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Regional Patterns and Determinants of New Firm Formation and Survival in Western Germany

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Abstract

There is a large body of literature on the determinants of regional variation in new firm formation. In contrast there are few articles on the spatial differences in new firm survival. Using panel data we analyse both items for 74 western German regions over a ten-year period.

The positive relationship between entry and exit which is often stated suggests a negative correlation between entry and survival. On the other hand, however, it seems convincing that regions with high birth rates should also have high survival rates, because a favourable environment for the founding of new firms should also be encouraging for the development of these firms. However, an analysis of both rates for 74 western German regions over a ten-year period reveals the existence of a negative relationship in general. This means that the survival rates are below average in regions with high birth rates. Despite this overall correlation, however, it is shown that the spatial pattern of a combination of both rates is complex, and all types of possible relationships exist.

With a multivariate panel analysis we study the factors that influence regional birth and survival rates using the same set of independent variables. It is shown that in the service sector most variables literally work in opposite directions in the birth and survival rates models. But this does not hold for the manufacturing sector. This can be rated as evidence for the “supportive environment thesis”. The reason for this is a completely different outcome of the estimated birth rates models for both industry sectors, whereas there are only minor differences in the estimated survival rate models.

We can therefore deduce firstly that the two industries have different requirements for their “seed bed” but not for their further successful development; and secondly, that the spatial structures which increase the number of newly founded businesses in the service sector are detrimental to the survival rates of newly founded firms.

JEL-Klassifikation: R11, J23, L25, M13

1 Introduction

The spatial variation in the number of newly founded businesses has been the subject of research for some time (Armington/Acs 2002). But far less attention has been paid to spatial differences in the survival of new firms. This is perhaps surprising since the question is of great relevance. Newly founded firms are seen as central to regional economic growth and structural change. They have therefore been the target of many policy measures at federal and regional level. Very often the well-known “liability of newness” (Freeman/Carroll/Hannan 1983) is not taken adequately into account. One reason for there having been comparatively little research activity to date is the fact that there are hardly any suitable longitudinal data sets that can provide information about the spatial differentiation of the survival chances.

There is a relatively large amount of literature on firm exit, however (Love 1996, Berglund/Brännäs 2001). There is evidence of a strong relationship between entry and exit, which has been proved at three levels: space, time and industry. The reasons for this positive relationship are twofold. On the one hand there are factors which are inherent in newly founded firms that limit their life expectation on average. The reasons are widely discussed (see the review by Schutjens/Wever 2000). This leads to the “revolving door” regime described by Audretsch and Fritsch (1992). On the other hand newly founded businesses compete with existing firms and force the latter to adapt or even to close, although closures of established firms are less frequent than the displacement of young firms by new ones. However, exit rates do not allow us to distinguish between these two effects. It remains open how long a firm existed before closure. Therefore little can be concluded about spatial differences of the success of newly founded businesses. In order to measure the success of newly founded firms it is necessary to use longitudinal data.

In terms of regional economics the question as to whether there is a connection between the number of new firms in a region – or the regional new-firm formation rate – and the chances of survival is an important one. The positive relationship between entry and exit mentioned earlier suggests a negative relationship between regional entry and survival. Sternberg (2000: 202), however, assumes that young firms continue to benefit

from an environment that is positive for new firms in the first years following the start-up. He expects that *"in the context of a process that reinforces itself, [...] regional clusters of new firms [may] develop in which, as a result of agglomeration advantages and other positive external effects associated with the spatial closeness, new firms develop more favourably in economic terms than they do outside this cluster"* (ibid.). If there is such a connection then regions that show high rates of new-firm formation can be expected to have high survival rates, too ("supportive environment thesis").

Using a comprehensive data set which covers all new firms with at least one employee, we are able to analyse a period of 14 years (1983 until 1997) at regional level in western Germany. This data set is briefly described in the next section. Section three presents a descriptive analysis of the spatial variation of firm births and survivals as well as the relationship between the two. In the fourth section two analogous panel models are presented to highlight the reasons behind this association. In the last section the results are summarised and some conclusions are drawn.

2 Data

The data used in this study is derived from a rich database the "IAB Establishment Register"[1], which is sometimes also called the "German Social Insurance Statistics" (see Fritsch and Brixy 2004 for details). It requires all public and private employers to report certain information about every employee who is subject to obligatory social insurance, i.e. health and unemployment insurance along with pension funds. Misreporting is legally sanctioned. The information collected is transformed into an establishment file by means of an establishment identification-number that is reported. A great advantage of this database is that it covers all establishments that employ at least one employee who is liable to social insurance. The register includes not only single units but branch plants as well. Longitudinal data on each establishment is available covering the number of employ-

[1] IAB is an acronym for "Institut für Arbeitsmarkt- und Berufsforschung", which is the research institute of the German Federal Employment Agency.

ees, the industry and the location on the 30th June of the years 1981 until 1997[2].

Newly founded establishments are identified by new identification-numbers for firms. Certainly very many - though not all - of the new identification numbers in the database represent genuine new firms. However, since this data is primarily collected for the use of the German employment statistics, not for use as an establishment database, let alone for a database on newly founded firms, there are some deficiencies in the original data that have to be dealt with. The main shortcoming is the absence of any identifier for newly founded firms. There are circumstances under which an existing establishment is registered under a new identification number. Most of these cases can be excluded by applying certain rules to identify genuine newly founded firms (cf. Fritsch/ Brixy 2004)[3]. A problem in identifying start-ups and closures is establishments with 'perforated' employment, where information is interrupted for some time. In this case, it is unclear whether in the years with missing information the respective establishment has existed (i.e. without an employee) or not. Because establishments with 'perforated' employment tend to be rather small[4], one can assume that in many cases they have existed without an employee during the interruption. To deal with this problem we used the length of the time period for which there is no information about an establishment in the data to separate continuing establishments from start-ups and closures.[5] Establishments with an interruption of less than three years are assumed to have continued without an employee during that time. If an interruption has lasted longer than three years, the disappearance of the

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2 From 1998 the industry code changes, so that a longitudinal analysis can either end in 1997 or start in 1998.

3 Fortunately the effectiveness of these assumptions could be tested with the data of a yearly interview survey of some 4,000 firms which is based on a random sample of the "IAB Establishment Register" and showed quite satisfactory results (Brixy 1999).

