduce their output or exit.[3] At a constant output level, this market selection process should lead to a

[3] Crowding-out effects may occur in the output market because the entrants gain market share as well as in the input market due to the additional demand of the new businesses for resources, which can lead to scarcity of inputs and increasing factor prices.

decline in employment, not to new jobs, because fewer resources are needed in order to produce the given amount of goods and services at a higher productivity level. Hence, although starting a new business means creating additional capacities that require personnel to operate them, the effect of new business formation on the number of jobs in the economy does not necessarily need to be positive but could just as well be negative.

However, a well-functioning market process is in no way a zero-sum game in which the gains of one actor are necessarily completely at the expense of the other actors. There are several ways in which competition by entry of new businesses can stimulate employment growth on the supply-side of the market. The main supply-side effects of entry could be (cf. figure 1):

- Securing efficiency and stimulating an increase in productivity by contesting established market positions;
- *Acceleration of structural change*: It can frequently be observed that structural change is mainly accomplished by a turnover of the respective economic units, i.e., by entries of new firms joined by exits of old-established incumbents. In this case, the incumbents do not undergo any? necessary internal changes, but rather are substituted by newcomers;
- *Amplified innovation*: particularly, the creation of new markets; and
- *Greater variety* of products and problem solutions[4].

These effects are rather indirect in character and lead to improvements on the supply-side of the market. They are not necessarily limited to the industry to which the start-up belongs, but rather may also occur in completely different industries that use the improved supply as an input. For a regional analysis it is important to note that a considerable part of

[4] Such an increased variety implies a higher probability of finding a supply that better fits the customers' preferences. Increased variety due to new supplies may stimulate an intensified division of labor as well as follow-up innovation and can, therefore, generate significant impulses for economic development.

the supply-side effects may occur in the industry's establishments of the industry which are located in other regions. Therefore, the size of the supply-side effect is probably underestimated, and it only focuses on development in the region where the start-ups occurred. If empirical analyses find considerable supply-side effects in the same region, this can be regarded as an indication for the importance of space in competitive processes.

The *indirect supply-side effects* are the drivers of competitiveness of the respective industries, which may induce employment growth and increasing welfare. They are the reason why one should expect positive employment effects of new business formation.[5] It is of critical importance that market selection works in accordance with a "survival of the fittest" scenario for the emergence of an employment-increasing supply-side effect. If the market mechanism would force the relatively efficient firms to exit and would let the inefficient firms survive, competitiveness of the economy would decrease.

Empirical studies on the employment effect of new business formation have shown that this effect can be spread over a period of about a decade. Analyses of the time-lag structure of these effects for a number of countries and regions found quite similar basic patterns (for an overview, see Fritsch, 2008). In most of the cases, the lag distribution was s-shaped indicating that an initial increase in employment in the year that the new businesses are set-up is followed by a decline in employment. After about five years after the initial start-up, the effect on regional employment becomes positive. Whereas the employment in start-up cohorts tends to decline about two years after they initially entered the market, this long-term positive effect of new business formation on regional employment

[5] The emergence of the supply-side effects of new business formation does not necessarily require the newcomers to be successful and to be able to? survive. As long as entry induces improvements on the side of the incumbents, it will generate positive supply-side effects even if most of the new businesses fail and have to exit the market just shortly after entry. Therefore, even the failed start-ups may also make a significant contribution to the improvement of supply and competitiveness.

cannot result from the employment in the new businesses, but rather it is probably caused by supply-side effects. Figure 2 displays this time-lag structure, which was found by Fritsch and Mueller (2004) for the regions of West Germany.

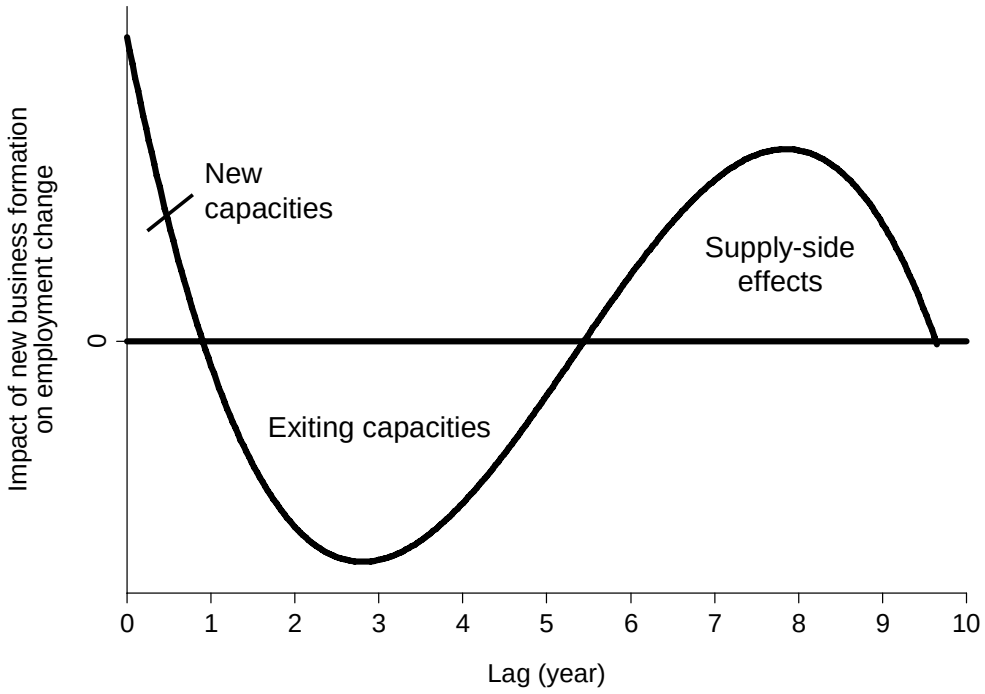

Figure 2: The effects of new firm formation on employment change over time – regression coefficients for start-up rates

In these estimations, a start-up rate was used as an indicator for regional new business formation activity. This start-up rate relates the number of new businesses that occur in a region within a certain time period to a measure of the economic potential of that region in order to make the levels of new business formation in different regions comparable. In the empirical analyses reported here, the start-up rate according to the 'labor market' approach was used. This means that the number of start-ups per period is divided by the number of persons in the

regional workforce at the beginning of the respective period.[6] The indicator for regional development is the relative change in employment.

Some studies have found considerable differences for the overall effect of new business formation on regional development between regions. For example, Fritsch and Mueller (2004, 2008) showed that the effects were more pronounced and, particularly, more positive in agglomerated areas than in rural regions. Fritsch and Mueller (2008) also found that the overall effects of start-ups on employment in high productivity regions are rather positive but can have a negative effect in the low productivity areas. This clearly suggests that new business formation may, in certain regions, lead to a decrease and not to an increase in employment. Negative overall effects of new business formation on employment have also been found by Mueller, van Stel, and Storey (2008) for Scotland and Wales as well as for those regions of Great Britain that are characterized by a rather low start-up rate. An overall negative impact was also identified by van Stel and Suddle (2008) for the rural regions of the Netherlands. Acs and Mueller (2008) compared the effects for the Metropolitan Statistical Areas in the USA, areas which have a relatively high share of rapidly growing companies (‘gazelles’), with the rest of the regions of their sample and found that the start-ups in those gazelle regions produced larger employment effects.

These results clearly show that a positive effect of new business formation on regional development is not at all self-evident. So what determines the scale of these effects?

[6] This kind of start-up rate is based on the notion that each member of the workforce is faced with the decision to work as a dependent employee in someone else’s business or to start his or her own firm. As start-ups are usually located close to the founder’s residence (Gudgin, 1978; Mueller and Morgan, 1962; Cooper and Dunkelberg, 1987), the regional workforce can be regarded as an appropriate measure of the number of potential entrepreneurs. According to the labor market approach, the entry rate may be interpreted as the propensity of a member of the regional workforce to start an own business. See Audretsch and Fritsch (1994) for different approaches of calculating start-up rates.

3. What determines the magnitude of the regional employment effects?

One important factor that may be responsible for the magnitude of the effects that new business formation has on regional employment can be the *quality of the new businesses*. The quality of a new business may be proven by such factors as the qualification of the entrepreneur[7], the amount and quality of resources that are mobilized for the new business, the marketing strategy that is pursued as well as the innovativeness of the supplied goods and services. The higher the quality of an entry, the greater the challenge that the new businesses exert on the incumbents should be. This challenge for the incumbents can be assumed to be a key determinant of all three kinds of effects that new businesses have an employment.

