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Start-Ups and Employment Growth

– evidence from Sweden

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Abstract

We use longitudinal data over a decade on start-ups and employment in Swedish regions and analyze the effect of start-ups on subsequent employment growth. We extend previous analyses by examining the influence of regional start-ups in a sector on regional employment growth in the same sector and on other sectors. We find differences between different types of start-ups. Knowledge-intensive start-ups seem to have larger effects on the regional economy. In particular, start-ups in high-end services have significant negative impacts on employment in other sectors but a positive long-run impact. This is consistent with the idea that start-ups are a vehicle for changes in the composition of regional industry. Moreover, our results illustrate that the known S-shaped pattern can be attributed to different effects that start-ups in a sector have on employment change in the same sector and in others.

Keywords: Entrepreneurship, Employment Growth, Regional Development, Start-ups

JEL: J23, M13, O52

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1 INTRODUCTION

In the past few decades, interest in questions pertaining to the role of start-ups and small firms for employment growth and economic development has increased substantially. One reason is that several regions in advanced economies have experienced stagnation or decline in traditional manufacturing jobs. Stimulation of entrepreneurship in general and new business formation in particular is viewed as a means to secure present and future job opportunities.[1] Many countries do indeed have various policies in place that rest precisely on the assumption that start-ups and small firms generate growth.[2] The extent to which start-ups and small firms generate employment and growth has, however, been widely debated in the literature (see e.g., Storey 1994, Davis et al. 1996, Davidsson et al. 1998, Carree and Thurik 2003, Fritsch 1996). Recent overviews are provided in Braunerhjelm (2008), Nyström (2008a), van Praag and Versloot (2007), and Fritsch (2008).

The current paper contributes to the understanding of the relationship between new business formation and employment growth. We use longitudinal data over a decade (1994-2004) on start-ups and employment in Swedish regions and analyze the effect of start-ups on subsequent employment growth. Recent research shows that indirect supply-side effects of start-ups are important and are actually the main reason for the positive effect on employment (Fritsch and Mueller 2004). Although such impacts are likely to not be bound to sectors in which the start-ups are established, few studies have examined how start-ups in a sector influence employment growth in other sectors in a regional context. We extend previous studies by examining the influence of regional start-ups in a sector on regional employment growth in the same sector and on others. By analyzing effects within as well as between sectors, this paper takes a step forward in untangling the relationship between start-ups and overall employment growth in regions.

We distinguish between three broadly defined sectors: manufacturing, low-end services, and high-end services. Low-end service sectors comprise industries such as logistics, transport, and wholesale services. High-end services include real estate, finance and insurance, R&D services, and other business services. This sector comprises those services normally labeled

[1] The role of small and new firms is maintained to be amplified by the increased pace of technological change and innovation which shorten product cycles. Small and new firms are often maintained to have innovation and growth advantages in such contexts (cf. Acs and Audretsch 1987, Christensen and Rosenbloom 1995).

[2] Moreover, a significant fraction of EU funding, for instance from the European Regional Development Fund (ERDF), is devoted to projects aimed at supporting start-ups in EU regions.

knowledge-intensive business services (KIBS). The distinction among these three sectors is interesting for several reasons. First, because services are normally associated with high spatial transaction costs (in particular, knowledge-intensive services), one can expect that transaction linkages (input-output relations) between services and manufacturing have a regional or localized dimension. If manufacturing firms benefit from the short-distance supply of producer business services and service suppliers benefit from proximity to customers among manufacturing firms, expansion in a region in either sector (for example, through start-ups) is likely to generate expansion in the other sectors in the same region (cf. Andersson 2006). Mechanisms of this kind are, for example, essential in basic theories of industry clustering (see e.g., Venables 1996).