4 94.6 percent of all West German establishments that were characterized by perforated information in the 1981-97 period had no more than three employees in the year before the interruption occurred. 77.8 percent had only one employee. 96.1 percent of these establishments reported no more than three employees when they re-appeared in the statistics. 80.3 percent had only one employee.

5 Taking the West-German data, we find that between 1981 and 1997 about 60 % of all interruptions were just for one year. Only 14.5 % of all interruptions related to a period longer than three consecutive years.

establishment number is classified as a closure and re-emergence as a start-up.

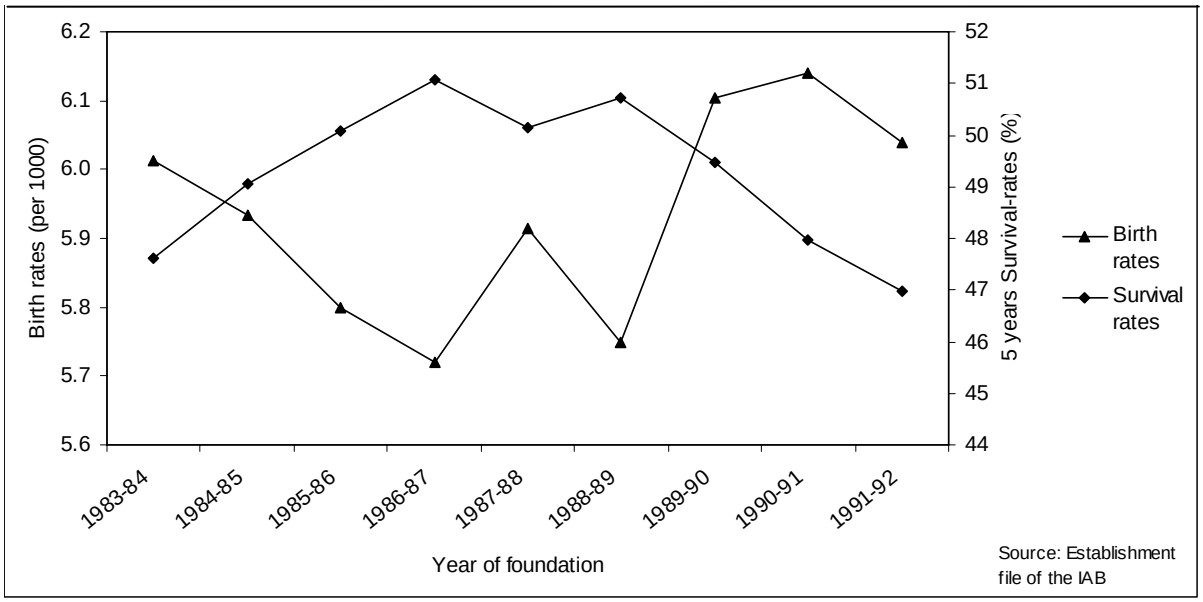
So newly founded firms need to have no employment registered for at least three succeeding years prior to a minimum of one year with at least one employee. Firms are judged as closed after three succeeding years without employment. This procedure makes it possible to conduct an analysis of birth-rates and survival-rates from 1984 to 1997.

3 Is there a spatial connection between new-firm formation rates and survival rates?

For assessing the survival chances of firms, a period of five years has normally been taken as the comparison framework in the literature. Because the data basis is too short for regional analyses in eastern Germany, our analysis here is restricted to western Germany alone. Figure 1 shows the new-firm formation rates calculated on the basis of the workforce[6] (per 1000: left-hand axis) and the proportion of the new-firm cohort that survived at least five years (five-year survival rate, right-hand axis). The observation period of five years inevitably reduces the series of available cohorts by five. At the start of the observation period the five-year survival rate stood at approximately 48 %, it then increased until 1988/89 to about 51 % and then fell back to 47 %. The simultaneous representation of new-firm formation rates and survival rates shows a high negative correlation over time (r = -0.79): in large new-firm cohorts, young businesses obviously have poorer chances of surviving the first five years than is the case in smaller cohorts. This supports the “competition thesis” explained above and can be rated as evidence for the existence of a “revolving door effect”.

[6] Workforce is defined number of people between 15 and 65 years

Figure 1: Birth rates and survival rates: a temporal comparison*



* Birth rates per 1000 employees
Survival rates: share of firms which survive at least 5 years in every period

The competitive pressure among young firms, which, owing to their age, are generally still small and have little market experience, is especially strong in large new-firm cohorts. It seems reasonable to assume that new firms struggle for market shares principally with other young businesses and less with firms that are already established on the market.

The regional economic structure has a considerable influence on new-firm formation activity. By far the most new firms are set up in the rather short-lived area of consumer services. Only one in ten new firms is in the manufacturing industry. However, it is especially these new manufacturing firms that are credited with having particular potential for the development of the regional economy. The same is true of business-related services; they, too, are of great importance for regional development. Furthermore in both of these sectors the survival rates of the young businesses are especially high. For this reason three categories are always formed for the analysis: total, manufacturing and business-related services.

The correlation between the intensity of new-firm formation and the survival rates of young businesses calculated on the basis of 74 western German standard statistical regions (*Raumordnungsregionen*) shows only a weak negative correlation across all sectors (r = -0.32). Such an effect

does not exist at all for the manufacturing industry (r = -0.06), which makes it clear that the negative correlation for all sectors can be attributed to the large number of new firms in the services sector. A clearly negative relationship can also be found for business-related services (r = -0.60). There are obviously a number of factors that determine the relationship between new firms and their survival. What is of interest first of all is the empirically ascertainable relationship between the level of the new-firm formation rate and the rate of survival of these firms on a regional basis.

A high rate of new-firm formation in a region can probably be regarded as desirable and is therefore to be assessed in positive terms. The more firms are founded, the greater the chances are that some of them will prove to have a promising future and make a substantial contribution to the prosperity of the region in which they are located. They raise the competitive pressure, thus intensifying market selection and consequently improving the efficiency of the market.

Assessing a high regional survival rate is more difficult. Usually a large proportion of surviving businesses among the new firms is assessed as positive. In this case a high survival rate is judged as an indication of good planning and of the new firms being of high quality. A high survival rate can, however, also be a sign of low competitive pressure on the part of established firms or other new firms. Therefore low survival rates can be a sign of a weak regional economy. This is in line with results obtained by Lane Schary (1991), who state that high rates of business failure can be the outgrowth of a healthy economy.

