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The effect of new firm formation on regional development over time

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The Effect of New Firm Formation on Regional Development over Time

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Abstract

In our analysis of the impact of new firm formation on regional employment change we identified considerable time lags. We investigated the structure and extent of these time lags by applying the Almon lag model and found that new firms can have both a positive and a negative effect on regional employment. The results indicate that the indirect effects of new firm formation (crowding-out of competitors, improvement of supply conditions and improved competitiveness) are of greater magnitude than the direct effect, i.e., the jobs that are created in the new businesses. The peak of the positive impact of new firms on regional development is reached about eight years after the new firms have been started.

JEL-classification: M13, O1, O18, R11
Keywords: Regional growth, new firms, entrepreneurship, time lags.

Zusammenfassung

"*Der Einfluss von Gründungsprozessen auf die Regionalentwicklung im Zeitablauf*"

Für den Einfluss von Gründungsaktivitäten auf die Regionalentwicklung lassen sich erhebliche Zeitverzögerungen feststellen. Wir analysieren das Ausmaß und die Struktur dieser Zeitverzögerungen mit dem Almon-Lag Verfahren. Die Ergebnisse zeigen, dass Gründungen sowohl einen positiven als auch einen negativen Einfluss auf das Beschäftigungsniveau haben können. Allgemein scheinen die indirekten Effekte des Gründungsgeschehens (Verdrängung etablierter Konkurrenten, Verbesserung des Angebots und gesteigerte Wettbewerbsfähigkeit) stärker ausgeprägt zu sein als der direkte Effekt, gemessen als die in den neuen Firmen entstandenen Arbeitsplätze. Das Maximum des positiven Einflusses der Gründungen auf die Regionalenwicklung wird nach ca. acht Jahren erreicht.

JEL-Klassifikation: M13, O1, O18, R11
Schlagworte: Regionalentwicklung, Unternehmensgründungen, Entrepreneurship, Time Lags.

1. Introduction[1]

Does a high level of new firm formation in a region stimulate economic development? While most people believe that this is the case, a clear and indisputable empirical proof for this hypothesis is still lacking. Some results of recent research suggest that the lack of clarity with regard to the relationship between the level of new firm formation and economic growth could be attributed to long time lags that are needed for the main effects of new firm formation to become evident. In their analysis of the relationship between new firm formation and employment growth in West German planning regions Audretsch and Fritsch (2002) found that start-ups that occurred in the years 1983-85 could contribute to explaining employment change in the 1993-98 period. Van Stel and Storey (2002), in an investigation of the relevance of such time lags for British regions, arrived at the conclusion that the strongest employment effect can be attributed to new firm formation activity occurring about five years earlier.

This paper investigates the time lag of the effect of new firm formation on regional growth for West Germany.[2] As a starting point, we first review the possible direct and indirect effects of the setup of new businesses on regional development (section 2). We then provide an overview of the empirical evidence attained thus far (section 3) and deal with data and measurement issues (section 4). The results of the analysis of the time lag distribution of new firm formation on regional employment change are reported in section 5. Finally, we discuss implications of our findings for policy and for further research (section 6).

2. Possible effects of new firm formation on regional growth

The relationship between new businesses and economic development is quite complex. Analyzing this relationship requires a rather comprehensive approach which should include more than the development of employment in the new units and should particularly account

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[1] We are indebted to Gerd Ronning for advice regarding the application of the Almon lag procedure. Financial support from the German Science Foundation (grant FR 242/7-1) is gratefully acknowledged.

[2] As compared to the data analyzed by Audretsch and Fritsch (2002), we have a longer time series of data available and we perform the analysis for smaller spatial units (districts instead of planning regions).

for the related supply-side effects. Figure 1 gives an overview of the different effects of new firms on economic development.

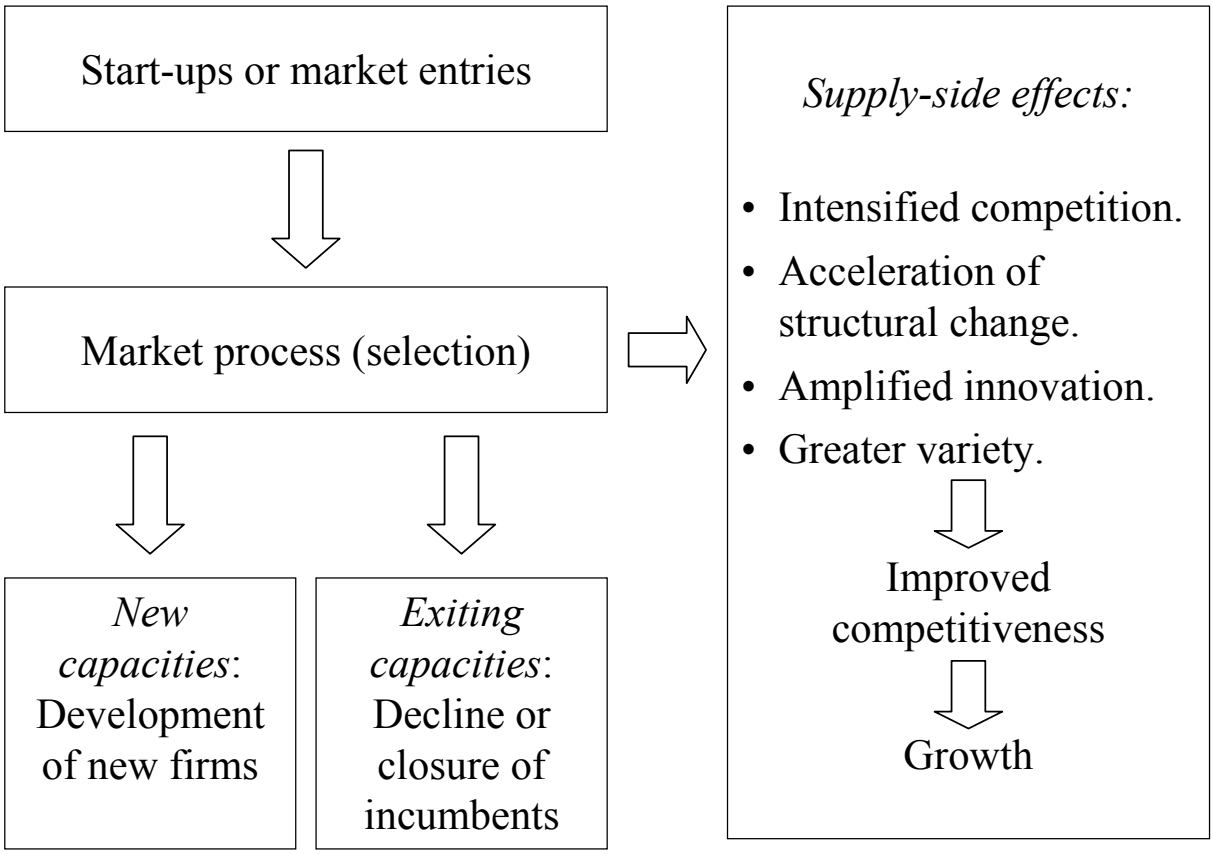

Figure 1: New firm formation and the market process

New firms represent an entry of new capacities into the market and are therefore an essential element of the market process. One of the contributions of new businesses to economic development is the evolution of newcomers, which may be labeled as the *direct effect* of new capacities. Two types of *exits* may result from the entry of new capacities; firstly, new businesses which fail to be sufficiently competitive and thus they have to leave the market after some time and secondly, the crowding-out of incumbents by their new competitors leading to declining market shares or market exit. Further effects that are rather indirect in nature pertain to the supply-side of the market. There are four main kinds of such *indirect supply-side effects* resulting from new firm formation:

- First, *initiating or intensifying competition* by contesting established market positions. Not only the actual entry but also the very possibility of entry forces the incumbents to behave more efficiently (Baumol, Panzar and Willig, 1988).