High-end services constitute an interesting contrast to both manufacturing and low-end services. High-end services have, for example, higher knowledge content and a development trajectory that is distinct from the other two. While low-end services and manufacturing experienced a modest increase in employment during the 1990s, high-end services employment has grown significantly. This can be interpreted as an indication of high market opportunities, which can imply larger direct effects of start-ups through the lower probability of exit and/or higher growth potential of entrants. Henrekson and Johansson (2008) review the literature on gazelles, i.e., rapidly growing firms, and find that knowledge-intensive business-to-business services is one sector in which they tend to be more frequent. Moreover, some argue that knowledge-based start-ups are more likely to have strong impacts on regional development since they introduce novelties with higher knowledge-content and as such boost innovation (see e.g., Baptista and Preto 2008). From this viewpoint, one would expect to observe a positive relationship between high-end service start-ups and employment growth in the same as well as other sectors.

Moreover, the expansion of knowledge-intensive services has been described as a characteristic feature of the structural change process of advanced economies (see e.g., Fuchs 1968, Andersson and Strömquist 1988, Peneder et al. 2003, Schettkat and Yocarini 2006). Several different explanations for this development at the macro-level have been advanced in the literature (see e.g., Schettkat 2007). One is that there has been a shift of demand to services, such that the demand share for services with constant prices has increased. Another is Baumol's (1967) supply-side hypothesis that the relative productivity of services declines. In addition, there has been a debate in the literature to what extent the shift in employment

from manufacturing to services is "real" and how much is the result of strategic outsourcing decisions by manufacturing firms. In reviewing the literature, Schettkat and Yocarini (2006) conclude that the shift to service employment is indeed real. They also illustrate that service employment across countries increases with per capita income. At the regional level, knowledge-intensive services are concentrated in large urban regions and metropolitan areas (see e.g., Noyelle 1982, Noyelle and Stanback 1984, Keeble et al. 1991, Sassen 2006, Johansson and Klaesson 2008).

If start-ups are a driver of structural change, as maintained by Schumpeter (1911), one would expect a negative relationship between high-end services and employment growth in other sectors. Structural change is defined as an invariant change-process in which a sector gradually increases its share of employment, whereas others decline. A structural change in favor of high-end services can be expected to be particularly pronounced in regions with high start-up rates in the sector such that employment growth in other sectors, all else being equal, is lower.

There are, of course, several effects of new firm formation on employment change with opposite impact. Many of them are likely to materialize only after significant time lags. Fritsch and Mueller (2004) showed that the impact of start-ups on employment growth follows a wave pattern. A series of papers have later confirmed this finding.[3] Thus, acknowledging the lag structure of the effects of start-ups is important. Otherwise, the role of start-ups for employment growth can be underestimated. In our empirical analysis, we apply a similar strategy as that of Fritsch and Mueller (2004) and van Stel and Storey (2004) and include lagged start-up rates to capture the lag structure of the effects on employment change.

Our analysis is conducted on Swedish data, and there are a number of previous analyses that examine the relationship between start-up (or self-employment) rates and employment change at the regional level in Sweden. Davidsson et al. (1994) examined new firm formation in the form of simples, i.e., single establishment firms that are not part of a corporation, among 80 labor market areas in Sweden between 1985 and 1990. They found that entry and exit of simples account for a substantial share of both gross and net job creation in Swedish regions.

[3] A special issue in *Small Business Economics* (2008 vol. 30) collected a number of contributions applying a similar methodology which produced comparable results from regions in different countries. Analyses were conducted for Portugal (Baptista et al. 2008), Netherlands (van Stel and Suddle 2008) Germany (Fritsch and Mueller 2008), the US (Acs and Mueller 2008), Spain (Arauzo Carod et al. 2008) and Great Britain (Mueller et al. 2008). An analysis was also conducted for a set of OECD countries (Carree and Thurik 2008).