The innovativeness of entries may critically depend on the characteristics of the regional environment such as the *regional availability of important resources* (e.g., *venture capital*, other *supportive services*, *qualified labor*), the *regional knowledge base* (innovation activity of regional firms, presence and quality of universities and other public research institutes), the *intensity of the regional knowledge spillovers,* and the *quality of the regional innovation system*. As the incumbent firms in the respective region also benefit from these factors, they do not necessarily lead to higher survival chances of the newcomers and higher direct employment effects. The high quality of entries and a high quality response from the incumbent may, however, produce relatively pronounced supply-side improvement.

A number of these factors are empirically closely associated with *population density*. A high density of economic activity directly results in a correspondingly high degree of competition, i.e., more firms demanding similar inputs or supplying goods and services on the same market. This high level of competition may facilitate the process of market selection and

[7] Wagner and Sternberg (2004) provide evidence for an unequal spatial distribution of entrepreneurial qualification, spirit, and talent in Germany.

stimulate the performance of the surviving firms.[8] Hence, high density areas should be characterized by a relatively high level of competitiveness due to high entry rates and rigorous market selection (Fritsch and Mueller, 2004, 2008). Moreover, agglomerated areas are often characterized by a large supply of qualified labor and other inputs, tend to have a rich knowledge base, and there should be more knowledge spillovers available than in rural areas due to a higher number of innovative actors. Also, the share of start-ups in knowledge-intensive industries and in high-tech industries, which can be regarded as being innovative, tends to be relatively high in the agglomerations and comparatively low in rural areas (Audretsch, Keilbach, and Lehmann, 2006, 87-90; Bade and Nerlinger, 2000).[9] This larger share of high-quality entry should also contribute to a high intensity of competition and market selection in agglomerations leading to relatively pronounced employment effects of new business formation processes.

Regions in which most of the incumbent businesses are characterized by a relatively high *productivity level* can be expected to experience a less severe decline in employment due to the displacement effects of entry in comparison to those regions where a high share of suppliers is in the low productivity range. Moreover, incumbent firms operating close to the efficiency frontier may be better able to react and implement improvements, thereby, generating stronger supply-side effects if challenged by entries versus the low productivity suppliers (Aghion et al., 2006). Therefore, the supply-side effects in the high productivity regions

[8] The conjecture of a relatively high level of competition in agglomerations is supported by empirical analyses that find a higher level of start-ups (Brixy and Niese, 2006; Fritsch and Falck, 2007) but a lower probability of survival (Fritsch, Brixy, and Falck, 2006; Weyh, 2006) in these areas.

[9] According to our data, the share of start-ups in knowledge-intensive industries in the agglomerations during the years 1998-2002 is 33.6 percent as compared to 28.4 percent in rural regions and 30.0 percent in the intermediate category, the moderately congested regions. The share of start-ups in high-tech industries on all manufacturing start-ups is 11.9 percent in agglomerations, 9.7 in moderately congested regions, and 10.0 in the rural regions. For the classification of German industries, see Grupp and Legler (2000) and BMBF (2005). Unfortunately, our database only allows a rather crude identification of knowledge-intensive and high-tech industries in the years prior to 1998.

should be more significant than in regions with a relatively low level of productivity.

Prosperous *economic conditions* in a region, as reflected by a strong rise of demand and a low unemployment rate, may, particularly, lead to relatively high survival chances of new businesses and to pronounced direct employment effects. However, such a prosperous environment can also result in a scarcity of resources and high factor prices, which impede the development of the start-ups.

A high *share of small businesses* in the region may imply a favorable environment for start-ups, particularly better availability of inputs than in regions that are dominated by large firms, which tend to pay higher wages and provide better career opportunities for their personnel (Brixy, Kohaut, and Schnabel, 2007). Contestability of market positions and survival chances of the entries may also be shaped by *the type of technological regime* that dominates the industry and region (Audretsch, 1995, 39-64; Winter, 1984). In an entrepreneurial regime where small firms play an important role in innovation processes, it should be easier for newcomers to seriously challenge the incumbents than under the conditions of a routinized regime in which the large firms have the innovative advantage. Accordingly, new business formation can be expected to be an important determinant of growth in an entrepreneurial industry or region but to a much lesser degree in an industry or region that is routinized. Although the theory of technological regimes has been developed for industries, it may also be applied to geographical units of observation (Audretsch and Fritsch, 2002; Fritsch and Mueller, 2006). Yet, empirical research has shown that an industry's mode of production in a particular location may be rather specific and distinct from the type of production that is common in other regions.[10] This implies that the technological regime of an industry

[10] Saxenian's (1994) study of the US computer industry in the Boston-area and Silicon Valley provides an illustrative example of such different regional regimes in an industry.

is not necessarily invariant over space, but that there may be important differences that can lead to a rather divergent performance.

A further factor that may shape the magnitude of the regional effects of new business formation is the *size of the respective industry in the region*. If, for example, a successful start-up is the only industry supplier located in the region, output-induced crowding-out effects will not occur and supply-side effects may be relatively minimal. It can, therefore, be assumed that the greater the *share of the industry located in the region* is, the higher the probability that improvements induced by newcomers imitated by a supplier in that region are.[11] Therefore, the probability that a supply-side improvement is induced in other regions becomes lower. The *market size of the industry* is important because improvements in industries that operate in large inter-regional markets, e.g., the world market, may result in a larger output increase and employment growth than in those industries that supply only to the local market. Moreover, the larger the spatial extend of the market, the lower the probability that a crowding out of competitors will occur in the same region in which a new firm is set up.

The above considerations clearly suggest that the effects of new business formation cannot be expected to be identical in all regions. Rather, there should be considerable differences. The employment effects of new business formation will probably be larger in high density regions with a high level of productivity and a high share of high-quality entries, abundant resources, and a well-functioning innovation system. They will be much smaller or may even be negative in low productivity regions with a high share of low-quality entries, scarcity of relevant resources, and an inefficient innovation system.

[11] Location and space may be important in this respect because spatial distance can, at least in the short-run, work as an impediment to the diffusion of innovations introduced by newcomers to their competitors.

4. Data and empirical approach

4.1 Data

Our analysis of the effect of new business formation on regional economic development over time is at the spatial level of planning regions (*Raumordnungsregionen*). Planning regions consist of at least one core city and the surrounding area. Therefore, the advantage of planning regions in comparison to districts (*Kreise*) is that they can be regarded as functional units in the sense of traveling to work areas and that they account for economic interactions between districts. Planning regions are slightly larger than what is usually defined as a labor market area. In contrast to this, a district may be a single core city or a part of the surrounding suburban area (see Federal Office for Building and Regional Planning, 2003, for the definition of planning regions and districts). We restrict the analysis to the planning regions of West Germany for two reasons. First, while data on start-ups for West Germany are currently available for the time period between 1984 and 2002, the time series for East Germany is much shorter, first beginning in the year 1993. Second, many analyses show that the developments in East Germany in the 1990s were heavily shaped by the transformation process to a market economy and, therefore, it represents a rather special case that should be analyzed separately (e.g., Fritsch, 2004; Kronthaler, 2005). The Berlin region had to be excluded due to changes in the definition of that region after the unification of Germany in 1990.[12]

The establishment file of the German Social Insurance Statistics provided the number of new businesses and employees (for a description, see Fritsch and Brixy, 2004). This database comprises information on all establishments that have at least one employee subject to obligatory

[12] For historical reasons, the cities of Hamburg and Bremen are defined as planning regions even though they are not functional economic units. In order to avoid possible distortions, we merged these cities with adjacent planning regions (Hamburg with the region of Schleswig-Holstein South and Bremen with Bremerhaven and Bremen-Umland). Therefore, we have 70 regions in our sample.

social insurance. Due to the fact that the database records only businesses with at least one employee, start-ups consisting of only owners are not included. Unfortunately, the German Social Insurance Statistics is completely on the level of establishments and does not allow us to separate new firms from new plants and new branches that are created by existing firms. In order to avoid distortions caused by new large subsidiary plants of incumbent firms, new establishments with more than 20 employees in the first year of their existence are not counted as start-ups.[13] Moreover, start-ups in agriculture and fishery, energy, mining, railway, and postal services are excluded because of highly regulated market conditions that strongly diverge from the rest of the economy. Data on regional gross value added and population density (population per square km) are from various publications of the German Federal Statistical Office.