A simple approach for analysing the relationship between new firms and their survival chances is to combine the characteristics of an “above-average or below-average new-firm formation rate” and an “above-average or below-average survival rate”. This makes it possible to categorise the regions into one of four classes (cf. Table 1).

Regions with an above-average amount of new-firm formation activity are certainly to be regarded in principle as economically successful regions. In combination with a low survival rate they are characterised by a high turnover of firms (“revolving-door regions”). In combination with above-

average survival rates, this can point both to differences in the industry structure and to the new firms being of high quality. They could be labelled as “growing stock regions”.

Table 1: Types of Regional Founding-Regimes

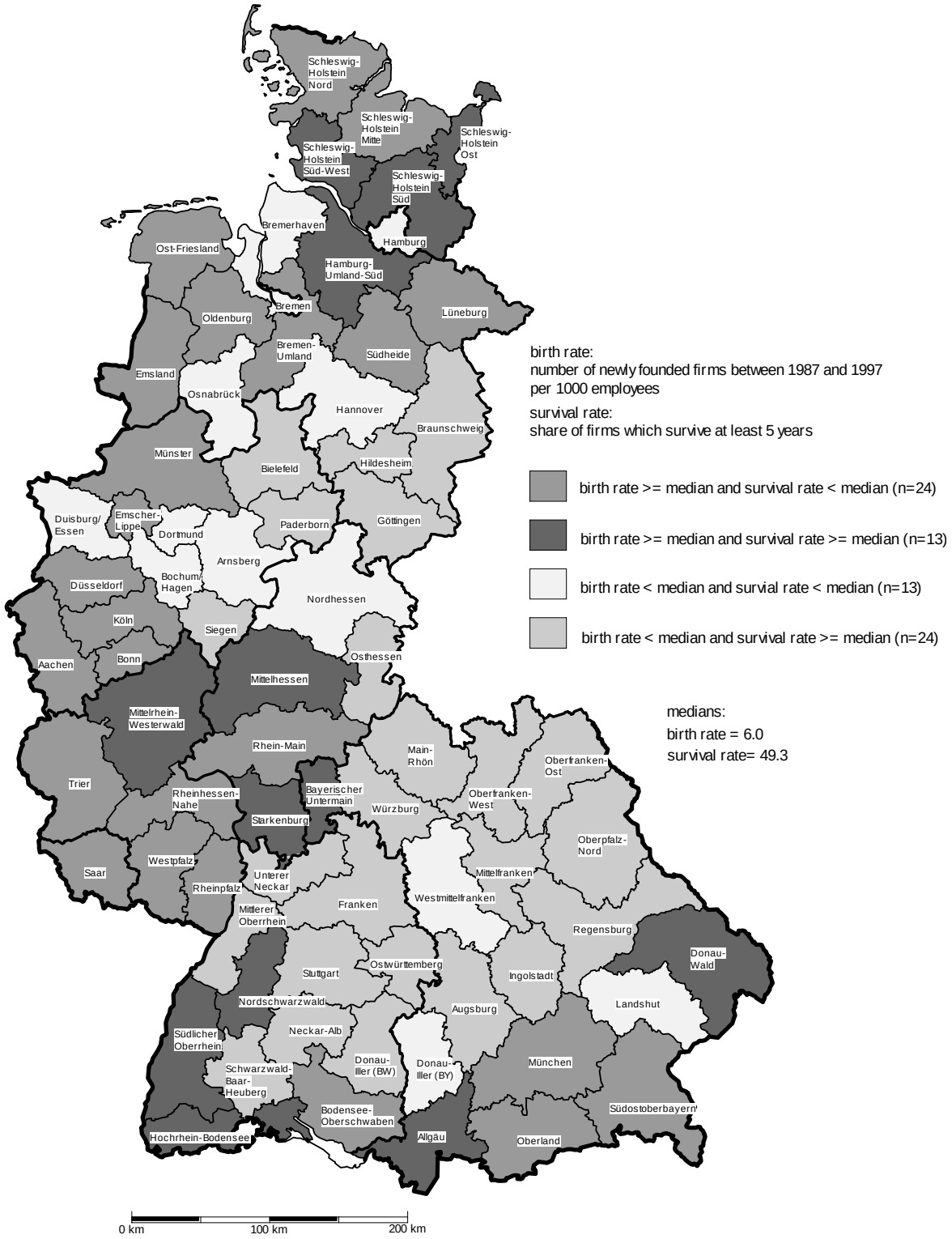
Entry	Survival	
	Low	*High*
Low	“shrinking stock”	“low turnover”
High	“revolving door”	“growing stock”

A below-average rate of new-firm formation is a sign of the economy lacking potential for renewal. In connection with high survival rates (“low turnover regions”) it can be assumed that in addition competition from established businesses is comparatively weak. This is an indication of efficiency deficits and an insufficient market selection in the regions.

Regions in which both the rate of new-firm formation and the survival rate are below average (“shrinking stock regions”) obviously offer poor basic conditions for young firms and are to be classified as problem areas.

The four combinations of characteristics result in a typical spatial distribution pattern for western Germany (cf. fig. 1). The group with above-average new-firm formation rates and survival rates includes the more immediate and in part the broader area around Hamburg, the outstanding centre in the north; and the Frankfurt region, too, has four large regions of this type in its surrounding area. The same constellation occurs as a cluster in south-western Germany. The remaining two regions in the south and the south east with this combination of characteristics are only isolated occurrences of this type.

Figure 2: Connection between birth rates and survival rates in western Germany



Most of western Germany can be assigned to one of the two groups with one above-average and one below-average characteristic. Here it stands out that the regions with low rates of firm formation but above-average survival rates are located primarily in the south. But there is a second

cluster in the northern part of Germany. Some of the regions of this type are structurally weak regions along the former border to East Germany and the Czech Republic, though major economic regions also belong to this group. In the case of the latter regions there are grounds for supposing that due to their comparatively one-sided economies they must be regarded as having only limited potential for renewal and therefore as not being very dynamic.