- Second, *acceleration of structural change*. It can frequently be observed that structural change is accomplished by a turnover of the respective economic units, i.e. by entries of new firms joined by exits of incumbents. In this case, the incumbents do not undergo necessary internal changes but are substituted by newcomers.[3] This type of process has been put forward by J.A. Schumpeter's (1911/1934; 1942) concept of „creative destruction" and by Alfred Marshall's (1920) analogy of a forest in which the old trees must fall in order to give way to the new ones.

- Third, *amplified innovation*, particularly the creation of new markets. There are many examples of radical innovations that have been introduced by new firms (Acs and Audretsch, 1990; Audretsch, 1995). One major reason for this pronounced role of new firms in introducing innovation could be that incumbent suppliers are more interested in exploiting the profit possibilities of their given product program than they are in searching for new opportunities (Geroski, 1995, 431). Another explanation could be that to set up one's own business may appear to be the only or the most promising possibility to commercialize knowledge (Audretsch, 1995).

- Fourth, innovative entry may lead to a *greater variety* of products and problem solutions. If the product program of the newcomers differs from those of the incumbents or if they introduce significant process innovation, this leads to a larger spectrum of available goods and problem solving methods. Such an increased variety implies a higher probability of finding a supply with a better match for customer preferences than the supply that was available before. Increased variety due to new supplies may stimulate an intensified division of labor as well as follow-up innovation and can in this way generate significant impulses for economic development.

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[3] Such a process could for example be observed in the transformation of former socialist economies of Central and Eastern Europe where new firms – the bottom-up component – had a considerably stronger impact on structural change, cf. Brezinski and Fritsch (1996) and the contributions in Pfirrmann and Walter (2002).

The supply-side effects of new firm formation processes may lead to significant improvements in the *competitiveness* of an economy, industry, or region, and thereby stimulate *economic growth*.

While the direct impact of new firm formation on employment, namely the setting-up of new capacities, is positive by definition, the net effect in terms of employment in new capacities minus employment in exiting capacities may well be negative. Such a negative net effect of market entry on employment can be expected if the market mechanism results in a "survival of the fittest" scenario while the market volume remains constant. In this case the surviving firms will be able to provide a given amount of output more efficiently than before and, insofar as labor productivity rises, this implies less employment. However, while such a labor-saving effect of increased efficiency may occur, it also concurrently results in improved competitiveness which may lead to rising market shares. Such a labor saving effect is favorable from a growth perspective due to the fact that it provides resources for growth in other markets. It follows that with a well-functioning selection mechanism an increase of employment can mainly be expected from growth induced by the supply-side effects of the new firm formation process. The magnitude of these supply-side effects should depend on the quality of the newcomers as well as on the efficiency of the market process. Quality of newcomers in this context means their competitiveness and thus the challenge that they pose for the incumbents. A main determinant of this challenge is their innovativeness, i.e. to what degree their supply is of a new or higher quality or is produced with lower costs than that of the incumbents.

The efficiency of the market process with regard to the effects of entries may be judged according to the following two criteria:

- How quickly and how intensely do the incumbents react to an actual or a potential entry?

- How reliably does the market mechanism discriminate between the better and the inferior solution, i.e. how far does the selection by competition result in "survival of the fittest" scenario?

According to these criteria, the market process can be judged to be more efficient the more reliably a superior solution turns out to be economically successful. If the market selection process favors the inferior alternative then no competitiveness-increasing supply-side effects

will emerge. Two effects must be considered with regard to the speed and intensity of the reaction of incumbents. On the one hand, market processes should be fast so that improvements become effective without unnecessary delay. On the other hand, anticipation of a more or less immediate reaction of the incumbents may deter entries and result in a relatively low level of new firm formation. Particularly if innovative newcomers have to expect speedy imitation of their advancement, this will reduce the expected profit and the incentive for innovative entry. Therefore, market entry and its associated effective economic development depend on the selection mechanism, which may foster or hamper the innovative success of new firms.

The emergence of the supply-side effects of new firm formation does not necessarily require that the newcomers be successful. As long as entry induces improvements on the side of the incumbents it will generate positive supply-side effects, even if the new businesses fail and have to exit the market soon after entry. It is irrelevant if the improved supply is provided by the newcomers or by the incumbents for these supply-side effects to occur. Therefore, even the failed start-ups can make a significant contribution to the improvement of supply and competitiveness. Insofar as competition leads to a "survival of the fittest" scenario, one could expect that high turnover in the stock of firms results in relatively large improvements of supply and competitiveness (see Caves, 1998, for a review of the evidence). A high probability of failure could, however, have a negative effect if it were to discourage potential market entry resulting in the fact that a certain kind of innovation does not occur.

A main problem related to the empirical assessment of these outcomes is found in the correct identification of the various indirect effects. This is particularly difficult because such indirect effects, like the exit of an incumbent competitor or an improvement of their supply, may not necessarily occur in the same region or even country. Since an innovation may also be applied in other industries, it may also have an impact outside the industry of origin. An analysis that measures only the effects of new firm formation within the respective industry or region is therefore incomplete and will underestimate the total impact. Due to these problems of identifying the diverse indirect effects, a comprehensive assessment may be impossible. This holds particularly true for long-term supply effects which become effective only with a considerable time lag. Therefore, any measurement of the indirect effects of new firm formation on economic development will be incomplete.

3. Review of the evidence

The empirical evidence for the impact of new firm formation on economic development is somewhat diffuse. One reason for the mixed results may be that different indicators for market dynamics as well as for economic development are used. While some studies examine the effect of entries others use turbulence, i.e. the sum of entries and exits, as the independent variable. Common indicators for economic development are changes in employment, unemployment, and productivity. Most studies have regions as units of analysis, but some are for nations and some are on the level of industries.

A clear positive impact of new firm formation on regional employment change has been found in studies about the USA (Acs and Armington, 2003; Reynolds, 1994, 1999), however, the magnitude of the relationship seems to vary over time. Empirical proofs of a clear positive relationship for other countries are relatively rare (see Carree and Thurik, 2003, 457-463 for an overview). Ashcroft and Love (1996) detected evidence that entrepreneurship had a positive effect on employment change in Great Britain in the 1980s. Davidsson, Lindmark and Olofsson (1994a, b) identified some impact of regional new firm formation in Sweden on a complex indicator for economic well-being. Another study about Sweden by Foelster (2000) found a positive impact of increased self-employment rates on regional employment. And Brixy (1999) showed that new firm formation had a strong positive effect on regional employment in East German regions in the first years of the transformation process. However, analyses about the Netherlands (EIM, 1994) and of West Germany (Audretsch and Fritsch, 1996; Fritsch, 1996, 1997) for the 1980s found no such relationship.