Moreover, they also found a strong correlation between the start-up of simples and measures of the change in regions' economic well-being. Fölster (2000) investigated the relationship between self-employment and total employment across Swedish counties for 1976-1995. Using various instruments to control for simultaneity between employment and self-employment, the results suggest that self-employment has a positive effect on overall employment. Braunerhjelm and Borgman (2004) investigated changes in within-industry labor productivity across local labor market regions in Sweden and found that regional entrepreneurship, measured as the share of all firms with zero employees, had a positive effect that remains when controlling for several other factors. Moreover, in a recent study, Borgman and Braunerhjelm (2007) regressed regional entrepreneurship on the compounded annual employment growth in 70 Swedish labor market regions in three- and six-year periods in the 1990s. Regional entrepreneurship is measured by the change in the number of establishments with zero or one employee normalized by the number of employees in the region. Controlling for a number of other regional characteristics that plausibly influence regional employment growth, he finds that entrepreneurship has a significant impact on employment growth in Swedish regions, although the results are somewhat weaker when compared to regions in the United States. While these studies give support for a positive relationship between start-ups and employment growth, they neither acknowledge the lag structure in the way we do here nor analyze effects within and between sectors.

The remainder of the paper is organized in the following manner: Section 2 discusses the effects of start-ups on employment growth and focuses on effects within and between sectors and link them to direct and indirect effects. Section 3 presents the data and describes the empirical strategy. In Section 4, we present the results, and Section 5 concludes.

2 Effects of start-ups on employment growth

The current evidence on supply-side effects is primarily based on examinations of the lag structure of the effect of overall start-up rates on overall employment change. One reason for this is that supply-side effects can span different sectors. However, distinguishing between sectors is a way to untangle the overall effect of start-ups on employment.

For West German regions the wave pattern of the relationship between start-ups and employment growth (Fritsch and Mueller 2004) follows the following sequence: Positive effects of start-ups on regional employment change are followed by a negative impact. For

later lags, the impact becomes positive again, fading out after a period of ten years. Fritsch and Mueller suggest the following interpretation: First, there is a positive direct effect on employment. Second, due to crowding out, there is a negative displacement effect. Third, there are positive effects on employment from indirect supply-side effects. The resulting S-shaped pattern has been confirmed for many other countries. However, a negative displacement effect does not appear for all countries or types of regions (see Acs and Mueller 2008, Fritsch and Mueller 2008). This overall pattern can naturally be driven by the way start-ups generate effects within as well between sectors in a region.

In the first years after entry, the effect on employment can be split into two major sources. A new firm will by definition employ people such that employment in the sector with which the firm is affiliated increases. The new firm will, however, also demand inputs from other sectors. To the extent that transaction linkages are localized, part of the direct effect could be attributed to the fact that new firms stimulate employment growth in other sectors of the region through a demand effect.

The negative displacement effect, which is found to dominate after the direct effect, could also be attributed to effects that start-ups generate on employment in the same sector the start-ups are established and on other sectors. While displacement effects of the form that incumbents exit due to intensified competition on product markets are most likely to be bound to the sector in which the start-ups are established, two other displacement effects can span sectors. First, if different sectors compete for similar resources on a regional basis, for instance, labor with a similar profile, a displacement effect could occur, affecting firms in other sectors through intensified competition for resources. Second, start-up activity is a characteristic feature of structural change processes. A structural change process of a regional economy characterized by a gradual increase in the employment share of a sector is most likely associated with high rates of start-up activity in the sector. Consistent with a displacement effect, start-up activity in a sector should, from this perspective, be associated with lower employment growth in other sectors. The very definition of a structural change process is the gradual increase of the employment share of one set of activities and the gradual decline among others.

Finally, the positive impact of supply-side improvements can be expected to the result of employment changes in the sector in which the start-ups were established as well as in other sectors. The theoretical motivations for these effects include (i) higher efficiency and

productivity because of intensified competition, (ii) structural change through creative destruction, (iii) the higher pace of innovation as new firms bring novelties to markets and open up new markets, and (iv) expansion of product and process varieties in the economic system (see *inter alia* Fritsch 2008). Clearly, effects of this type are not bound to the sectors in which start-up activity originates.