New business formation activity is measured by the yearly start-up rates calculated according to the labor market approach; namely, the number of start-ups per period is divided by the number of persons in the regional workforce (in thousands) at the beginning of the respective period (see also Audretsch and Fritsch, 1994). An important adjustment was made to control for the fact that not only does the composition of industries differ considerably across regions but that the relative importance of start-ups and incumbent enterprises also varies systematically across industries. For example, start-up rates are higher in the service sector than in manufacturing industries. This means that the relative importance of start-ups and incumbents in a region is confounded by the composition of industries in that region. This would result in a bias of overestimating the level of entrepreneurship in regions with a high composition of industries, where start-ups play an important role, and underestimating the role of new business formation in regions with a high share of industries, where

[13] The share of new establishments in the data with more than 20 employees in the first year is rather small (about 2.5 percent).

the start-up rates are relatively low. To correct for the confounding effect of the regional composition of industries on the number of start-ups, a shift-share procedure was employed to obtain a sector-adjusted measure of start-up activity (see the Appendix of Audretsch and Fritsch, 2002, for details). This sector-adjusted number of start-ups is defined as the number of new businesses in a region that could be expected if the composition of industries were identical across all regions. Thus, the measure adjusts the raw data by imposing the same composition of industries upon each region. Our analysis shows that this procedure leads to somewhat clearer results and higher levels of determination than the estimates using the non-adjusted start-up rate do. However, the basic relationships are left unchanged. Table A1 in the Appendix shows descriptive statistics for the variables used in the analysis for all regions as well as for different spatial categories.

According to our data, on average 124,637 new businesses were founded every year over the 1984-2000 period. The majority of the start-ups (78.9 percent of all start-ups) were in the service sector, whereas 11.6 percent and 9.8 percent belonged to manufacturing and to other industries[14], respectively (table 1). With regard to the type of region, most new businesses were set-up in agglomerations (57.6 percent), while only 10.6 percent were located in rural regions. The start-up rate calculated as the number of new businesses per year divided by the number of employees (per 1,000) in the respective sector[15] was highest in services (13.7) and lowest in manufacturing (2.07). For manufacturing and services, the rural regions experienced the highest start-up rates (table 1).

[14] The “other industries” comprise agriculture and forestry, fishery, energy, water supply, mining, and construction.

[15] Unemployed members of the workforce were not accounted for because unemployment cannot be assigned to sectors.

Table 1: Average yearly number of start-ups and start-up rates in different sectors by type of region, 1984–2000

	Agglomerations	*Moderately congested regions*	*Rural regions*	*All regions*
All industries	71,735 (57.6 / 100) 7.75	39,700 (31.8 / 100) 7.23	13,201 (10.6 / 100) 8.04	124,637 (100 / 100) 7.57
Manufacturing	7,583 (52.4 / 10.6) 1.99	5,221 (36.1 / 13.2) 1.97	1,674 (11.5 / 12.7) 2.38	14,477 (100 / 11.6) 2.07
Services	57,174 (58.3 / 79.7) 12.53	30,600 (31.2 / 77.1) 13.95	10,215 (10.5 / 77.4) 14.71	97,989 (100 / 78.6) 13.70
Other industries	6,979 (57.3 / 9.73) 7.72	3,879 (31.9 / 9.7) 6.62	1,313 (10.8 / 9.9) 6.24	12,171 (100 / 9.8) 6.86

Notes: First value in parentheses is the row percent; the second value is the column percent.

4.2 Empirical approach

Our indicator for regional development is the average yearly change of employment (*E*) over a two-year period (percentage), i.e., between the current period t=0 and t+2. A two-year average is used in order to avoid disturbances by short-term fluctuations. The regional differences of the effects of start-up activity on employment change are estimated by the regression

$$E_{it} / E_{it+2} = a + b_1 * \text{average start-up rate}_{it} + b_2 * \text{average start-up rate}^2_{it} + b_3 * \text{control variable I}_{it} + b_4 * \text{control variable I}_{it} * \text{average start-up rate}_{it} + b_5 * \text{control variable II}_{it} + b_6 * \text{control variable IIII}_{it} * \text{average start-up rate}_{it} + \ldots + u.$$

E_{it} is employment in region *i* in year *t*. The *average start-up rate* is calculated over the years *t=0, …, t-10* in order to account for the relevant long-term effects that have been found in recent analyses. We also include the squared value of the start-up rate in order to control for a non-linear relationship with employment change. Several control variables that may be responsible for the differences of the employment effects of new business formation such as population density, qualification of the

workforce, sectoral structure, labor productivity, level of innovation activity, etc. (see table 1) are included as well as the interactions of the control variables with the average start-up rate. The values of these variables are also computed as averages over the years t=0, ..., t-10. The estimated coefficients of the start-up rates and the control variables indicate their direct influence on employment change. The coefficients of the interaction terms can be regarded as a measure of the impact that the respective control variable has on the employment effect of the new businesses.[16] Therefore, we are able to distinguish between the effects of several regional characteristics on employment change and their impact, which become effective in interaction with start-up activity.

The length of our time series allows for the estimation of the regression for eight different periods (of employment change) between 1984 and 2002. However, we do not use a panel analysis, but rather we employ a pure cross-section approach by taking the average values of the variables over the eight periods of observation. The pure cross-section approach is preferred over a panel analysis forthree reasons. First, our main interest here is the differences between regions and not the developments over time. Second, the values of most of the variables tend to be rather constant over time; thus, fixed-effect regression methods do not seem to be appropriate because a large part of the regional differences would be assigned to the fixed effects[17] Third, the pure cross-section approach is

[16] Example: In the data, we can see that employment in agglomerations grew less than in the other types of regions during the period under inspection. Therefore, the coefficient for population density should be negative. However, a number of studies of the effects of new businesses on employment have found that the employment gain due to start-ups, is higher in the agglomerations than in other areas (section 3). This effect is measured by the interaction of the start-up rate and population density. If new businesses in agglomerations really have a larger positive impact on regional employment, the coefficient for this interaction variable should be positive.

[17] The regional level of new business formation is rather path-dependent; thus, changes over time are relatively small. In an analysis of start-up rates of German planning regions between 1983 and 2002, Fritsch and Mueller (2007) found that the correlation coefficient of start-up rates in subsequent years assume values between 0.96 and 0.98. Even over a ten, 15 and 19 year period the value of the correlation coefficient always remains above 0.8. Moreover, the population density as well as the regional education level are rather stable over time.

not sensitive for cyclical fluctuations that otherwise may distort our estimation results.

We find pronounced positive spatial autocorrelation between adjacent regions. This confirms earlier findings, which state that the geographical areas with a certain intensity of the relationship between new business formation and economic development are lager than planning regions (Audretsch and Fritsch, 2002; Fritsch and Mueller, 2006). In order to control for spatial autocorrelation, the average start-up rate in the adjacent regions has been included into the models[18]. A significantly positive coefficient for this variable would suggest that not only the start-ups of the same region but also the new business formation in the surrounding regions have an effect on regional employment.

4.3 Control variables

The following variables, which may be responsible for the effect of new business formation on employment change, have been tested (cf. table 1):

- *Population density* indicates the advantages as well as the disadvantages of being located in an agglomeration. The main types of such advantages (agglomeration economies) are the availability of large, differentiated labor markets and specialized services, proximity to research institutions, large number of customers, a high level of regional knowledge spillovers, etc. The main disadvantages of agglomerations (agglomeration diseconomies) are the higher costs of resources such as labor and floor space, higher intensity of local competition due to a higher density of firms as well as all kinds of congestion problems. There is a considerable degree of correlation between population density and a number of further regional characteristics such as qualification of the workforce, regional income

[18] Adjacent regions are all planning regions that directly share a common border with the respective region.

level, and labor productivity. Population density can, therefore, be regarded as a 'catch all'-variable for the local conditions.

- The *qualification of the regional workforce* may indicate several relevant aspects*.* First, assuming that new businesses are set-up indicated by members of the regional workforce[19], the share of highly qualified workforce may imply a large share of high-quality start-ups which in turn exert strong pressure on the incumbents. Second, it can be a measure for the availability of certain qualifications in a region that may be important for the success of the new competitors. Third, the qualification of the regional workforce also indicates the human capital employed in the incumbent firms that are located in the region and may shape the indirect effects of entry. For these reasons, we expect a positive relationship between this variable and the employment effects of new businesses. We test two measures of the qualification of the regional workforce: the share of employees with a tertiary degree as well as the share of employees with a medium level of qualification[20], qualified employees. They were and with secondary degree and vocational training (skilled labor), respectively.