The regions in which both values are below average include a broad strip in central Germany that runs from west to east and includes a large part of the old industrialised "Ruhr area". However, two minor centres in the north as well as the city-states of Hamburg and Bremen also come under this category. In the case of the latter, this is presumably mainly because these regions are small and the cities are cut off from their hinterland[7]. Southern Germany is represented by this type in only three regions, which are less important in economic terms.

The accumulation of these regions in western and northern Germany is certainly a serious problem. This is in line with the general pattern of economically less successful regions in Germany. Especially in the case of the Ruhr area the question arises as to whether the firms lack the flexibility needed for adapting to changes. This could be a result of the long-established networks between large enterprises and their medium-sized suppliers. A closely woven network of relationships can in many ways hinder economic innovations and structural changes (cf. Grabher 1993). Networks with such negative effects certainly do not provide a favourable environment for young businesses.

4 The explanation of spatial distributions of firm-formation rates and survival rates by means of regression calculations

4.1 The dependent and independent variables

The determinants of the spatial differences in the rates of firm formation have already been the subject of many studies (e.g. Fritsch 1992;

[7] This is because the cities of Hamburg and Bremen are regarded, for historical reasons, as states (*Bundesländer*) and the standard statistical regions are demarcated at state level.

Audretsch/Fritsch 1994; Gerlach/Wagner 1994; Keeble/Walker 1994; Sutaria 2001; Armington/Acs 2002; Sutaria/Hicks 2004). However, there is hardly any literature that focuses on the spatial differences in the survival rates in Germany. In order to obtain a deeper understanding of the relationship between the regional rates of firm formation and the regional survival rate, we use the same set of independent variables in both estimations. In this way it is possible to test the impact of the same regional characteristics on the two dependent variables.

Calculations are made for different groups of industries, and the standard statistical regions (*Raumordnungsregionen*) serve as spatial units. The independent variables are selected largely following the studies cited above. Firstly this guarantees the comparability of the results obtained, and secondly the choice of new or alternative characteristics is considerably restricted due to the availability of data.

The rate of new-firm formation is estimated in separate models: for all industries, for manufacturing and for business-related services, each for the years 1987-1997[8]. The business-related services were selected because of their great importance for the economic development of the regions. As Marshall (1988, p. 56) showed, they increase the innovation capacity of industry considerably.

In order to have more time series available for the estimates of the survival rates, a period of only three years was taken as a basis when calculating the rate. In this way it was possible to calculate the models for explaining the survival rates for the new-firm formation years of 1987 to 1994. As the correlation between the 5-year and the 3-year rate is r=0.88, the differences between the two distributions are only modest.

The estimates serve first and foremost to check the relationship between new-firm formation rates and survival rates. Therefore the firm formation rates and survival rates are not only used as dependent variables but also as independent explanatory variables. This means that the corresponding survival rate enters into the estimate of the incidence of new-firm formation as an independent variable; and vice versa the corresponding new-

[8] Until 1987 only a few independent variables were available on a regional basis. The research period therefore starts in 1987.

firm formation rate enters into the estimates of the survival rate. In both cases negative coefficients are to be expected. Table 2 summarises the variables for a better overview. Fundamental statistics are shown in table 3.

Table 2: The dependent and independent variables

Variables	Description and calculation	Expected relationship
1. Indicators of regional demand		
Change in employment	Change in employment of employees covered by social security in the previous year	positive: increasing demand negative: alternative employment for potential entrepreneurs in prospering regions
2 Indicators of the reservoir of entrepreneurs		
Proportion of highly-qualified employees	Proportion of employees covered by social security with university degree	positive
Employees in R&D	Engineers, mathematicians and scientists as a proportion of all employees covered by social security	positive
Unemployment rate	Average unemployment rate	positive
Change in the unemployment rate	Change in the unemployment rate in the previous year	positive
3. Structural indicators		
Proportion of employees in small businesses	Proportion of employees covered by social security in firms with fewer than 50 employees	positive
Population density	Average employees covered by social security per square kilometre (log) in 1995	positive
Technological regime	Proportion of engineers, mathematicians and scientists in firms with fewer than 50 employees divided by the share of employees with these qualifications among all employees	positive
Survival rate (independent variable in the new-firm formation models)	Proportion of firms that survive at least three years	negative
Birth rate (independent variable in the survival rate models)	Number of newly founded firms per 1000 employees covered by social security	negative
4. Controlling for spatial autocorrelation		
Spill-over effect	Mean of the birth rates (new firms divided by the number of employees) of the neighbouring regions	positive
Residuals	Mean of the residuals of the neighbouring regions	positive, if unobserved relationships exist

The data set shows a panel structure (one observation per year). Therefore corresponding panel models are used. In the case of the incidence of new-firm formation this is a count data model based on a negative binomial distribution in which robust estimators following White's Sandwich procedure (Davidson & McKinnon, 1993: 552) are used to control for heteroscedasticity. For the survival rates a panel model with fixed effects was estimated

Variables with a possible influence on the regional share are manifold. They are often categorised into three classes. First, indicators of the level of regional demand. Second, indicators of the regional reservoir of entrepreneurs (supply-side) and third, indicators of structural differences between regions other than industry structure and size.

4.1.1 Indicator of regional demand

Regional demand is of great importance for young firms. Most of them trade on regional and local markets only. This is especially true for firms in the service sector, to which more than 50% of all newly founded firms belong. As an indicator of regional demand during the analysed period only the change in the number of employees is available at regional level. Therefore the change in the number of employees is included in the estimations with a lag of one year.

The change in employment can stimulate or hinder the development of newly founded firms (see i.e. Keeble & Walker 1994). A positive trend fosters regional demand and improves the economic prospects of the newly founded firms. This increases the motivation of entrepreneurs to found new firms and raises the new firms' prospects of survival. If a growing number of employees is associated with an increase in population (in-migration), the supply-side might be improved as well. Young and well educated people tend to migrate more often than older people. Hence the number of possible entrepreneurs increases even more. But prospering regions with high in-migration are likely to offer attractive employment alternatives to possible entrepreneurs. It can be expected that each person who considers setting up a business of their own takes into account the employment opportunities their region offers. In regions with a prospering labour market, there are presumably more and more attractive jobs available for possible entrepreneurs. Therefore, the opportunity costs

of setting up a new business rise as the economic success of a region grows. This could lead to a negative correlation between the development of employment and regional firm birth rates. In contrast, a positive relationship should be expected with the survival-rate. The bivariate correlation coefficients show no significant effect for the birth rate. However, this could be because the two effects oppose each other. As expected there is a low positive correlation with the survival rate.