Audretsch and Fritsch (2002) suggested that the lack of clarity with regard to the impact of new firm formation on regional development may be attributed to relatively long time lags that are required for the main effects of new firm formation to become evident. They found that the level of start-ups in the 1980s could not contribute to explaining employment change in the 1980s but could explain changes in the 1990s. Van Stel and Storey (2002), in their analysis for British regions, investigated the relevance of such time lags somewhat more systematically. They confirmed that the regional growth rate is positively shaped by new firm formation of several of the earlier periods. According to their results, the magnitude of the effects over time takes the form of an inverse U with a peak for the start-up activity from five years earlier. After ten years no effect of new firm formation on regional employment can be identified. Audretsch and Keilbach (2002) analyzed the impact of the regional level of

entrepreneurship on growth in West German regions in the framework of a production function and found a positive impact that is quite pronounced. Because their analysis was only for one year they were not able to examine the significance of a time lag in the relationship.

Audretsch, Carree and Thurik (2001) investigated the impact of changes in self-employment on unemployment for 23 OECD countries on a national level.[4] They found some unemployment-reducing effects of increased self-employment, but their analysis also shows that such a kind of relationship does not hold true for all of the countries in their sample. Remarkably, the effect tends to be larger for longer time spans. Regressions with change of unemployment and entrepreneurship measured over a period of eight years show a stronger relationship between these indicators than do regressions for values calculated over a four-year period. If calculations are based on a twelve-year period, the impact of changes of self-employment on the unemployment rate becomes even more pronounced.

A number of studies that analyzed the effect of turbulence on productivity growth in regions and industries also found positive effects (see Callejon and Segarra, 2000; Bosma and Nieuwenhuijsen, 2000, and the survey of earlier work in Caves, 1998). In some of these studies this effect comes with a considerable time lag. If the impact of entry or turbulence is investigated for the large economic sectors separately, the effect found in services often tends to be somewhat stronger than that in manufacturing, where it may not even be statistically significant (Acs and Armington, 2003; Bosma and Nieuwenhuijsen, 2000). This supports Geroski's (1995) assessment that new firm births do not appear to play an important role in manufacturing.

We conclude from the available evidence that there is a positive impact of new firm formation on economic development and that nevertheless there may be considerable time

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[4] Unemployment may be a quite problematic indicator for the effect of new firm formation or self-employment on economic development because it is shaped by demographic factors such as age of the work force, development of labor-force participation rates and mobility between regions or countries. Moreover, unemployment may spur the unemployed persons to set up their own business, so that there is also an effect of the level of unemployment on self-employment and it could be difficult to separate this influence from the effect of the new firms on unemployment.

lags involved. However, the magnitude of the overall effect as well as the length and the structure of this time lag remain unclear.

4. Data and measurement approach

Our data on new firm formation and regional development is from the establishment file of the German Social Insurance Statistics (see Fritsch and Brixy, 2004, for a description). This database provides information about all establishments that have at least one employee who is subject to obligatory social insurance. Currently, the information on West Germany is available on a yearly basis for a relatively long time period of 20 years, from 1983 to 2002. Because the database records only businesses with at least one employee, start-ups consisting of only owners are not included. We exclude new businesses with more than 20 employees in the first or second year of their existence; as a result, a considerable number of new subsidiaries of large firms are not counted as start-ups.[5] Hence, although the database is limited to the level of establishments, the focus is on entrepreneurship and new firm formation. A detailed analysis of our database reveals that these data reflect the new firm formation activity relatively well (see Fritsch and Brixy, 2004).

Other data used in the analysis are from publications of the German Federal Statistical Office ('Statistisches Bundesamt'). We restricted our analysis to West Germany because of two reasons: Firstly, many studies indicate that East Germany in the 1990s was a special case with very specific conditions that cannot be directly compared to West Germany (cf. Brixy and Grotz, 2004; Fritsch, 2004). Secondly, in order to determine the indirect effects of new firm formation, we rely on a long time period for West Germany that is not existent for East Germany.[6] Our spatial units of analysis are the 326 West German districts ('Kreise'). Districts can be quite different in character: some are core cities, others are part of an agglomeration's suburban ring and some comprise the core of a smaller city as well as the surrounding area. The advantage of choosing districts as spatial units of analysis is that the sample contains a

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[5] A main reason for excluding new establishments with more than 20 employees is that some of the large new establishments reported in our data are probably a result of the reorganization of larger firms and do not reflect entrepreneurial activity.

[6] We excluded the Berlin region due to changes in the definition of that region during the inspected time period.

higher number of cases in the examination that allows for more sophisticated empirical analysis. A severe disadvantage could be that certain influences prove to be relevant for larger spatial units than districts, resulting in autocorrelation across regional borders. We indeed have found quite a considerable degree of spatial autocorrelation that we have explicitly accounted for in our analysis.

Our indicator for regional development is relative employment change in the private sector (measured as a percentage). To avoid disturbances by short run fluctuations we use the change rate over a two year period as the dependent variable (employment of t+2 relative to employment in t). Variables for new firm formation activity are the yearly start-up rates calculated according to the "labor market" approach, i.e. 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.[7] 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 firm formation in regions with a high composition of industries where new-firm start-ups are relatively unimportant. 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 firms 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 do estimations using the non-adjusted start-up rate. However, the basic relationships are left unchanged.

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[7] See Audretsch and Fritsch (1994) for different approaches of calculating start-up rates.

We used panel estimation techniques that allowed us to account for unobserved region-specific factors. Application of the Huber-White method provides robust standard error estimates. To analyze the impact of new firm formation on regional employment change we included the yearly start-up rates at the beginning of the inspected employment change periods (current year) and for the ten preceding years. This led to 8 observations per district. We found a rather strong correlation between start-up rates of subsequent years (see table A1 in the Appendix); all correlation coefficients for the relationship between start-up rates are statistically significant at the 1-percent level. In order to cope with this strong correlation we have applied Almon polynomial lags for estimating the time lag structure of the effect of new firm formation on regional employment change (Greene, 2003). Variables for regional characteristics other than start-ups that may be relevant for employment change, such as population density, did not prove to have any statistically significant effect and were therefore not included.[8]

5. The distribution of time lags

To shed light on the lag structure of the effect of new firm formation on regional employment change we first estimated a model that includes the start-up rate at the beginning of the inspected period of employment change (current year) and all start-up rates of the preceding ten years. Because of a relatively high level of correlation between the start-up rates of subsequent years we also analyzed the impact of each lagged start-up rate separately (table 1). When including all start-up rates in one model, we found the highest positive impact for new firm formation of the current year and of the years t-6 and t-7, i.e. the start-up rates of six and seven years ago. Remarkably, the start-up rates of period t-3 and t-4 have a significantly negative impact on employment change. Thus, the results of the regression including all relevant start-up rates between t and t-10 indicate both a positive and a negative relationship between entrepreneurial activity and employment growth (figure 2). However, when running separate regression for each start-up rate individually, we found that there is always a significantly positive relationship between the new firm formation and regional employment change. The separate regressions with the single start-up rates show the strongest impact for

[8] Population density can be regarded as a proxy variable for all kinds of regional characteristics such as availability of qualified labor, house prices, local demand, and the level of regional knowledge spillovers.

the start-up rates of the years t-5 and t-6. The impact of start-ups on employment change between t and t+2 first increases and then decreases the further back the time lags lie.