- The *regional unemployment rate* serves as an indicator of the general economic conditions in a region and can influence the propensity to found new businesses as well as its effects in several ways. First, a high share of unemployed people may indicate low levels of local demand and unfavorable conditions for those start-ups that produce mainly for the local market. Second, high unemployment may stimulate new business formation by unemployed persons. Thirdly, high unemployment implies readily available labor at moderate costs. As these three possible effects of unemployment on start-ups work in different directions, the effect of the unemployment rate on the

[19] Empirical analyses (Mueller and Morgan, 1962; Cooper and Dunckelberg, 1987) clearly show that the bulk of the new businesses are set-up close to the founder's residence.

[20] The medium qualification level comprises all employees who have vocational training or a high-school degree but no university degree.

employment effects of start-ups is a priori unclear. Distinguishing between short-term (up to one year) and long-term unemployment (more than one year), we expect a positive influence of short-term unemployment on the effects of start-ups and a negative impact of longer term unemployment. The reason is that the share of people who are unemployed for less than one year do not necessarily point to an unfavorable economic environment but rather refelcts with regular labor market dynamics. Moreover, as far as unemployed persons starting new businesses, the qualifications of the short-term unemployed persons to successfully operate their own firms may be higher than of those persons that suffer from unemployment for a longer period of time.

- *Regional labor productivity* measured as Gross Value Added per employee. There is a pronounced positive relationship between this variable and the level of wages and income. As explained above (section 3), we expect that high labor productivity in a region is conducive to the positive effects of start-ups on employment.

- *Small firm presence* defined as the share of employees in establishments with less than 50 employees. We expect that a regional environment in which small businesses play a considerable role may be more favorable for start-ups than a regional economy that is dominated by large establishments, which are better able to acquire the necessary resources.

- The *technological regime* in a region designates the importance of small establishments for R&D activity (Audretsch, 1995, 39-64; Winter, 1984). It is measured by the proportion of R&D employees in establishments with less than 50 employees over the share of R&D employment in total employment.[21] The concept of technological

[21] Acs and Audretsch (1987) have introduced an output-oriented measure for the technological regime. In their approach, it is the number of innovations per employee

regime characterizes the nature of innovation activity in an industry, particularly the role of small and large firms. A technological regime is called “entrepreneurial” if a high share of innovation activity is conducted by small firms; therefore, entrants have a relatively good chance to compete successfully. In a “routinized” regime, the incumbent large firms have the innovative advantage and small firms only play a minor role. Therefore, the survival chances of new businesses can be assumed to be comparatively small.

- The *specialization* of a regional economy points towards its comparative advantage in one or several industries. It is defined as the variance of the locational coefficients of the regional industries. The locational coefficient is the regional employment share of an industry in relation to its employment share in the national economy. If the value of the locational coefficient is one, the regional share of the industry equals the share in the national economy. A high variance of regional locational coefficients indicates a high specialization of the regional economy in one or in several industries[22]. As previously mentioned (section 3), a high share of employment in the industry in which the new businesses occur should increase the probability that positive supply-side improvements caused by start-ups occur in the same region and not elsewhere. For this reason, the effect of regional industry specialization should be positive.

introduced by small firms (with less than 500 employees) as compared to the number of innovations per employee in all firms.

[22] This indicator is based on a classification of 53 private-sector industries. The correlation coefficient between the industry share in incumbent employment and in the numbered start-ups is 0.77.

Table 2: Definition of the variables and expected signs for their interaction terms with new business formation

Variable	*Definition*	*Expected sign*
Start-up rate	Number of start-ups in a region over the regional workforce[a]	+
Population density	Number of inhabitants in a region per square kilometer (log)[c]	+
High education level	Share of employees in a region with a university degree[a]	+
Medium education level	Share of employees with secondary degree or / and vocational training (skilled labor)[a]	+
Unemployment rate	Share of persons in a region who have been unemployed for less than one year in the regional workforce[b]	+/-
Short-term unemployment rate	Share of persons in the regional workforce who have been unemployed for less than one year[b]	+/-
Long-term unemployment rate	Share of persons in the regional workforce who have been unemployed for more than one year[b]	+/-
Labor productivity	Gross Value Added[c] per employee[a] in a region	+
Small business presence	Share of employees in small- and medium-sized businesses (< 50 employees) of private sector employees in a region[a]	+
Entrepreneurial regime	Share of R&D employees in establishments with less than 50 employees over the share of R&D employment in total employment in the respective region, industry, and year[a]	+
Specialization	Variance of regional locational coefficients.[a]	+

a) Source: Social Insurance Statistics; b) Source: Federal Employment Services; c) Source: Federal Statistical Office

Table A1 in the Appendix shows descriptive statistics for the variables used in the analysis.

5. Results

A graph with the distribution of the average start-up rate and average employment change (figure 3) shows broad variation. Although, there appears to be a positive relationship between the two variables, there are

also regions with a relatively low start-up rate and a high level of employment change. The most obvious cases in this respect are “Ingolstadt,” “Munich,” “Cologne,” and “Brunswick.” The region with the highest average start-up rate, “Oberland,” has experienced a development of employment that is slightly below the average. This indicates that the effects of start-ups on employment change are shaped by other factors or that factors which are independent of new business formation also play a role.[23]

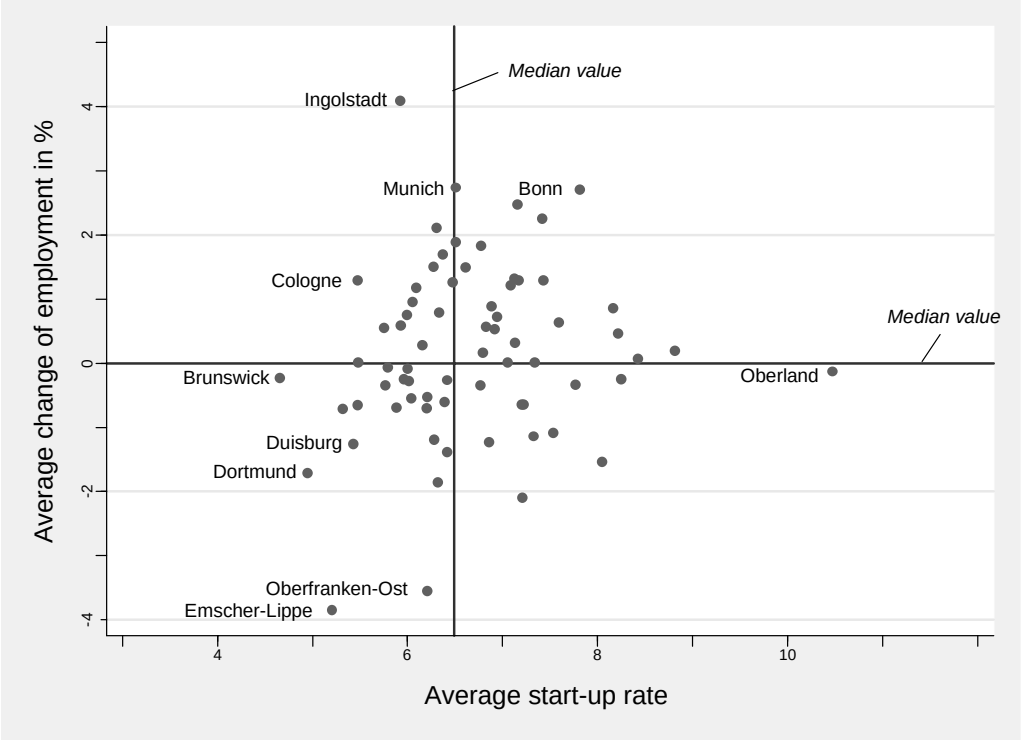

Figure 3: The empirical relationship between the average start-up rate and average employment change in West German regions

[23] Audretsch and Fritsch (2002) suggested that regions with a below average start-up rate but above average employment change may be characterized by a “routinized” growth regime in which employment is mainly generated by large incumbent firms and not by young businesses. This corresponds to a number of those regions in our sample. For example, the region of “Ingolstadt” is the main location of the Audi car manufacturing firm, the region of Brunswick includes the headquarters of Volkswagen in Wolfsburg, and Munich is the headquarters of BMW, Siemens, and several other larger companies.