As stated in the introduction, we distinguish between three broad sector aggregates: (i) manufacturing, (ii) low-end services, and (iii) high-end services. For the purpose of the present study, this sector delineation is warranted for several reasons. Because of relatively high spatial transaction costs associated with service production and delivery (especially knowledge-intensive services), transaction linkages between service suppliers and manufacturing firms can be expected to have a regional component (Andersson 2006). This means that one could expect demand effects on services from start-ups in manufacturing to be particularly pronounced in the same region as the start-ups are established. Moreover, the expansion of high-end service sectors has been a characteristic feature of the structural change process of the Swedish economy in recent decades. During the period examined in this paper (1994-2004), they account for the majority of employment growth, and an increasing share of the yearly start-ups are in these sectors. This development pattern provides an opportunity to test for displacement effects in a sector driven by a steady stream of start-ups in other sectors associated with structural change processes. However, high-end service start-ups, in particular, can be expected, to in the long-run, have a positive impact on those firms that remain in other sectors of the regional economy in the structural change process. There is ample literature suggesting that knowledge-intensive services play an important role in the innovation and growth processes of regions (see e.g., Miles 2003, Hansen 1993, Marshall et al. 1987, Miles et al 1995, Muller and Zenker 2001, Czarnitzki and Spielkamp 2003). They can, for example, facilitate manufacturing firms' adapting to changes in skills, products, and processes on the market. They may also help to reduce organizational, managerial, and informational barriers to adjustment (Marshall et al. 1987). Makun and McPherson (1997) find, for instance, that the probability of successful product development is markedly higher in regions hosting rich stocks of KIBS firms. If high-end services yield effects of this kind on other sectors over the long-run, as theory and previous research suggest, one would expect to find a positive effect on employment growth in other sectors than high-end services occurring after significant time lags. Hence, supply-side effects from high-end services are likely to be associated with positive effects on other sectors of the economy.

In the subsequent sections, we present an empirical analysis of how regional start-ups in a given sector impact employment growth in the same sector and on other sectors. Our results at the sector level are compared with the results we obtain at the aggregate level.

3 DATA AND EMPIRICAL STRATEGY

3.1 Description of data

We use start-up data maintained by Statistics Sweden (SCB), which provide information on the number of start-ups in each municipality in the private sector in Sweden 1994-2004.[4] There are 286 municipalities over the period considered.[5] A start-up is defined as a new establishment, and the data contain FAD information distinguishing between truly new establishments and new establishments that occur because of reorganizations and change of ownership structure, etc. Persson (2004) uses similar data. In the Business Register, each establishment is assigned a unique identity number (CFAR). For all new identity numbers between years, the FAD database furnishes information as to whether an establishment identity number is truly new or new due to mergers and splits of existing establishments. This classification involves an analysis of which individuals are associated with the establishments between executive years. This analysis is conducted by SCB. In our analysis, we make use of data on truly new establishments.[6]

The analysis we present in the subsequent sections excludes new establishments with personal liability. New establishments of this type are in general small and have zero or very few employees and can be expected to have a small impact on employment growth. Some start-ups with personal liability, however, may be large in terms of employees, in particular when investments and risks are low, e.g., household cleaning services.[7]

In the data, new establishments may be the result of a new firm being started or an incumbent firm opening a new establishment. We cannot discriminate between these two alternative forms in the data. At the aggregate level, we know that the latter type of start-up constitutes

[4] These are the same data as Andersson and Koster (2008) make use of in their analysis of persistence in start-up rates across Swedish municipalities.
[5] Data have been corrected for change in municipality classifications between 1994 and 2004.
[6] In relation to some previous Swedish analyses of start-ups and employment we employ more a more precise measure of start-ups. Data on start-ups in e.g. Nyström (2008) is based on tracing new firm identity numbers in the business register on a year to year basis. In this case, the identity may change due to changes in for instance legal form or simply an error. Borgman and Braunerhjelm (2007) measure entrepreneurship by the change in the number of establishments with 0 or 1 employee.
[7] As a robustness check we have also estimated our empirical model with start-ups rates that also include start-ups with personal liability. This does not change the results we present in the sequel and are available from the authors upon request.