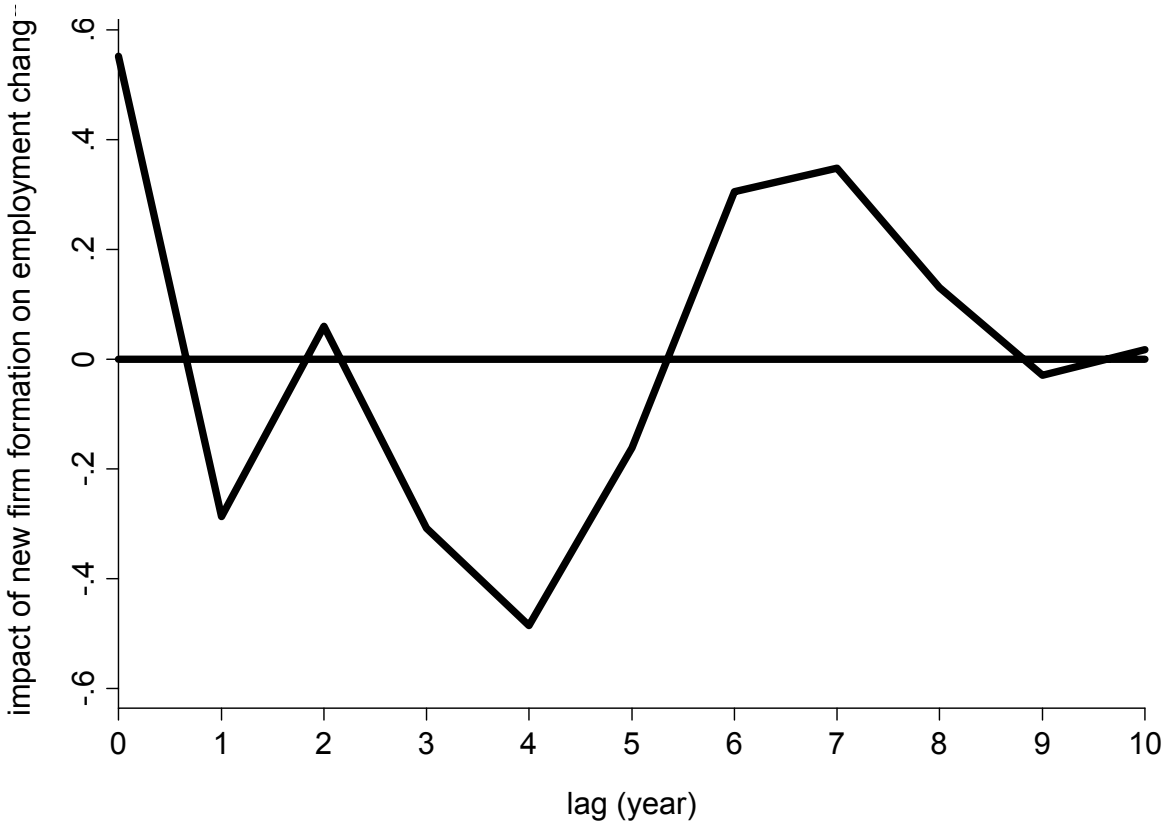

Figure 2: The structure of the impact of new firm formation on regional employment growth based on a regression that accounts for entry rates over eleven years

Table 1: The impact of new firm formation on regional employment change

	Two year regional employment change (percentage) [Huber-White]											
Constant	-1.28** (3.13)	-0.47* (1.98)	-0.26 (1.10)	-0.72** (3.00)	-0.91** (3.83)	-1.01** (4.13)	-1.22** (4.88)	-1.67** (6.52)	-2.22** (8.12)	-2.62** (9.36)	-2.17** (7.25)	-1.06** (3.09)
Start-up rate current year t	0.55** (6.65)	0.25** (9.75)	-	-	-	-	-	-	-	-	-	-
Start-up rate year t-1	-0.29** (5.12)	-	0.23** (9.23)	-	-	-	-	-	-	-	-	-
Start-up rate year t-2	0.06 (0.78)	-	-	0.29** (11.04)	-	-	-	-	-	-	-	-
Start-up rate year t-3	-0.31** (4.07)	-	-	-	0.31** (11.57)	-	-	-	-	-	-	-
Start-up rate year t-4	-0.48** (6.60)	-	-	-	-	0.31** (11.27)	-	-	-	-	-	-
Start-up rate year t-5	-0.16* (2.28)	-	-	-	-	-	0.32** (11.50)	-	-	-	-	-
Start-up rate year t-6	0.31** (3.95)	-	-	-	-	-	-	0.32** (11.63)	-	-	-	-
Start-up rate year t-7	0.35** (4.73)	-	-	-	-	-	-	-	0.31** (10.57)	-	-	-
Start-up rate year t-8	0.13 (1.93)	-	-	-	-	-	-	-	-	0.29** (9.87)	-	-
Start-up rate year t-9	-0.03 (0.40)	-	-	-	-	-	-	-	-	-	0.24** (7.43)	-
Start-up rate year t-10	0.02 (0.26)	-	-	-	-	-	-	-	-	-	-	0.15** (4.08)
Spatial autocorrelation (residuals in adjacent regions)	0.48** (8.01)	0.79** (31.44)	0.80** (31.57)	0.81** (31.69)	0.81** (30.74)	0.81** (30.24)	0.81** (29.90)	0.80** (29.76)	0.72** (19.45)	0.64** (15.25)	0.66** (15.69)	0.63** (14.02)
R^2	0.16	0.41	0.41	0.44	0.44	0.44	0.45	0.43	0.30	0.21	0.22	0.18
F-value	32.41	543.19	536.87	546.29	514.40	508.30	506.74	529.50	278.70	175.35	154.08	105.92
Number of observations (No. of obs. per district)	2,608 (8)	5,868 (18)	5,542 (17)	5,216 (16)	4,890 (15)	4,564 (14)	4,238 (13)	3,912 (12)	3,586 (11)	3,260 (10)	2,934 (9)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

We accounted for spatial autocorrelation in two different ways. Firstly, we have included an average of the residuals in the adjacent regions in order to account for unobserved influences that affect larger geographical entities than district and that are not totally reflected in the explanatory variables (cf. table1). Secondly, we employed spillover effects measured as an average of the employment change in the adjacent districts to account for determinants of employment change which are not limited to the particular region (cf. table A2 in the appendix). Both indicators of spatial autocorrelation resulted in the same lag-structure, yet the magnitude of the positive effects were stronger in the regressions that included the residuals of adjacent regions as a measure of spatial autocorrelation. Accounting for both control variables at the same time led to implausible results. As an alternative estimation method to the Huber-White method, we applied the model with fixed effects regression (cf. table A3 and A4). The differences to the results of using the robust standard error estimates are more or less gradual. The lag structure remains the same in the model using fixed effects; however, the magnitude of the impact of new firm formation on regional employment change came out to be stronger.