4.1.2 Indicators of the regional reservoir of entrepreneurs

The state of the regional labour market is important for two reasons. Not only does it have an influence on the number of possible entrepreneurs but it also characterises the environment in which the setting-up of new businesses takes place. The qualification level of the population is of great importance for assessing the size of the pool of likely entrepreneurs. According to a study conducted by Brüderl, Preisendörfer & Ziegler (1996: 85) in the greater Munich region, the share of new entrepreneurs that hold a university degree is 23 %. This is distinctly more than the average of all employees (16 %). This result is similar to other studies (see Storey 1994 and literature mentioned there).

Data on the qualification level of the whole labour force is not available on a regional basis for this period. We therefore took the qualifications of employees covered by social security and the unemployed together and calculated the share of people with a university education among the total.

The unemployment rate is generally seen as a sign of quantitative and structural problems on the labour market (Fritsch 1992; Gerlach & Wagner 1994; Storey 1994; Armington/Acs 2002). Problems on the regional labour markets lead to lower levels of spending power and thus to lower levels of demand. Hence a negative influence on the value of the regional share can be expected. On the other hand it is argued that an unfavourable labour market is associated with low opportunity costs because of a lack of alternatives. This might result in “entrepreneurs of need” (Bögenhold & Staber 1990; Gerlach & Wagner 1994), which means people setting up their own businesses because they see no other way to get work. However, empirical studies did not prove this connection, there was

no evidence for a larger share of entrepreneurs among the unemployed (Brüderl, Preisendörfer & Ziegler 1996; Preisendörfer 1999: 54; Fritsch & Falk 2002; Armington/Acs 2002). It can be expected though that there are more cases of such “entrepreneurs of need” in times of rising unemployment. For this reason the rate of change in unemployment is also included in the estimations with a lag of one year.

4.1.3 Indicators of structural differences between regions

Besides the number of potential entrepreneurs there are habitual factors that are far more difficult to measure. In some cases these are based on regional traditions and attitudes which gave rise to the “incubator theory”. This assumption states that people employed in smaller firms are more likely to set up a business of their own. It is thought that smaller firms allow a deeper insight into the running of a firm, whereas work in larger firms is more specialised. To measure this effect, the share of employees working in small firms is integrated into the estimations.

Another important structural indicator is the population density. According to the “urban incubator hypothesis” (Tödling/Wanzenböck 2003) most newly founded firms start in urban areas. Therefore assessing the effect of agglomeration is important.

Newly founded firms are often pioneers in the development and use of innovations (cf. Acs/Audretsch 1990). In order to quantify the regional innovative potential, two indicators are calculated. First the share of natural scientists and engineers is taken. If this share is above average, the regional level of innovation is assumed to be above average, too. However, for the regional entrepreneurial potential it is more important if the natural scientists and engineers are working in smaller firms due to the “incubator theory”. Audretsch (1995) introduced the so-called “technological regime” as an indicator of the innovative potential of the small-firms sector of industries. This approach is used for regions in a similar way (Audretsch & Fritsch 2002). Therefore, the regional share of natural scientists and engineers working in SMEs is taken into the estimations. The higher its value, the higher the importance of the small-firm sector is for innovative activities in the region and the higher the entrepreneurial character of the region is.

4.1.4 Controlling for spatial autocorrelation

Spatial autocorrelation can cause the standard deviation of the estimated coefficients to be underestimated. With these inefficient estimators the significance of the coefficients becomes unreliable (Anselin & Rey 1991).

There are two possible reasons for such spatial autocorrelation. First, the effect of the factors that are responsible for new-firm formation and survival may not be limited to the particular region but may spill over into other regions. We have accounted for this type of spatial autocorrelation by including a weighted average of the industries' rates of new-firm formation[9] and survival in the adjacent regions. This indicator should estimate the quantity of spatial autocorrelation. For the second type of spatial autocorrelation we have included the mean of the residuals of the neighbouring regions. With the aid of this indicator, unknown factors which are not fully reflected in the explanatory variables of the model but which influence neighbouring regions in an equal way are to be captured. In fact, Audretsch and Fritsch (2002) and Fritsch and Falck (2002) found that a certain type of growth regime tends to apply to geographical areas that are considerably larger than standard statistical regions.

Table 3: Summary statistics for the regional variables

	mean	standard deviation	median
Change in unemployment rates	-0.95	16.02	-3.18
Unemployment rates	8.02	2.88	7.73
Change in employment	1.63	1.89	1.69
Population density (log)	4.39	0.81	4.24
Technological regime	13.46	9.13	11.49
Proportion of employees in small businesses	40.69	5.90	40.26
Proportion of highly-qualified employees	4.88	1.84	4.43
Employees in R&D	0.02	0.01	0.02
Birth rates	6.15	1.00	6.03
Survival rates	57.91	2.57	57.88

[9] In this case we included a new-firm formation rate and not the average number to control for different sizes of adjacent regions. The rate is calculated by dividing the number of new firms by the number of people aged between 15 and 65 in the population.

4.2 Interpretation of the regressions

In order to avoid multicollinearity, several models are estimated in each case: eight for the firm formations and nine for the survival rates. The results of the individual regression models are shown in summary form in table 4. The detailed results can be found in the appendix (Tables A1-A6).

Table 4: Summary of the results of the panel regressions with fixed effects

Independent variables	New-firm formation models			Survival rate models		
	all industries	manufac. industries	business services	all industries	manufac. industries	business services
New-firm formation rate	-	-	-	neg.**	n.s.	neg.**
Survival rate	neg. **	n.s.	neg. **	-	-	-
Population density	pos.**	pos.**	pos.**	neg. **	neg. **	neg. **
Development of employment	pos.**	pos.**	pos.**	pos. **	pos. **	pos. **
Unemployment rate	n.s.	n.s.	n.s.	neg. **	neg. **	neg. **
Development of the unemployment rate	neg.** (partially)	neg.** (partially)	neg.** (partially)	neg.** (partially)	neg. *	neg. **
Proportion of highly-qualified workers	pos.**	pos.**	pos.**	neg. **	neg. **	neg. **
Employees in R&D	pos.**	pos.**	pos.**	neg. **	neg. **	neg. **
Proportion of employees in small businesses	neg. **	neg. **	neg. **	neg. **	neg. **	neg. **
Technological regime	neg. **	neg. **	neg. **	n.s.	n.s.	n.s.
Spillover effect	n.s.	neg.*	neg.*	pos. **	n.s.	pos. *
Residuals	n.s	n.s.	n.s.	n.s.	n.s.	n.s.