about 12% of all start-ups when excluding start-ups with personal liability and about 6% when we include start-ups with personal liability. Systematic differences between municipalities in the type of start-ups can potentially influence results. Research by Miner (1997), for instance, suggests that new firms may offer more "idiosyncratic" jobs where human capital requirements are different. The likelihood such jobs is hypothesized to be higher in the presence of e.g., resource uncertainty, mission ambiguity and change in organizational size. Additionally, wages tend to be lower in small and new firms (Albaek et al. 1998). Systematic differences across municipalities in terms of the respective share of the type of start-up is a source of unobserved heterogeneity across municipalities. In the empirical analysis we account for this with a fixed effects model.

As described in previous sections, we distinguish between three sector aggregates: (i) manufacturing, (ii) low-end services, and (iii) high-end services.[8] High-end services have higher average knowledge content than low-end and comprise those service sectors normally labeled KIBS. Data do not allow us to make a distinction between different types of manufacturing sectors. These three sector aggregates are broadly defined. The manufacturing aggregate includes manufacturing sectors with different knowledge and service content. Moreover, the high-end service sector aggregate certainly mixes more knowledge-intensive services, such as R&D, with other services, such as real estate agencies. However, our analysis is not an industry-level analysis. The breadth of the aggregates, nevertheless, implies that municipalities can be specialized in different sub-sectors with different characteristics within each respective sector aggregate. Systematic differences in such specializations across municipalities is a further motivation for including fixed effects in our empirical analysis.

We measure new firm formation in each municipality and sector aggregate in terms of start-up rates, i.e., the number of start-ups divided by the total number of employees (cf. Audretsch and Fritsch 1994). Data on employment also come from SCB.

3.2 Start-up activity and employment growth in Sweden – a description of the overall pattern

Figure 1 describes the distribution of the total number of start-ups in Sweden across the three sector aggregates in 1994-2004. As is evident from Figure 1, a small and declining share of the total number of start-ups in the three aggregates occurs in manufacturing. The lion's share

[8] Low-end services are defined by NACE code 50-64 and include logistics and transport services, retail, wholesale, hotels, restaurants and repair shops. High-end services are defined by NACE code 65-99 and include advanced producer services, R&D institutions, education services, etc.

of the start-ups is in services and increasingly in high-end services. This is in line with developments in other advanced countries. Over the same period, the yearly number of start-ups has fallen in both manufacturing and low-end services, whereas it has been roughly the same per year in high-end services.[9]

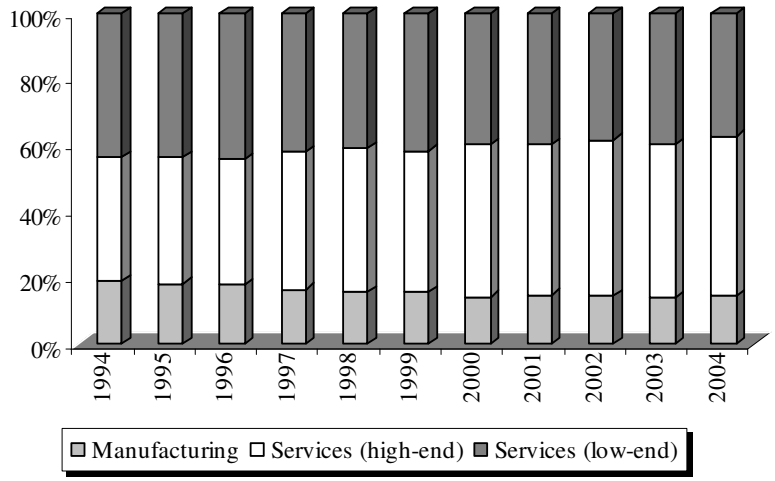

Figure 1. Distribution of start-ups 1994-2004.