In the first step of the analysis, we estimated the isolated effect of new business formation on regional employment change. Using all observations, we find a statistically significant coefficient for the average start-up rate and a significantly negative coefficient for the squared term (table 3). The negative coefficient for the squared term indicates an inverse 'u'-shaped relationship between the level of start-up activity and employment change, whereby the effect of new business formation on employment change is first positive with decreasing marginal effects and then, after a maximum is attained, decreases again. This suggests that there are decreasing marginal returns for a policy that attempts to boost the regional level of start-up activity in order to stimulate employment and that the effect of an increase of the start-up rate on employment could even be negative in regions where the level of new business formation is already rather high.[24] The negative sign for the constant term indicates that employment change would have been negative with a zero level of new business formation. The value of the R^2 for this model is only 0.06, meaning that only a rather small percentage of regional employment change can be explained with new business formation.

Adding control variables to this model leads to a considerable degree of multicollinearity due to the high correlation of some of the indicators. These correlations are particularly close for the relationship between the start-up rates and the interaction terms of the start-up rate with the control variables (cf. table A2 in the Appendix). In many of the models with control variables, this multicollinearity results in insignificant or a significantly 'wrong' sign of the coefficient for the start-up rate or the squared value of the start-up rate. We first estimated models with just one control variable (table 3) and then tested the joint effect of two control variables in the model (table 4).

[24] This inverse "u"-shaped pattern is not primarily caused by observations with relatively extreme values such as the "Oberland" region, but rather it remains quite stable if such 'outlier' regions are removed from the sample.

Table 3: Regressions with start-up rates and single control variables

	1	2	3	4	5	6	7	8	9	10	11
Start-up rate	0.027** (2.65)	-0.035 (1.32)	0.027* (1.92)	-0.039 (0.88)	0.007 (0.45)	0.012 (0.88)	0.003 (0.20)	0.019 (1.47)	0.031** (2.43)	0.015 (1.17)	0.032*** (3.14)
Start-up rate squared	-0.002*** (2.82)	-0.000 (0.11)	-0.002** (2.42)	-0.003 (3.25)	-0.001 (1.24)	-0.001* (1.82)	-0.001 (0.79)	-0.002*** (3.25)	-0.002 (1.21)	-0.002** (2.20)	-0.002*** (3.07)
Population density (log) (pop)		-0.044** (2.35)									
Pop * start-up rate (log)		0.007** (2.44)									
High education level (HEL)			-0.106 (0.13)								
HEL * start-up rate			0.043 (0.34)								
Medium education level (MEL)				-0.849 (1.51)							
MEL * start-up rate				0.136 (1.60)							
Unemployment rate (U)					-0.491 (1.63)						
U * start-up rate					0.064 (1.44)						
Short-term unemployment rate (STU)						-0.693 (1.47)					
STU * start-up rate						0.087 (1.29)					
Long-term unemployment rate (LTU)							-1.346* (1.95)				
LTU * start-up rate							0.186* (1.78)				
Labor productivity (LP)								-0.945 (0.77)			
LP * start-up rate								-0.202 (1.08)			
Small business presence (SBP)									-0.050 (0.16)		
SBP * start-up Rate									0.000 (0.01)		
Entrepreneurial regime (ER)										-0.120* (1.70)	
ER * start-up rate										0.018* (1.75)	
Specialization (log) (SP)											-0.002* (1.75)
SP * start-up rate											0.005 (1.47)
Average start-up rate in adjacent regions	0.012*** (3.35)	0.010*** (2.80)	0.009** (2.51)	0.012*** (3.25)	0.010*** (3.03)	0.010*** (3.10)	0.010*** (2.97)	0.010*** (3.16)	0.011*** (3.06)	0.011*** (3.28)	0.005* (1.91)
Constant	-0.165*** (3.67)	0.166 (1.11)	-0.157** (2.39)	0.268 (0.88)	-0.057 (0.78)	-0.078 (1.13)	-0.050 (0.74)	0.148 (1.09)	-0.163*** (2.99)	-0.089 (1.41)	-0.140*** (3.27)
R squared	0.20	0.26	0.23	0.24	0.25	0.24	0.25	0.26	0.21	0.23	0.21
F-value	5.27***	5.48***	4.55***	4.07***	5.44***	4.89***	5.90***	5.26***	3.87***	3.63***	2.80**

*: Statistically significant at the 10 percent level; **: statistically significant at the 5 percent level; ***: statistically significant at the 1 percent level.

In the models with just one control variable (table 3), we find a negative direct effect of population density on employment change but a positive effect of the interaction with the start-up rate. While the negative direct effects of population density indicate a below average employment growth in agglomerations, the positive coefficient of the interaction term suggests that the effect of start-ups on employment is strongly shaped by the degree of regional agglomeration. The positive sign for the respective interaction term confirms the results by Fritsch and Mueller (2004, 2008), who found that the effects of new business formation are more pronounced in agglomerations than in moderately congested areas or in rural regions. Both variables for the education level are not statistically significant. That a high level of unemployment goes together with a relatively poor employment performance of a region as indicated by the negative coefficients for the direct effects of the unemployment rate is hardly surprising. The positive coefficient of the interaction of the long-term unemployment rate with the start-up rate may be regarded as an indication that readily available labor at moderate costs is conducive to the effects of new businesses. According to our estimation results, labor productivity and small business presence have no statistically significant effect. It is quite remarkable that the indicator for the entrepreneurial character of the technological regime in a region has a strong impact, while the indicator for small business presence remains statistically insignificant. Obviously, it is not the size structure of the regional economy as such, but rather it is the innovativeness of the small establishments that is important for the impact of start-ups on employment. The significantly negative sign for the direct effect of the entrepreneurial regime indicator points to a below average employment change in the entrepreneurial regions if no start-ups would occur. We find a negative effect for regional industry specialization, which contradicts our expectations. However, the respective coefficient is only statistically significant at the ten percent level.

A number of further variables have been tested but did not prove to be statistically significant. Among these variables were the share of employees in high-tech industries, in manufacturing, and in services as

Table 4: Regressions with start-up rates and more than one control variable

	1	2	3	4	5	6	7	8	9
Start-up rate	-0.032 (1.22)	-0.222*** (2.77)	-0.047 (1.58)	-0.046 (1.56)	-0.043 (1.52)	-0.040 (1.44)	-0.033 (1.17)	-0.049 (1.63)	-0.038 (1.27)
Start-up rate squared	0.000 (0.02)	0.000 (0.07)	0.001 (0.49)	0.000 (0.36)	0.001 (0.53)	0.000 (0.57)	-0.002 (1.00)	0.000 (0.07)	-0.000 (0.10)
Population density (log) (pop)	-0.045** (2.46)	-0.073** (2.87)	-0.039** (2.21)	-0.041** (2.31)	-0.035** (2.00)	-0.06** (2.18)	-0.048** (2.47)	-0.044** (2.39)	-0.049*** (2.72)
Pop * start-up rate (log)	0.006** (2.26)	0.011*** (3.05)	0.006** (2.27)	0.007** (2.37)	0.006** (2.09)	0.009** (2.15)	0.007** (2.47)	0.007** (2.53)	0.007*** (2.66)
High education level (HEL)	0.197 (0.51)								
HEL*start-up rate	0.013 (0.23)								
Medium education level (MEL)		-1.971*** (2.78)							
MEL * start-up rate		0.301*** (2.99)							
Unemployment rate (U)			-0.449* (1.80)						
U * start-up rate			0.060 (1.62)						
Short-term unemployment rate (STU)				-0.687* (1.72)					
STU * start-up rate				0.090 (1.57)					
Long-term unemployment rate (LTU)					-1.147* (1.97)				
LTU * start-up rate					0.162* (1.78)				
Labor productivity (LP)						2.502 (1.21)			
LP * start-up rate						-0.304 (1.01)			
Small business presence (SBP)							-0.354 (1.17)		
SBP * start-up rate							0.045 (1.14)		
Entrepreneurial regime (ER)								-0.116* (1.78)	
ER * start-up rate								0.018* (1.95)	
Specialization (log) (SP)									-0.019** (2.04)
SP * start-up rate									0.002* (1.73)
Average start-up rate in adjacent regions	0.007 (0.82)	0.009** (2.49)	0.009** (2.51)	0.009** (2.55)	0.009** (2.53)	0.009** (2.58)	0.009** (2.53)	0.010*** (2.80)	0.005* (1.72)
Constant	0.204 (1.42)	1.397** (2.59)	0.224 (1.39)	0.230 (1.40)	0.189 (1.25)	0.148 (1.09)	0.249 (1.47)	0.242 (1.50)	0.278* (1.47)
R squared	0.25	0.36	0.29	0.29	0.29	0.33	0.27	0.29	0.29
F-value	5.96***	5.10***	5.51***	5.28***	5.35***	5.86***	4.57***	4.36***	7.18***

*: Statistically significant at the 10 percent level; **: statistically significant at the 5 percent level; ***: statistically significant at the 1 percent level

well as measures for regional innovation activity (e.g., presence of academic and non-academic research institutions, R&D intensity of firms in the region, number of patents per employee, etc.).