Due to the observed high correlation of start-up rates of subsequent years, the regression coefficient for a certain year may not necessarily reflect the impact of start-up activity only in this specific year but in other years as well. The pronounced multicollinearity of the start-up rates makes the interpretation of the regression coefficients problematic. To cope with this problem we apply Almon polynomial lags.[9] This method reduces the effects of multicollinearity in distributed lag settings by imposing a particular structure on the lag coefficients. We assume that the effect of changes in yearly start-up rates will be distributed over eleven periods.[10]

9 See van Stel and Storey (2002) for a similar approach.

10 We chose ten lags due to the fact that the strongest impact on employment change was for start-up rates of the years t-5 and t-6 in the separate regressions and of the years t-6 and t-7 in the single regressions (cf. table 1).

Table 2: The impact of lagged start-up rates on regional employment change

	Two year regional employment change (percentage) [Huber-White]				
		Almon method assuming a polynomial of			
	Standard	2nd order	3rd order	4th order	5th order
Constant	-1.28**	-1.21**	-1.19**	-1.21**	-1.20**
	(3.13)	(3.06)	(2.95)	(2.99)	(2.96)
Start-up rate current year	0.55**	0.16	0.42	0.48	0.44
	(6.65)				
Start-up rate year t-1	-0.29**	0.06	-0.03	-0.09	-0.02
	(5.12)				
Start-up rate year t-2	0.06	-0.03	-0.25	-0.31	-0.30
	(0.78)				
Start-up rate year t-3	-0.31**	-0.08	-0.30	-0.31	-0.36
	(4.07)				
Start-up rate year t-4	-0.48**	-0.11	-0.22	-0.19	-0.23
	(6.60)				
Start-up rate year t-5	-0.16*	-0.12	-0.07	-0.02	-0.02
	(2.28)				
Start-up rate year t-6	0.31**	-0.09	0.09	0.12	0.18
	(3.95)				
Start-up rate year t-7	0.35**	-0.04	0.22	0.20	0.25
	(4.73)				
Start-up rate year t-8	0.13	0.03	0.26	0.20	0.18
	(1.93)				
Start-up rate year t-9	-0.03	0.13	0.16	0.10	0.03
	(0.40)				
Start-up rate year t-10	0.02	0.25	-0.13	-0.06	-28.3
	(0.26)				
Spatial autocorrelation	0.48**	0.60**	0.52**	0.51**	0.51**
(residuals in adjacent regions)	(8.01)	(13.01)	(9.68)	(9.56)	(9.45)
R^2	0.16	0.18	0.16	0.16	0.16
F value	32.41	53.13	53.21	45.55	39.01
Number of observations (No. of obs. per district)	2,608 (8)	2,608 (8)	2,608 (8)	2,608 (8)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

When applying the Almon lag procedure, the type of polynomial assumed is a rather critical issue. Table 2 gives an overview of the result of robust regressions with the current start-up rate and ten time lags as well as the result of the regressions applying the Almon procedure with a polynomial lag of second-, third-, fourth-, and fifth-order. Figure 3 is a graphical exposition of the estimated lag structures that result from the different types of polynomials assumed. We found that a second-order polynomial results in a U-shape structure

for the impact of new firm formation on regional development. The results indicate that while the start-ups of the current period and of t-1 have a positive impact, the effects of new firm formation in t-2 to t-7 is negative. New firm formation of the last three years included (t-8 to t-10) has again a positive impact that is strongest for the last period (t-10). Assuming a third-order polynomial leads to a quite different type of lag structure that can also be found for a fourth- and a fifth-order polynomial[11].

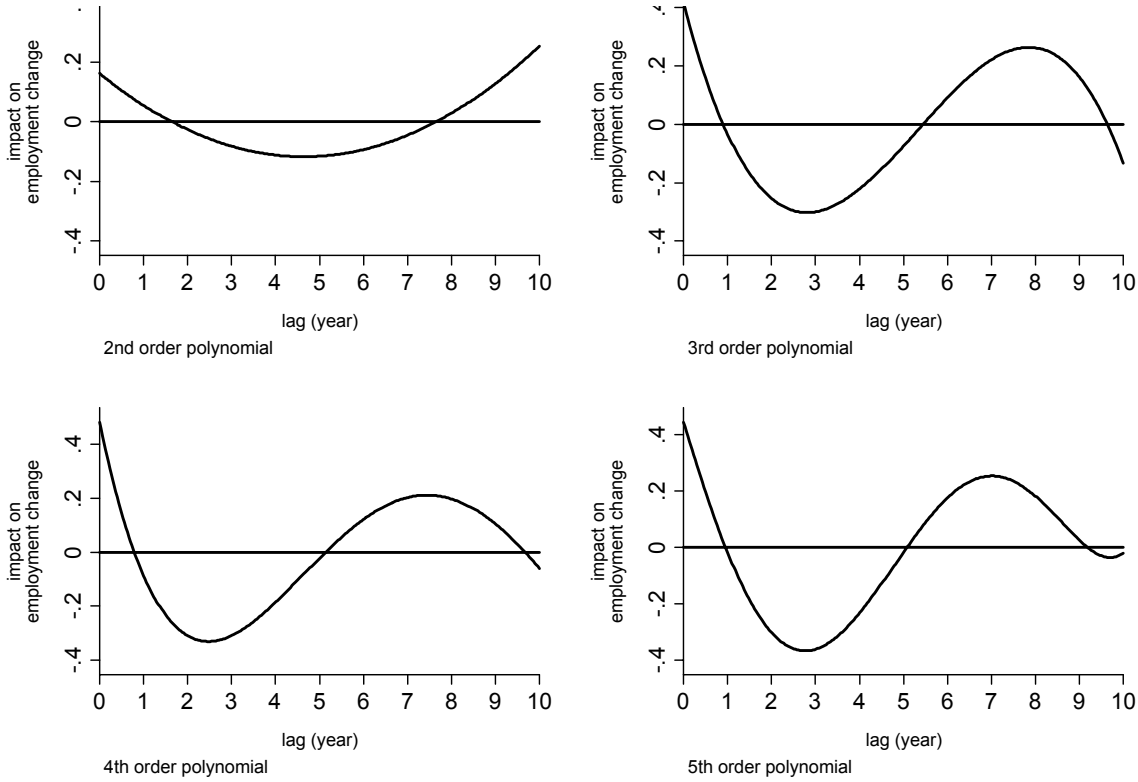

Figure 3: The lag structure of the impact of new firm formation on regional employment growth

This pattern suggests that new firm formation of the current year has a positive impact on employment change. For the years t-1 to t-5 the effect is negative with a minimum in t-3. For the entries in the years t-6 to t-9 there is a positive relationship with a maximum between year

[11] The model with the fifth-order polynomial has a comparatively low level of statistical significance.

t-7 and t-8. The intensity of the effect then decreases and is somewhat negative in the last year that is included (t-10). The relatively high F-value for the estimates with a third-order polynomial indicates that this assumption fits the data rather well. However, the F-value for estimates based on a second-order polynomial is about the same, indicating that this type of polynomial can also be seen as a reasonably good approximation.