** highly significant influence (1 % level)
* significant influence (5 % level)
n.s. not significant
- not included in the model

The multivariate estimates, too, result mainly in negative correlations between the number of firms founded and the survival rates. They are more pronounced in the models for explaining the survival rates than in the analogous firm-formation models. This holds for the models for all indus-

tries as well as for the models for the business services. However, there is no significant correlation in the manufacturing industry. Therefore the correlation in the models for all industries obviously mirrors a negative relationship in the service industries.

The thesis that young firms continue to benefit afterwards from the environment that promoted their establishment, therefore applies at most in the manufacturing industry. However it does not apply in the services sector. In this sector, with a much higher firm-formation-rate the influence of strong competition leads to lower survival and hence no "supportive environment" exists. In the result the strong competition in these areas should lead to the surviving firms being especially efficient and thus having a significant growth potential. Brixy (1999: 116) found such a correlation for eastern Germany. There it was found that in districts with low survival rates the growth rates of the young firms that did survive were above average.

A high level of agglomeration has a positive influence on the formation of new firms irrespective of the industry. In the survival rates models on the other hand a highly significant negative influence of this variable is detectable in all models. Young firms in agglomeration areas have a lower survival expectation than those in rural areas. It seems reasonable to put this effect down to differences in costs (rents, wages) between urban and rural areas, which determine the cost structure of firms in a different way[10]. But also differences with regard to the intensity of competition could be of importance. A greater level of agglomeration means that firms in the same industry are closer together in spatial terms. That is why it is easier for customers in highly agglomerated regions to change their supplier than it is for customers in less highly agglomerated ones.

The level and development of the unemployment rate and the development of employment fundamentally reflect the economic development of regions. The amount of unemployment has no significant impact on the number of new firms founded but it does have a clear negative impact on the chances of the firms surviving. However, the development of unem-

[10] Unfortunately there exists no data on a regional level to control for these differences.

ployment tends to have a negative impact in all the models. If the quality of the workforce (qualification level or proportion of R&D employees) is controlled for, then the model gains explanatory power overall and the negative correlation with the development of the unemployment rate becomes highly significant.

These opposing patterns of the unemployment indicators and the development of employment do not come as a surprise. The always positive influence of the development of employment on the firm formation activity with a simultaneous negative influence of the development of unemployment shows the importance of the economic development for the willingness to set up new businesses. During bad times the propensity to set up a new firm is relatively low. Hence, there are no indications of a push-effect as a result of impending unemployment ("new firms from sheer need"). An unfavourable economic development or situation also reduces the survival chances of the young firms, which can certainly be seen as being associated with insufficient demand. Hence, the direction of economic development affects both new firm formation and survival, whereas the level of economic performance effects only the survival.

The qualification level of the workforce proves to be the most important explanatory variable for the number of new firms founded. This was operationalised by two variables: the proportion of highly qualified workers and the proportion of employees in R&D[11]. These are important variables for the survival rates, too. Both of the indicators are also "agglomeration indicators" to a great extent; this means that they have considerably higher values in the more highly agglomerated regions. It is therefore no surprise that, like the population density, they are included in the models for the number of new firms with a positive sign and in the survival rates model with a negative sign. However, whilst in the survival rates model the t-values of population density, the proportion of highly qualified workers and the proportion of R&D employees are roughly equal, in the new-firm formation models the qualification variables are clearly more significant than the population density variable (t-values in Tables A1-A3 in the

[11] The exceptionally high coefficients of these variables can be put down to the very small proportions of scientists and engineers among all workers in the regions.

appendix). Therefore in the survival rates models it remains unclear whether these variables have an endogenous influence. But it can be seen that the qualification level of the workforce is of great importance for the creation of new firms, which can not be explained solely by the concentration of employment.

The proportion of small firms in a region is intended to be an indicator for the "incubator theory". In contrast to expectations, the indicator is included in the model with a negative sign, however. This result comes as a surprise and conflicts with the results of other studies (Armington/Acs 2002, for a summary see Storey 1994: 67). But most of the empirical analyses use a new-firm formation **rate** as a dependent variable[12]. This can result in considerable illusory correlations which are ruled out by the count data model used here[13]. The negative correlation with the incidence of new-firm formation could be explained by the comparatively large proportions of small firms in less agglomerated regions.

Likewise the survival rates fall as the importance of the small firms increases, irrespective of the industry. In this case it is surprising as there is a high negative correlation (-0.76) between the proportion of employees in small firms and the population density. Like other "agglomeration indicators", however, the population density is also included in the estimates with a negative sign. The also highly significant correlation between the incidence of small firms and the survival rate shows that in addition to the agglomeration effects, the size of the enterprises has clear effects, too. Exactly what these effects are, however, remains unclear. But it could be presumed that this is a further sign of "revolving-door regimes". Thus competition would tend to be stronger for new firms in regions with a small-firm structure and consequently the survival chances would be poorer.

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[12] There are two different kinds of rates in use. One is based on the number of firms in a region ("ecological approach", the other on the number of employees/ economically active population ("labour-marked approach") (see Fritsch/Audretsch 1994). Gerlach/ Wagner (1994) show that there are different outcomes for this indicator depending on what type of rate should be explained.

[13] This is also confirmed by other calculations in which a new-firm formation rate was calculated with the same independent variables. In these estimates the proportion of workers employed in small firms was included with a positive sign.

The indicator which is intended to measure the importance of the small-firm sector for research and development (technological regime) is included in all the estimates of the incidence of new-firm formation with a negative sign. Although this does not correspond with the theoretical expectations, it is not surprising as a result of the high bivariate correlation with the proportion of workers employed in small firms ($r = 0.74$). It therefore seems obvious to refer, in this case too, to the centre-periphery difference in new-firm formation activity. However the two variables do not correspond entirely, which is shown by the technological regime not being included significantly in any of the survival rates models. This could be put down to the fact that in this indicator opposing factors are expressed which thus balance each other out. The significance of the small firms is higher above all in the less agglomerated regions in which highly qualified scientists and engineers are under-represented.