The estimated coefficient for the average start-up rate in adjacent regions that is included into the model in order to control for spatial autocorrelation has almost always – an exception is in model nine – a highly significant positive sign. This indicates that the employment effects of new businesses reach far beyond the borders of the respective region.

The strong impact of population density on the effects of start-ups on employment is confirmed in models with more than one control variable (table 4). We found the role of population density to be rather dominating; thus, we included this variable into all of the models and then added an additional control variable. In the models with population density and a second control variable, we find positive effects for the share of skilled labor among the regional workforce, the unemployment rate, industry specialization, and the indicator of the entrepreneurial character of the technological regime. The share of employees with a medium qualification level, which had no statistical impact in the model with only one control variable, now becomes statistically significant at the one percent level and turns out to be a rather important determinant of the employment effects of start-ups. However, the influence of the share of employees with a high level qualification remains insignificant. The significantly positive coefficient of the entrepreneurial regime indicator as opposed to the insignificance of the measure of small business presence suggests that it is more the size structure of innovation activity rather than the size structure of employment that is important. The interaction of our indicator for regional industry specialization with the start-up rate has now the expected positive sign, although, it is only statistically significant at the ten percent level. Again, the control for spatial autocorrelation detected strongly positive neighborhood effects on the employment impacts of the regional start-up activity. Models with more than three control variables did

not lead to meaningful results for the start-ups in all private sector industries because most of the coefficients turned out to be insignificant.

Conducting our analysis separately for start-ups in manufacturing and in services confirms the pattern of our previous results only for manufacturing. The inverse 'u-shaped' relationship between the level of new business formation and regional employment change can also be found in manufacturing, whereas there is no significant relationship between the two variables in the service sector (see table A3 to A5 in the Appendix). Moreover, the key determinants of the effects of new businesses on regional employment are more distinct if the analysis is constrained just to manufacturing. In the regressions with one control variable (see table 3 Appendix), we found positive effects for population density, the regional share of skilled workers, and the indicator of the entrepreneurial character of the technological regime. Models including population density and a second control variable confirmed the key role of skilled labor as well as the importance of unemployment and the entrepreneurial character of the technological regime for the employment effects of new businesses in manufacturing (table A4). In contrast to our analysis for the whole economy, the inclusion of three control variables delivers some meaningful results. Model nine once again displays the positive influence of population density and the entrepreneurial character of the technological regime; however, it also hints at a negative impact of labor productivity. The negative coefficient for the interaction of labor productivity with the start-up rate is surprising and contradicts the finding of Fritsch and Mueller (2008), whereby the positive employment effects were stronger in regions with high labor productivity. The reason for this difference in the results for the effect of labor productivity is probably that Fritsch and Mueller (2008) in their approach could not simultaneously control for the effects of labor productivity and population density.[25] This

[25] Moreover, their analysis was based on a classification of regions according to their level of labor productivity and not on a continuous variable. In the analysis of Fritsch and Mueller (2008), there was a considerable overlap between the classification of regions according to their labor productivity and their population density. Twelve out of the 19

negative influence of labor productivity on the employment effects of start-ups suggests that the improvements, which are initiated by start-ups, are stronger in regions with a poor productivity level as compared to high productivity regions.

These results imply that employment growth due to new business formation is mainly caused by the start-ups in manufacturing. This is particularly remarkable because the new businesses in manufacturing compromise only a little more than eleven percent of all new businesses, while the share of start-ups in the service sector is more than 78 percent (table 1). Assuming that start-ups in manufacturing are faced with higher entry barriers in terms of minimum efficient size and capital intensity and that these higher entry-barriers result in relatively few, but high-quality start-ups, these findings further supports the hypothesis that the magnitude of the employment effects of new businesses is strongly determined by their quality.

6. Conclusions

We could show that the effect of new business formation on regional employment differs considerably between regions. Generally, the positive effect of new business formation becomes smaller with an increasing start-up rate. This indicates that there are decreasing marginal returns for a policy that tries to stimulate regional start-up activity. Hence, regions with a relatively low level of start-ups may benefit more from an increase in the start-up rate than regions in which the start-up rate is already rather high. Key factors that shape the effects of new business formation on employment are population density, the share of medium-skilled employees in the region, the unemployment rate, and the regional

---

regions that had been defined as areas with high labor productivity belonged to the agglomerations, four of them were moderately congested areas, and only three were rural regions.

technological regime. A somewhat weaker effect could also be found for the regional level of labor productivity and the degree of industry specialization. Our analysis clearly suggests that the positive effects of new business formation are more pronounced in high density areas than in rural regions. Moreover, regions with an entrepreneurial technological regime (i.e., where a high share of innovation activity is conducted in the small establishments) benefit significantly more from new business formation than regions that are characterized by a routinized regime, where innovation activity is mainly in the larger establishments. Further positive effects could be found for the share of employees with a medium level qualification, the unemployment rate, small business presence, and the industry specialization of the regional economy. The effect of labor productivity on the employment effects was negative. The share of highly-skilled employees as well as the measures of the general innovation activity in the region remained insignificant.

As a general conclusion, we can state that start-ups tend to make a positive contribution to regional employment but that the size of the effects may considerably vary depending on regional characteristics, particularly the population density, the skills of the regional workforce, the level of unemployment, and the characteristics of the regional technological regime. This most significant out of these variables seems to be population density, as it plays a key role. This implies that the policies that try to stimulate new business formation in order to generate employment growth are most effective in high density areas with a relatively low start-up rate, a high share of medium level skills, high unemployment, and a high share of innovation activity conducted in smaller establishments. The effects will be relatively low in rural areas with high start-up rates, a low degree of industry specialization, and low unemployment in which a large share of R&D is conducted in large establishments.

Given the limited number of regions in our sample, we feel that we have stretched our method of analysis to its limits. Having identified some key variables that govern the effects of small business formation on

employment, other approaches, particularly regional case studies, are needed for a further exploration of the effects. Unfortunately, we could control for the effect of the quality of start-ups only rather indirectly by indicators such as industry structure of the region and qualification level of the regional workforce, which did not prove to be statistically significant. The role of the quality of the start-ups should be further explored if better information on this issue becomes available.

References

Acs, Zoltan J. and David B. Audretsch (1987): Innovation, Market Structure and Firm Size, *Review of Economics and Statistics*, 69, 567-575.

Acs, Zoltan J. and Pamela Mueller (2008): Employment Effects of Business Dynamics: Mice, Gazelles and Elephants, *Small Business Economics*, 30 (forthcoming).

Aghion, Philippe, Richard Blundell, Rachel Griffith, Peter Howitt and Susanne Prantl (2006): The Effects of Entry on Incumbent Innovation and Productivity, Working Paper 12027, Cambridge, MA: National Bureau of Economic Resarch.

Arauzo-Carod, Josep-Maria, Daniel Liviano-Solis and Mònica Martin-Bofarull (2008): New business formation and employment growth: some evidence for the Spanish manufacturing industry, *Small Business Economics*, 30 (forthcoming).

Audretsch, David B. and Michael Fritsch (2002): Growth Regimes over Time and Space, *Regional Studies,* 36, 113-124.

Audretsch, David B., Max C. Keilbach and Erik E. Lehmann. (2006): *Entrepreneurship and Economic Growth*, New York: Oxford University Press.

Bade, Franz-Josef and Eric A. Nerlinger (2000): The spatial distribution of new technology-based firms: empirical results for West Germany', *Papers in Regional Science*, 79, 155-176.

Federal Office for Building and Regional Planning (Bundesamt für Bauwesen und Raumordnung), 2003, *Aktuelle Daten zur Entwicklung der Städte*, Kreise und Gemeinden, Vol. 17, Bonn: Federal Office for Building and Regional Planning.