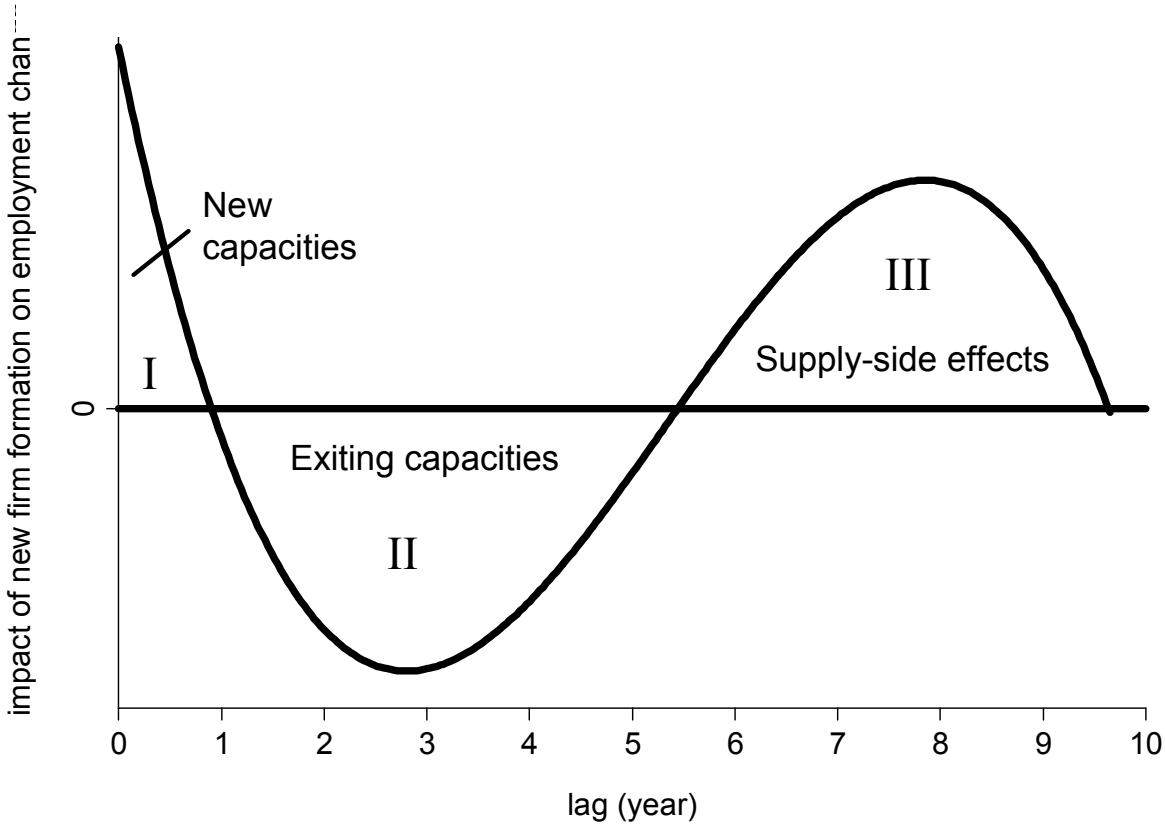

Figure 4: Direct and indirect effects of new firm formation on employment change over time

The pattern we found for the lag distribution of the impact of new firm formation on regional employment suggests a certain time sequence of the different effects that were described in section 2. We first use the results of the model with the third-order polynomial for our interpretation and then apply this reading to the pattern that we obtained for the model with the second-order polynomial. The positive employment impact for start-ups in the current year can be taken as the additional jobs that are created in the newly founded businesses at the time of inception. This direct employment effect is given by area I in figure 4. We know from other analyses that employment in entry cohorts tends to be stagnant or declining from the second or the third year on (Boeri and Cramer, 1992; Brixy and Grotz,

2004; Fritsch and Weyh, 2004). Therefore, new firm formation activity for the years t-1, t-2 and for earlier years should not lead to any significant direct employment effect. As soon as a new business is set up it is subject to market selection and will perhaps gain market shares from incumbent suppliers. We may therefore assume that the negative impact of the start-ups in the years t-1 to t-5 (area II in figure 4) results from exiting capacities, i.e. new businesses that fail to be competitive and from the crowding-out of incumbents. The positive impact of new firm formation for the years t-6 to t-10 on employment is probably due to a dominance of indirect supply-side effects, i.e. increased competitiveness of the regional suppliers (area III in figure 4). After about nine or ten years the impact of new firm formation on regional employment has faded away. We have no plausible explanation for the slightly negative value that we found for new firm formation in period t-10 and presume that it represents a kind of approximation error of the Almon lag procedure.

The interpretation of the lag structure that we found when assuming a second-order polynomial is quite similar, particularly regarding the direct effect of new firm employment and the crowding-out effects. Also, the lag from which point on the supply-side effects start to dominate is in about the same range. What is different, however, is that these supply-side effects then become stronger and stronger without decreasing again in the more backdated years. But this latter pattern appears highly implausible to us and is due to the structure of a second-order polynomial.

If our interpretation of the lag structure is correct, both patterns imply that the employment gain due to indirect supply-side effects of new firm formation is much larger than the initial employment created in the newly founded businesses, i.e. the direct employment effect. One indication for this conjecture is that, according to the estimated coefficients, the area in figure 3 that represents the indirect supply-side effect is always larger than the area of the initial employment effect. This becomes particularly clear if the supply-side effects are compared to the net effect of new capacities and exiting capacities that is given by area I minus the area II in figure 4. Because we cannot account for those parts of the supply-side effects that occur in other regions, this type of impact is considerably underestimated here. But if the true supply-side effects are considerably larger than what we have estimated, we can conclude that this effect is the most important result of new firm formation for economic development.

Results of sensitivity analyses support our interpretation. Taking a longer time period for employment change as the dependent variable leads to a greater magnitude of the effects. However, there is also an increased probability of attaining implausible coefficients for new firm formation in the years that lie relatively far behind.[12] We also analyzed the impact of entrepreneurial activity on employment change for longer time lags. Testing for 12-year time lags showed plausible estimates only for a third-order polynomial. The results when assuming a 14-year time lag were not very robust and partly implausible which may be due to the relatively low number of observations. A common result of the various alternative versions that led to plausible lag structures was that start-up activity in the current year and of the years t-7 to t-9 had the strongest positive impact on employment change.

Estimating the models for start-ups and employment change in the manufacturing and the service sectors independently shows much larger effects of new capacities (area I in figure 4) for manufacturing, which is probably due to the higher average size of entries in this sector. This contradicts Geroski's (1995) conjecture that new firm formation is relatively unimportant in manufacturing. Negative employment effects due to exiting capacities occur earlier in services than in manufacturing, already appearing in some of the models in the year after start-up. This result corresponds to the relatively high hazard rates of new service firms during the first years of their existence (cf. Fritsch and Weyh, 2004; Fritsch, Brixy and Falck, 2004). We find the supply-side effects in manufacturing slightly less pronounced than in services. This is compatible with the observation that markets for output of manufacturing firms tend to be geographically larger than in the case of services, so that supply-side effects are less concentrated within the start-up region.

Relating start-ups in services and in manufacturing to regional employment change in the respective sector and the private economy as a whole showed some differences. For start-ups in manufacturing, the magnitude of initial employment change due to new capacities is larger for models that explain private sector employment change as compared to employment change in manufacturing. The supply-side effects of new firm formation in either the

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[12] Taking longer time periods for the dependent variable employment change might lead to the problem that those lagged start-up rates that maximize the impact can be pinpointed more imprecisely. Additionally, we find that a time period of four years and longer for employment change does not lead to any stable results and they are easily implausible.

manufacturing or in the service sector are higher for employment within the respective sector. We found that the supply-side effects in the service sector tend to last longer than those in manufacturing. However, the estimated indirect effects of new firm formation (area II and III in figure 4) are always larger in regressions that try to explain employment change in the respective sector. The fact that we find quite similar longer-term effects of new firm formation on employment in the same sector and for the private economy as a whole suggests that the impact of new firm formation is not limited to the respective sector or industry.