The spillover effect is not significant in the new-firm formation models of all industries, but is positive and highly significant in the survival rates models. Therefore there is an indication of spatial autocorrelation only for the survival rates. The residual variable is, as expected, not included significantly in any estimate.

5 Conclusions

The main focus of interest in this article is the relationship between the regional rates of new-firm formation and the firms' chances of survival, with an application to the German case. The positive relationship between entry and exit, which is often stated, gave cause for the assumption of a negative relationship between the birth and survival of firms. It was possible to confirm this expectation in models which included all industries and those for business services, but not for the manufacturing industry. This relationship can be found primarily in the multivariate models, in other words when other important structural variables are controlled.

A regional structural policy should therefore focus not only on encouraging the creation of as many new firms as possible but also on ensuring the quality of the new firms. This applies above all in the services sector. The empirical results for western Germany show that as the rates of new-firm formation increase, the duration of survival decreases. As this relationship varies according to the industry, it is efficient to pay great attention to the

industry spectrum and the competition situation, in other words to the ability of the young firms to assert themselves on the market. However, high survival rates can also be a sign of a lack of competition and of poor regional dynamics.

The models for estimating the new-firm formation rates and survival rates clarify the negative relationship between the new-firm formation rate and the survival rate. There are clear signs of the role of competition between young firms as the driving force behind low survival rates. In the new-firm formation rates models, many of the independent variables have the opposite signs to the survival rates models. This applies in particular for the impact of the agglomeration level, in other words the settlement structure, and for the qualification level of the workers.

The location factors that are conducive to the formation of new firms in the services sector have the opposite effect on the survival chances of the young firms. This points to a high level of competitive pressure from the firms in this sector, which quickly pushes firms that do not prove themselves out of the market again. In manufacturing there is no direct negative relationship between the incidence of new-firms and the survival rate, but here, too, the effects of the level of agglomeration and the qualification level of the workforce point in different directions in both approaches. It therefore seems reasonable to suppose that this is not a sign of low competitive pressure in this sector but more an effect of the time framework for the survival rates, which at three years is relatively short. In manufacturing the barriers to market entry are higher; setting up a new firm requires on average considerably more planning and more capital. These are factors which are known to have a positive influence on the duration of survival of the young firms. That is why it is quite possible that if even longer time-series were evaluated, a negative correlation would appear between the regional rate of new-firm formation and the survival rate.

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Appendix

Table A 1: Results of the panel regression with fixed effects for all industries

Independent variables	New-firm formation models (all industries)							
	I	II	III	IV	V	VI	VII	VIII
Change in the unemployment rate	-0.002 (-1.82)	-	-	-0.001 (-0.40)	-0.002 (-1.92)	-0.004** (-4.36)	-0.004** (-3.70)	-0.001 (-0.61)
Survival rate	-0.029* (-2.09)	-	-0.029* (-2.19)	-0.055** (-3.33)	-0.050** (-2.82)	-0.008 (-0.71)	-0.027 (-1.92)	-
Population density	0.588** (5.67)	0.594** (5.80)	0.592** (5.76)	-	-	-	-	0.574** (5.53)
Residuals	0.000 (0.10)		0.000 (0.10)	-0.000 (-0.27)	0.000 (0.25)	0.000 (0.34)	0.000 (0.64)	-
Unemployment rate	-	-0.011 (-0.61)	-	-	-	-		
Development of employment	-	-	0.022** (2.67)	-	-	-		
Proportion of small firms	-	-	-	-6.186** (-5.98)	-	-		
Technological regime	-	-	-		-0.036** (-5.84)	-		
Proportion of highly qualified workers	-	-	-	-	-	0.260** (8.90)		
Employees in R&D	-	-	-	-	-	-	47.640** (7.85)	
Spillover effect	-	-	-	-	-	-		0.045 (0.54)
Wald chi²	36.89**	35.03**	48.38**	41.60**	39.22**	82.57**	65.71**	34.67**

Negative-binomial regression. Heteroskedasty robust estimators in accordance with the Huber-White-Sandwich procedure. 518 cases each.
In brackets: z-values. * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account
Stata 7.0: : nbreg, robust cluster (standard statistical regions)

Table A 2: Results of the panel regression with fixed effects for the manufacturing industry

Independent variables	New-firm formation models (manufacturing industry)							
	I	II	III	IV	V	VI	VII	VIII
Change in the unemployment rate	-0.002* (-2.28)	-	-	-0.001 (-0.46)	-0.002 (-2.23)	-0.005** (-4.57)	-0.004** (-4.63)	-0.002* (-2.05)
Survival rate	-0.001 (-0.23)	-	-0.002 (-0.37)	-0.014 (-1.82)	-0.015* (-2.12)	-0.001 (-0.23)	-0.012 (-1.63)	-
Population density	0.517** (5.29)	0.520** (5.63)	0.522** (5.39)	-	-	-	-	0.521** (5.37)
Residuals	0.000 (0.34)		0.000 (0.33)	-0.000 (-0.19)	0.001 (0.44)	0.001 (0.52)	0.001 (0.74)	-
Unemployment rate	-	-0.026 (-1.41)	-	-	-	-		
Development of employment	-	-	0.024** (2.98)	-	-	-		
Proportion of small firms	-	-	-	-5.356** (-5.41)	-	-		
Technological regime	-	-	-		-0.032** (-5.75)	-		
Proportion of highly qualified workers	-	-	-	-	-	0.201** (6.86)		
Employees in R&D	-	-	-	-	-	-	37.672** (6.43)	
Spillover effect	-	-	-	-	-	-		-0.006 (-0.01)
Wald chi²	31.72**	37.10**	40.72**	42.47**	44.77**	59.16**	59.12**	32.00**

Negative-binomial regression. Heteroskedasty robust estimator in accordance with the Huber-White-Sandwich procedure. 518 cases each.
In brackets: z-values * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account
Stata 7.0: nbreg, robust cluster (standard statistical regions)

Table A 3: Results of the panel regression with fixed effects for business-related services