Boeri, Tito and Ulrich Cramer (1992): Employment growth, incumbents and entrants – Evidence from Germany, *International Journal of Industrial Organization*, 10, 545-565.

Brixy, Udo and Michael Niese (2006): The determinants of regional differences in new firm formation in Western Germany, in: P. Nijkamp, R.L. Moomaw and I. Traistaru (eds.), *Entrepreneurship, investment, and spatial dynamics : lessons and implications for an enlarged EU*, Cheltenham: Elgar, 109-120.

Brixy, Udo, Susanne Kohaut and Claus Schnabel (2007): Do Newly Founded Firms Pay Lower Wages? First Evidence from Germany, *Small Business Economics*, 29, 161-171.

Carree, Martin and Roy Thurik (2008): The Lag Structure of the Impact of Business Ownership on Economic Performance in OECD Countries, *Small Business Economics*, 30 (forthcoming).

Cooper, Arnold and William C. Dunkelberg (1987): Entrepreneurial Research: Old Questions, New Answers and Methodological Issues, *American Journal of Small Business*, 11, 11-23.

Fritsch, Michael (2004): Entrepreneurship, Entry and Performance of New Businesses Compared in two Growth Regimes: East and West Germany, *Journal of Evolutionary Economics,* 14, 525-542.

Fritsch, Michael and Udo Brixy (2004): The Establishment File of the German Social Insurance Statistics, *Schmollers Jahrbuch / Journal of Applied Social Science Studies,* 124, 183-190.

Fritsch, Michael, Udo Brixy and Oliver Falck (2006): The Effect of Industry, Region and Time on New Business Survival – A Multi-Dimensional Analysis, *Review of Industrial Organization*, 28, 285-306.

Fritsch, Michael and Pamela Mueller (2004): The Effects of New Business Formation on Regional Development over Time, *Regional Studies,* 38, 961-975.

Fritsch, Michael and Pamela Mueller (2006): The Evolution of Regional Entrepreneurship and Growth Regimes, in: Michael Fritsch and Juergen Schmude (eds.), *Entrepreneurship in the Region*, New York: Springer, 225-244.

Fritsch, Michael and Antje Weyh (2006): How Large are the Direct Employment Effects of New Businesses? – An Empirical Investigation, *Small Business Economics,* 27, 245-260.

Fritsch, Michael and Pamela Mueller (2007): The Persistence of Regional New Business Formation-Activity over Time – Assessing the Potential of Policy Promotion Programs, *Journal of Evolutionary Economics*, 17, 299-315

Fritsch, Michael (2008): How Does New Business Formation Affect Regional Development? *Small Business Economics*, 30 (forthcoming).

Fritsch, Michael and Pamela Mueller (2008): The Effect of New Business Formation in Regional Development over Time: The Case of Germany, *Small Business Economics*, 30 (forthcoming).

Fritsch, Michael and Oliver Falck (2007): New Business Formation by Industry over Space and Time: A Multi-Dimensional Analysis, *Regional Studies*, 41, 157-172.

Greene, William (2003): *Econometric Analysis*, 5th ed., Upper Saddle River, NJ: Prentice Hall.

Grupp, Hariolf and Harald Legler (2000): *Hochtechnologie 2000*, Karlsruhe: Fraunhofer Institute for Systems and Innovation Research (ISI).

Kronthaler, Franz (2005): Economic capability of East German regions: results of a cluster analysis, *Regional Studies,* 39, 739-750.

van Stel, André and David J. Storey (2004): The Link Between Firm Births and Job Creation: Is there a Upas Tree Effect? *Regional Studies,* 38, 893-909.

Mueller, Eva and James N. Morgan (1962): Location Decisions of Manufacturers, *American Economic Review*, 52, 204-217.

Mueller, Pamela, André van Stel and David J. Storey (2008): The Effect of New Firm Formation on Regional Development over Time: The Case of Great Britain, *Small Business Economics*, 30 (forthcoming).

Saxenian, Annalee (1994): *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Cambridge (Mass.): Harvard University Press.

van Stel, André and Kashifa Suddle (2008): The Impact of New Firm Formation on Regional Development in the Netherlands, *Small Business Economics*, 30 (forthcoming).

Wagner, Joachim and Rolf Sternberg (2004): Start-up activities, individual characteristics, and the regional milieu: lessons for entrepreneurship support policies from German micro data, *Annals of Regional Science*, 38, 219-240.

Weyh, Antje (2006): What Characterizes Successful Start-Up Cohorts? in: Michael Fritsch and Juergen Schmude (eds.), *Entrepreneurship in the Region*, New York: Springer, 61-74.

Winter, Sidney G. (1984): Schumpeterian Competition in Alternative Technological Regimes, *Journal of Economic Behavior and Organization*, 5, 287-320.

Appendix

Table A1: Descriptive statistics for variables

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Employment change	0.00	0.00	0.01	-0.04	0.04
Start-up rate (SR)	6.67	6.49	0.97	4.65	10.47
Start-up rate squared	45.42	42.14	13.98	21.65	109.65
Population density (log) (POP)	5.40	5.27	0.67	4.30	7.11
POP * SR	35.68	36.16	4.33	25.20	50.37
High education level (HEL)	0.03	0.03	0.02	0.01	0.09
HEL * SR	0.21	0.19	0.10	0.09	0.61
Medium education level (MEL)	0.54	0.54	0.02	0.48	0.61
MEL * SR	3.62	3.57	0.57	2.58	5.80
Unemployment rate (U)	0.11	0.10	0.03	0.06	0.19
U * SR	0.70	0.66	0.23	0.32	1.38
Short-term unemployment rate (STU)	0.07	0.07	0.02	0.04	0.13
STU * SR	0.49	0.44	0.16	0.23	1.00
Long-term unemployment rate (LTU)	0.03	0.03	0.01	0.01	0.07
LTU * SR	0.19	0.17	0.09	0.06	0.43
Labor productivity (LP)	0.08	0.08	0.01	0.07	0.10
LP * SR	0.55	0.54	0.10	0.38	0.84
Small business presence(SBP)	0.38	0.37	0.05	0.29	0.55
SBP * SR	2.60	2.50	0.74	1.44	5.26
Entrepreneurial regime (ER)	0.57	0.57	0.12	0.30	0.90
ER * SR	3.81	3.79	1.08	1.80	7.32
Specialization (S)	3.95	1.24	9.63	0.27	76.74
S * SR	26.73	8.75	66.84	1.64	533.03

Table A2: Correlations between variables (*Pearson* correlation coefficients)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Employment change	1																					
2	Start-up rate	0.140	1																				
3	Start-up rate squared	0.113	0.993	1																			
4	Population density (POP)	-0.117	-0.565	-0.533	1																		
5	POP * start-up rate	0.107	0.616	0.626	0.290	1																	
6	High education level (HEL)	0.206	-0.397	-0.384	0.623	0.159	1																
7	HEL * start-up rate	0.275	-0.150	-0.143	0.514	0.355	0.960	1															
8	Medium education level (MEL)	0.045	0.227	0.212	-0.434	-0.013	-0.401	-0.340	1														
9	MEL * start-up rate	0.028	0.981	0.969	-0.619	0.778	-0.524	-0.176	0.407	1													
10	Unemployment (U)	-0.281	-0.188	-0.181	0.128	-0.124	-0.263	-0.334	0.210	0.106	1												
11	U * start-up rate	-0.173	0.246	0.237	-0.150	0.122	-0.411	-0.375	0.271	0.610	0.892	1											
12	Short-term unemployment (STU)	-0.240	-0.053	-0.055	0.005	-0.079	-0.317	-0.356	0.252	0.240	0.981	0.948	1										
13	STU * start-up rate	-0.124	0.392	0.378	-0.266	0.184	-0.445	-0.374	0.281	0.700	0.798	0.981	0.887	1									
14	Long-term unemployment (LTU)	-0.302	-0.331	-0.311	0.303	-0.134	-0.158	-0.261	0.149	-0.048	0.961	0.771	0.897	0.642	1								
15	LTU * start-up rate	-0.228	-0.051	-0.046	0.105	0.010	-0.275	-0.311	0.232	0.367	0.971	0.928	0.961	0.845	0.944	1							
16	Labor productivity (LP)	0.247	0.092	0.089	0.213	0.324	0.470	0.530	0.061	0.201	0.286	0.365	0.349	0.396	0.231	0.322	1						
17	LP * start-up rate	0.235	0.841	0.834	-0.339	0.657	-0.082	0.145	0.210	0.889	0.025	0.413	0.167	0.547	-0.122	0.153	0.612	1					
18	Small business presence (SBP)	0.027	0.840	0.824	-0.638	0.353	-0.590	-0.404	0.297	0.897	0.269	0.645	0.410	0.756	0.087	0.375	0.178	0.775	1				
19	SBP * start-up rate	0.070	0.959	0.957	-0.602	0.520	-0.497	-0.276	0.245	0.966	0.043	0.460	0.183	0.593	-0.119	0.172	0.151	0.849	0.951	1			
20	Entrepreneural regime (ER)	-0.044	0.200	0.186	-0.050	0.172	-0.347	-0.316	0.282	0.440	0.424	0.516	0.444	0.503	0.392	0.497	0.102	0.226	0.391	0.230	1		
21	ER * start-up rate	0.061	0.664	0.648	-0.343	0.433	-0.459	-0.313	0.299	0.847	0.231	0.533	0.321	0.602	0.125	0.358	0.145	0.616	0.737	0.723	0.857	1	
22	Specialization (SP)	-0,054	0,044	0,030	-0,086	-0,025	-0,159	-0,176	-0,145	-0,005	-0,011	0,005	-0,017	-0,001	-0,024	-0,003	-0,210	-0,093	0,044	0,031	-0,055	-0,026	1
23	SP * start-up rate	-0,036	0,077	0,062	0,106	0,004	-0,163	-0,175	-0,148	0,025	-0,025	0,008	-0,026	0,008	-0,044	-0,026	-0,207	-0,066	0,066	0,060	-0,051	-0,004	0,998