6. Final discussion

We have investigated the lag structure of the effect of new firm formation on regional employment change. The results suggest that the indirect supply-side effects are considerably more important than the amount of jobs that are directly created in the new businesses. As we have argued, it is not necessary that the new firms be economically successful or even survive in order for these supply-side effects to occur. The critical point here is that improvements are made, whether on the side of the newcomers or on the side of the incumbents. Therefore, even those start-ups that fail to survive competition may make an important contribution. It is the contestability of markets that counts.

Our results imply that the evolution of indirect supply-side effects of new firm formation takes some time. In the year in which the new businesses are founded the employment gains are rather modest and are in subsequent years more than compensated for by exiting capacities due to crowding-out effects and failing newcomers. Therefore, the net-employment effect of new firm formation over the first six or seven years may well be negative. New firms do lead to more employment – but in the longer run. The magnitude of the different effects of new firm formation on regional employment may vary according to the characteristics of the entrants and their competitors in the respective industry and region. Because highly innovative entry constitutes a greater challenge to the incumbents than non-innovative entry, we may expect larger supply-side effects for this type of entry. It is quite likely that this relationship is shaped by the type of technological regime that dominates in the respective industry and region (Audretsch, 1995, 39-64; Winter, 1984). In an entrepreneurial regime it is easier for newcomers to seriously challenge the incumbents than under the conditions of a routinized regime.

Further research should try to achieve an in-depth understanding of the different effects of entry on market processes within different types of industries. Case studies could show to what extent our argument concerning the different effects and the respective time frame is deemed accurate. Another important question that is of particular interest for policy concerns the magnitude of the indirect supply-side effects. What determines the size of these effects and their regional incidences? Which market conditions and what kind of selection processes are conducive to the supply-side improvements that are induced by entry? What could policy do in order to stimulate these effects?

Another important step could be to employ other indicators for regional performance than simply employment change. If our interpretation of the empirical results attained is correct, we would expect that the negative impact that we attributed to failing newcomers and crowding-out of incumbents will disappear because of this market selection; while causing losses of employment, this should at the same time lead to rising total factor productivity. However, measuring total factor productivity requires estimating a regional production function with several input categories and such information is hardly available. Further research should try to shed more light on the sources of the considerable spatial autocorrelation that we found in our analysis.

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Appendix

Table A1: Correlation matrix of sector-adjusted start-up rates for subsequent time periods

	Start-up rate										
	Year t	Year t-1	Year t-2	Year t-3	Year t-4	Year t-5	Year t-6	Year t-7	Year t-8	Year t-9	Year t-10
Year t	1.0000										
Year t-1	0.8966	1.0000									
Year t-2	0.8373	0.8946	1.0000								
Year t-3	0.8262	0.8397	0.9030	1.0000							
Year t-4	0.8490	0.8524	0.8724	0.9053	1.0000						
Year t-5	0.8355	0.8461	0.8502	0.8722	0.9306	1.0000					
Year t-6	0.8250	0.8315	0.8424	0.8586	0.9184	0.9327	1.0000				
Year t-7	0.8327	0.8202	0.8260	0.8521	0.9076	0.9209	0.9329	1.0000			
Year t-8	0.8358	0.8277	0.8148	0.8336	0.9027	0.9092	0.9200	0.9322	1.0000		
Year t-9	0.8255	0.8318	0.8226	0.8232	0.8878	0.9048	0.9085	0.9193	0.9309	1.0000	
Year t-10	0.7945	0.8197	0.8260	0.8347	0.8881	0.8904	0.9038	0.9072	0.9181	0.9296	1.0000

Notes: All coefficients are statistically significant at the 1% level.

Table A2: The impact of new firm formation on regional employment change (spatial autocorrelation: employment change of adjacent regions)

	Two year regional employment change (percentage) [Huber-White]											
Constant	-1.12** (2.79)	-1.46** (6.00)	-1.40** (5.77)	-1.76** (6.95)	-1.84** (7.18)	-1.86** (7.10)	-1.95** (7.29)	-2.05** (7.51)	-2.10** (7.26)	-2.18** (7.49)	-1.76** (5.79)	-1.00** (2.92)
Start-up rate current year t	0.31** (3.54)	0.20** (7.33)	-	-	-	-	-	-	-	-	-	-
Start-up rate year t-1	-0.15** (2.64)	-	0.19** (7.29)	-	-	-	-	-	-	-	-	-
Start-up rate year t-2	0.10 (1.31)	-	-	0.24** (8.38)	-	-	-	-	-	-	-	-
Start-up rate year t-3	-0.22** (3.00)	-	-	-	0.25** (8.53)	-	-	-	-	-	-	-
Start-up rate year t-4	-0.36** (4.95)	-	-	-	-	0.25** (8.30)	-	-	-	-	-	-
Start-up rate year t-5	-0.10 (1.50)	-	-	-	-	-	0.25** (8.44)	-	-	-	-	-
Start-up rate year t-6	0.23** (3.07)	-	-	-	-	-	-	0.26** (8.40)	-	-	-	-
Start-up rate year t-7	0.23** (3.09)	-	-	-	-	-	-	-	0.25** (7.89)	-	-	-
Start-up rate year t-8	0.05 (0.79)	-	-	-	-	-	-	-	-	0.24** (7.79)	-	-
Start-up rate year t-9	-0.02 (0.29)	-	-	-	-	-	-	-	-	-	0.19** (5.90)	-
Start-up rate year t-10	0.06 (0.79)	-	-	-	-	-	-	-	-	-	-	0.12** (3.31)
Spatial autocorrelation (employment change in adjacent regions)	0.55** (10.96)	0.79** (30.97)	0.80** (31.15)	0.80** (31.03)	0.80** (30.55)	0.80** (30.27)	0.80** (29.46)	0.79** (28.70)	0.70** (19.10)	0.62** (15.43)	0.65** (16.04)	0.63** (14.27)
R^2	0.20	0.41	0.41	0.43	0.44	0.44	0.44	0.42	0.30	0.22	0.22	0.18
F-value	35.62	536.80	531.99	539.76	524.06	525.20	511.90	520.91	282.81	184.51	163.21	110.20
Number of observations (No. of obs. per district)	2,608 (8)	5,868 (18)	5,542 (17)	5,216 (16)	4,890 (15)	4,564 (14)	4,238 (13)	3,912 (12)	3,586 (11)	3,260 (10)	2,934 (9)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

Table A3: The impact of new firm formation on regional employment change (spatial autocorrelation: residuals in adjacent regions)