Independent variables	New-firm formation models (business-related services)							
	I	II	III	IV	V	VI	VII	VIII
Change in the unemployment rate	-0.001 (-0.95)	-	-	0.001 (0.46)	-0.002 (-0.96)	-0.005** (-4.07)	-0.005** (-3.29)	0.001 (1.18)
Survival rate	-0.023** (-2.72)	-	-0.025** (-2.95)	-0.042** (-4.76)	-0.036** (-3.37)	-0.004 (-0.66)	-0.017** (-2.44)	-
Population density	0.791** (6.33)	0.821** (6.74)	0.796** (6.43)	-	-	-	-	0.817** (6.44)
Residuals	-0.000 (-0.48)		0.000 (0.49)	-0.001 (-1.22)	-0.000 (-0.32)	0.001 (0.20)	0.001 (0.42)	-
Unemployment rate	-	-0.035 (-1.41)	-	-	-	-		
Development of employment	-	-	0.024* (2.24)	-	-	-		
Proportion of small firms	-	-	-	-8.445** (-7.41)	-	-		
Technological regime	-	-	-		-0.050** (-6.72)	-		
Proportion of highly qualified workers	-	-	-	-	-	0.347** (10.70)		
Employees in R&D	-	-	-	-	-	-	65.507** (8.89)	
Spillover effect	-	-	-	-	-	-		-0.396 (-0.75)
Wald chi²	82.20**	50.17**	59.76**	80.59**	61.73**	140.27**	96.93**	59.37**

Negative-binomial regression. Heteroskedasty robust estimator in accordance with the Huber-White-Sandwich procedure. 518 cases each.

In brackets: z-values * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account

Stata 7.0: nbreg, robust cluster (standard statistical regions)

Table A 4: Survival rates: results of the panel regression with fixed effects for all industries

Independent variables	Survival rates models								
	I	II	III	IV	V	VI	VII	VIII	IX
Change in the unemployment rate	-0.032** (-5.39)	-	-	0.000 (-0.02)	-0.030** (-4.81)	0.002 (0.31)	-0.011 (-1.66)	-0.014* (2.21)	-0.023 (3.90)
Population density	-15.544** (-6.60)	-24.076** (-8.38)	-17.952** (-7.13)	-	-	-	-	-4.756 (-1.61)	
Residuals	0.077 (0.37)		0.100 (0.48)	0.275 (1.30)	0.176 (0.82)	0.156 (0.80)	-0.000 (-0.02)	-	0.220 (1.09)
Unemployment rate	-	-0.410** (-5.37)	-	-	-	-			
Development of employment	-	-	0.202** (3.62)	-	-	-			
Proportion of small firms	-	-	-	-67.722** (-4.44)	-	-			
Technological regime	-	-	-		-0.062 (-0.89)	-			
Proportion of highly qualified workers	-	-	-	-	-	-2.594** (-9.50)			
Employees in R&D	-	-	-	-	-	-	-635.959** (-7.84)		
Spillover effect	-	-	-	-	-	-	-	0.491** (5.74)	
New-firm formation rate	-	-	-	-	-	-	-	-	-2.142** (-7.76)
R^2 (overall)	0.01	0.01	0.01	0.01	0.02	0.02	0.00	0.03	0.21!!

In brackets: t-values * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account

Stata 7.0: xtreg, fe

Table A 5: Survival rates: results of the panel regression with fixed effects for the manufacturing industry

Independent variables	Survival rates models								
	I	II	III	IV	V	VI	VII	VIII	IX
Change in the unemployment rate	-0.074** (-5.84)	-	-	-0.018 (-1.01)	-0.072** (-5.57)	-0.027 (-1.87)	-0.046** (-3.31)	-0.073** (-4.90)	-0.071** (-5,41)
Population density	-13.671** (-2.72)	-27.950** (-4.72)	-20.544** (-3.98)	-	-	-	-	-13.190** (-2.45)	
Residuals	-0.058 (-0.36)		-0.045 (-0.28)	0.037 (0.23)	-0.006 (-0.04)	-0.015 (-0.10)	-0.034 (-0.21)	-	-
Unemployment rate	-	-0.749** (-4.85)	-	-	-	-			
Development of employment	-	-	0.613** (6.07)	-	-	-			
Proportion of small firms	-	-	-	-106.728** (-4.46)	-	-			
Technological regime	-	-	-		-0.090 (-0.67)	-			
Proportion of highly qualified workers	-	-	-	-	-	-2.894** (-5.79)			
Employees in R&D	-	-	-	-	-	-	-701.851** (-4.47)		
Spillover effect	-	-	-	-	-	-	-	0.013 (0.14)	
New-firm formation rate	-	-	-	-	-	-	-	-	2.103 (0.87)
R^2 (overall)	0.06	0.06	0.05	0.00	0.02	0.04	0.01	0.06	0.02

In brackets: t-values * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account

Stata 7.0: xtreg, fe

Table A 6: Survival rates: results of the panel regression with fixed effects for business-related services

Independent variables	Survival rates models								
	I	II	III	IV	V	VI	VII	VIII	IX
Change in the unemployment rate	-0.089** (-7.40)	-	-	-0.046** (-2.62)	-0.086** (-6.79)	-0.031* (-2.20)	-0.048** (-3.60)	-0.074** (-5.28)	-0.073** (-5.83)
Population density	-30.106** (-6.26)	-48.760** (-8.58)	-38.069** (-7.69)	-	-	-	-	-24.711** (-4.61)	
Residuals	-0.058 (-0.35)		-0.022 (-0.13)	0.039 (0.23)	0.034 (0.20)	-0.043 (-0.26)	-0.077 (-0.46)	-	-
Unemployment rate	-	-0.969** (-6.54)	-	-	-	-			
Development of employment	-	-	0.715** (7.36)	-	-	-			
Proportion of small firms	-	-	-	-81.929** (-3.45)	-	-			
Technological regime	-	-	-		-0.126 (-0.95)	-			
Proportion of highly qualified workers	-	-	-	-	-	-3.608** (-7.45)			
Employees in R&D	-	-	-	-	-	-	-1033.88** (-6.81)		
Spillover effect	-	-	-	-	-	-	-	0.178* (2.16)	
New-firm formation rate	-	-	-	-	-	-	-	-	-11.530** (-5.57)
R^2 (overall)	0.05	0.04	0.04	0.00	0.02	0.08	0.05	0.05	0.19

In brackets: t-values * coefficient significant at the 5% level, ** at the 1% level. -: variable not taken into account

Stata 7.0: xtreg, fe

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