Table A3: Regressions with start-up rates in manufacturing and single control variables

	1	2	3	4	5	6	7	8
Start-up rate	0.022 (1.48)	-0.129* (1.82)	-0.142 (1.41)	0.010 (0.56)	0.015 (0.91)	0.007 (0.39)	0.044 (1.59)	0.015 (0.90)
Start-up rate squared	-0.006* (1.79)	0.006 (0.94)	-0.008*** (2.68)	-0.005* (1.71)	-0.007** (2.07)	-0.004 (1.33)	-0.004 (1.16)	-0.009** (2.17)
Population density (log) (pop)		-0.039** (2.24)						
Pop * start-up rate (log)		0.019** (2.24)						
Medium education level (MEL)			-0.655 (1.64)					
MEL * start-up rate			0.326* (1.72)					
Unemployment rate (U)				-0.360** (2.24)				
U * start-up rate				0.117 (1.63)				
Short-term unemployment rate (STU)					-0.556** (2.16)			
STU * start-up rate					0.175 (1.62)			
Long-term unemployment rate (LTU)						-0.913** (2.22)		
LTU * start-up rate						0.320 (1.64)		
Labor productivity (LP)							0.099 (1.08)	
LP * start-up rate							-0.370 (0.90)	
Entrepreneurial regime (ER)								-0.097* (1.70)
ER * start-up rate								0.043* (1.69)
Average start-up rate in adjacent regions	0.016* (1.88)	0.012 (1.41)	0.017** (2.03)	0.016** (2.23)	0.017** (2.34)	0.015** (2.06)	0.014 (1.59)	0.015* (1.85)
Constant	-0.52 (1.91)*	0.216* (1.69)	0.289 (1.33)	-0.015 (0.49)	-0.021 (0.72)	-0.017 (0.55)	-0.114* (1.78)	-0.016 (0.43)
R squared	0.07	0.15	0.10	0.17	0.16	0.18	0.08	0.10
F-value	1.98	2.51**	2.03*	3.30***	3.05**	3.37***	1.27	1.52

*: Statistically significant at the 10 percent level; **: statistically significant at the 5 percent level; ***: statistically significant at the 1 percent level

Table A4: Regressions with start-up rates in manufacturing and more than one control variable

	1	2	3	4	5	6	7	8
Start-up rate	-0.599*** (3.88)	-0.129* (1.92)	-0.128* (1.90)	-0.119* (1.80)	-0.103 (1.41)	-0.133* (1.87)	-0.103 (1.41)	-0.569*** (3.72)
Start-up rate squared	0.006 (1.32)	0.005 (0.88)	0.004 (0.74)	0.005 (0.89)	0.009 (1.06)	0.002 (0.33)	0.006 (0.72)	0.008 (1.58)
Population density (log) (pop)	-0.063*** (3.69)	-0.035** (2.10)	-0.036** (2.16)	-0.031* (1.92)	-0.042** (2.37)	-0.038** (2.20)	-0.042** (2.34)	-0.066*** (3.94)
Pop * start-up rate (log)	0.031*** (3.68)	0.018** (2.16)	0.018** (2.18)	0.017** (2.02)	0.020** (2.25)	0.019** (2.28)	0.020** (2.34)	0.031*** (3.79)
Medium education level (MEL)	-1.576*** (3.49)							-1.587*** (3.53)
MEL * start-up rate	0.750*** (3.69)							0.742*** (3.70)
Unemployment rate (U)		-0.370*** (2.73)						
U * start-up rate		0.128** (2.09)						
Short-term unemployment rate (STU)			-0.576** (2.61)					
STU * start-up rate			0.195** (2.09)					
Long-term unemployment rate (LTU)				-0.907** (2.58)				
LTU * start-up rate				0.332* (1.93)				
Labor productivity (LP)					1.575 (1.63)		1.917* (1.84)	1.453* (1.77)
LP* start-up rate					-0.577 (1.41)		-0.781* (1.75)	-0.508 (1.60)
Entrepreneurial regime (ER)						-0.083 (1.56)	-0.088 (1.57)	
ER * start-up rate						0.039* (1.68)	0.043* (1.80)	
Average start-up rate in adjacent regions	0.011 (1.43)	0.013 (1.63)	0.013* (1.72)	0.012 (1.53)	0.008 (0.92)	0.012 (1.41)	0.009 (1.10)	0.007 (0.77)
Constant	1.201*** (3.69)	0.222* (1.79)	0.226* (1.81)	0.194 (1.60)	0.143 (1.10)	0.237* (1.87)	0.149 (1.18)	1.141*** (3.50)
R squared	0.26	0.23	0.22	0.23	0.19	0.18	0.22	0.30
F-value	3.46***	2.94***	2.78**	2.82**	2.09**	2.02**	1.92*	3.13***

*: Statistically significant at the 10 percent level; **: statistically significant at the 5 percent level; ***: statistically significant at the 1 percent level

Table A5: Regressions with start-up rates in services

	1	2	3	4	5	6	7
Start-up rate (SR)	0.005 (0.60)	0.002 (0.25)	0.001 (0.12)	0.006 (0.67)	-0.003 (0.37)	0.003 (0.43)	-0.001 (0.14)
Start-up rate squared	-0.000 (0.67)	0.000 (0.66)	-0.000 (0.54)	-0.000 (0.668)	0.000 (1.16)	0.000 (0.76)	0.000 (1.05)
Small business presence (SBP)		0.615* (1.98)			0.832*** (2.69)	0.795** (2.55)	0.942*** (2.98)
SBP * start*Start-up rate		-0.038* (1.90)			-0.051** (2.57)	-0.050** (2.38)	-0.058*** (2.75)
Unemployment rate (U)			-0.456* (1.82)		-0.575** (2.64)		-0.510** (2.14)
U * start* Start-up rate			0.027 (1.51)		0.033** (2.03)		0.030 (1.66)
Specialization (log) (SP)				-0.012* (1.73))		-0.006** (2.01)	-0.005* (1.85)
SP * start* Start-up rate				0.000 (1.39)		0.000** (2.00)	0.000* (1.85)
Average start-up rate in adjacent regionsSpatial autocorrelation	0.005*** (3.00)	0.005*** (3.13)	0.003* (1.79)	0.004** (2.52)	0.004* (1.95)	0.005*** (3.00)	0.003* (1.80)
Constant	-0.088 (1.61)	-0.165** (2.43)	-0.015 (0.23)	-0.087 (1.49)	-0.100 (1.29)	-0.187*** (2.89)	-0.125 (1.62)
R -squared	0.10	0.15	0.15	0.16	0.22	0.22	0.28
F-value	3.30***	2.25*	2.97**	2.8383**	4.14***	2.98***	4.92***

*: Statistically significant at the 10 percent level; **: statistically significant at the 5 percent level; ***: statistically significant at the 1 percent level