	Two year regional employment change (percentage) [Fixed Effects]											
Constant	-17,26** (7,32)	-1,44** (4,47)	0,77* (2,19)	-1,44** (3,06)	-0,83 (1,66)	-0,28 (0,52)	-0,47 (0,81)	-0,72 (1,19)	-1,27 (1,95)	+2,70** (3,91)	-2,73** (3,73)	-0,86 (1,05)
Start-up rate current year t	0,82** (13,09)	0,38** (10,01)	-	-	-	-	-	-	-	-	-	-
Start-up rate year t-1	-0,21** (3,06)	-	0,12** (2,92)	-	-	-	-	-	-	-	-	-
Start-up rate year t-2	0,44** (4,00)	-	-	0,39** (6,79)	-	-	-	-	-	-	-	-
Start-up rate year t-3	-0,05 (0,51)	-	-	-	0,30** (4,97)	-	-	-	-	-	-	-
Start-up rate year t-4	-0,30** (2,91)	-	-	-	-	0,22** (3,41)	-	-	-	-	-	-
Start-up rate year t-5	0,01 (0,10)	-	-	-	-	-	0,23** (3,25)	-	-	-	-	-
Start-up rate year t-6	0,52** (5,17)	-	-	-	-	-	-	0,21** (2,85)	-	-	-	-
Start-up rate year t-7	0,55** (5,56)	-	-	-	-	-	-	-	0,20* (2,49)	-	-	-
Start-up rate year t-8	0,19 (1,88)	-	-	-	-	-	-	-	-	0,30** (3,63)	-	-
Start-up rate year t-9	0,01 (0,07)	-	-	-	-	-	-	-	-	-	0,31** (3,49)	-
Start-up rate year t-10	0,11 (1,04)	-	-	-	-	-	-	-	-	-	-	0,13 (1,27)
Spatial autocorrelation (residuals in adjacent regions)	0,44** (12,67)	0,80** (63,90)	0,81** (61,81)	0,82** (63,37)	0,82** (61,36)	0,82** (59,61)	0,82** (57,80)	0,82** (53,48)	0,73** (37,36)	0,64** (25,74)	0,67** (26,45)	0,64** (22,75)
R^2	0,04	0,38	0,38	0,41	0,42	0,42	0,42	0,40	0,27	0,19	0,19	0,15
F-value	43,63	2059,30	1918,94)	2011,35	1890,32	1779,41	1672,70	1432,02	703,36	345,96	358,91	258,89
Number of observations (No. of obs. per district)	2,608 (8)	5,868 (18)	5,542 (17)	5,216 (16)	4,890 (15)	4,564 (14)	4,238 (13)	3,912 (12)	3,586 (11)	3,260 (10)	2,934 (9)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

Table A4: The impact of new firm formation on regional employment change (spatial autocorrelation: employment change of adjacent regions)

	Two year regional employment change (percentage) [Fixed Effects]											
Constant	-14.22** (6.18)	-2.05** (6.33)	-1.55** (4.31)	-2.72** (5.75)	-1.89** (3.76)	-1.43** (2.66)	-1.53** (2.64)	-1.47* (2.40)	-1.26 (1.94)	-2.09** (3.03)	-2.16** (2.94)	-0.99 (1.21)
Start-up rate current year t	0.52** (8.09)	0.26** (7.00)	-	-	-	-	-	-	-	-	-	-
Start-up rate year t-1	-0.11 (1.64)	-	0.21** (4.91)	-	-	-	-	-	-	-	-	-
Start-up rate year t-2	0.41** (3.79)	-	-	0.35** (6.13)	-	-	-	-	-	-	-	-
Start-up rate year t-3	-0.03 (0.26)	-	-	-	0.25** (4.07)	-	-	-	-	-	-	-
Start-up rate year t-4	-0.22* (2.14)	-	-	-	-	0.19** (2.90)	-	-	-	-	-	-
Start-up rate year t-5	0.04 (0.43)	-	-	-	-	-	0.20** (2.79)	-	-	-	-	-
Start-up rate year t-6	0.43** (4.32)	-	-	-	-	-	-	0.18* (2.44)	-	-	-	-
Start-up rate year t-7	0.41** (4.20)	-	-	-	-	-	-	-	0.15 (1.86)	-	-	-
Start-up rate year t-8	0.11 (1.10)	-	-	-	-	-	-	-	-	0.23** (2.77)	-	-
Start-up rate year t-9	0.01 (0.09)	-	-	-	-	-	-	-	-	-	0.24** (2.75)	-
Start-up rate year t-10	0.14 (1.44)	-	-	-	-	-	-	-	-	-	-	0.12 (1.24)
Spatial autocorrelation (employment change in adjacent regions)	0.52** (16.93)	0.80** (63.74)	0.81** (62.18)	0.82** (63.13)	0.82** (61.19)	0.82** (59.57)	0.82** (57.77)	0.82** (53.45)	0.73** (37.46)	0.64** (26.17)	0.67** (26.67)	0.64** (22.75)
R^2	0.08	0.41	0.41	0.43	0.44	0.44	0.44	0.42	0.30	0.22	0.22	0.18
F-value	55.72	2049.57	1941.63	1996.57	1879.92	1776.97	1670.96	1430.56	707.14	357.07	364.68	258.75
Number of observations (No. of obs. per district)	2,608 (8)	5,868 (18)	5,542 (17)	5,216 (16)	4,890 (15)	4,564 (14)	4,238 (13)	3,912 (12)	3,586 (11)	3,260 (10)	2,934 (9)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

Table A3: The impact of lagged start-up rates on regional employment change (spatial autocorrelation: employment change of adjacent regions)

	Two year regional employment change (percentage) [Huber-White]				
		Almon method assuming a polynomial of			
	Standard	2nd order	3rd order	4th order	5th order
Constant	-1.12**	-1.08**	-1.04**	-1.05**	-1.03**
	(2.79)	(2.77)	(2.63)	(2.66)	(2.61)
Start-up rate current year	0.31**	0.10	0.23	0.26	0.23
	(3.54)				
Start-up rate year t-1	-0.15**	0.03	-0.02	-0.04	0.02
	(2.64)				
Start-up rate year t-2	0.10	-0.02	-0.15	-0.17	-0.17
	(1.31)				
Start-up rate year t-3	-0.22**	-0.05	-0.18	-0.18	-0.23
	(3.00)				
Start-up rate year t-4	-0.36**	-0.07	-0.13	-0.12	-0.16
	(4.95)				
Start-up rate year t-5	-0.10	-0.07	-0.04	-0.02	-0.01
	(1.50)				
Start-up rate year t-6	0.23**	-0.06	0.05	0.07	0.13
	(3.07)				
Start-up rate year t-7	0.23**	-0.02	0.13	0.12	0.18
	(3.09)				
Start-up rate year t-8	0.05	0.03	0.16	0.13	0.12
	(0.79)				
Start-up rate year t-9	-0.02	0.09	0.11	0.08	0.00
	(0.29)				
Start-up rate year t-10	0.06	0.18	-0.05	-0.02	-28.53
	(0.79)				
Spatial autocorrelation	0.55**	0.61**	0.57**	0.57**	0.57**
(employment change in	(10.96)	(13.73)	(11.91)	(11.82)	(11.84)
adjacent regions)					
R^2	0.20	0.19	0.19	0.19	0.20
F value	35.62	57.78	61.07	51.03	-
Number of observations (No. of obs. per district)	2,608 (8)	2,608 (8)	2,608 (8)	2,608 (8)	2,608 (8)

*Notes: T-values in parentheses; **: statistically significant at the 1% level; *: statistically significant at the 5%-level.*

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