The development of employment follows a similar pattern. Figure 2 presents the development of total employment in each respective sector aggregate between 1994 and 2004. The figure displays the remarkable growth in high-end services employment referred to in the previous sections. Whilst manufacturing and low-end services employment has grown by about 3% and 10%, respectively, between 1994 and 2004, employment in high-end services increased over 60%. The growth in high-end services employment was dampened in the beginning of the 2000s, corresponding to the IT crisis.

[9] A potential explanation for the observed decline in manufacturing and low-end services start-ups since 1994 is that 1994 marked the end of a recession in the early 1990s. Improved economic conditions and a consequent recovery of the labor-market in 1994 and onwards may have impeded start-up activity.

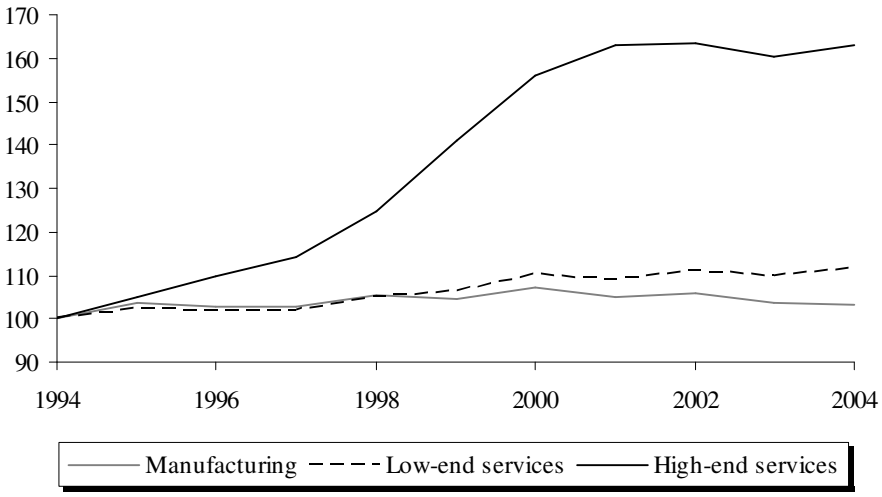

Figure 2. Employment growth in manufacturing, low-end services and high-end services in Sweden 1994-2004.

The development in Figure 2 is an illustration of the expansion of knowledge-intensive services, which has been described as a characteristic feature of the structural change process of advanced economies. Moreover, this development in aggregate employment concurs with the increasing share of start-ups in high-end services (Figure 1).

In terms of employment size, low-end services and manufacturing are fairly equal, with over 900 000 employees in each sector. High-end services is, in employment size, a little bit over 630 000. As illustrated in several studies (e.g., Noyelle and Stanback 1984, Keeble et al. 1991, Johansson and Klaesson 2008), high-end services are concentrated in metropolitan regions. Sweden's three metropolitan areas (Stockholm, Göteborg, and Malmö municipalities) constitute about 40% of the total employment in high-end services. The corresponding figure for low-end services and manufacturing is about 28% and 15%, respectively.

Table 1 provides descriptions of the employment growth across Swedish municipalities in the three sectors over the period of analysis. The employment growth in high-end services is markedly higher than that for manufacturing and low-end services. Moreover, there are marked differences in growth between the municipalities, as indicated by a comparison of the standard deviation to the average.

Table 1: Employment growth 1994-2004 across Swedish municipalities in three sectors

	Low-end services	Manufacturing	High-end services
Percentage employment growth			
Average	0.05	0.02	0.39
Median	0.04	0.02	0.40
Std. dev	0.17	0.20	0.39
Absolute employment growth			
Average	328	95	828
Median	37	27	146
Std. dev	1 064	811	4 485

Note: Percentage employment growth is approximated as ln(*Employment 2004*) – ln(*Employment 1994*). Absolute employment growth is simply *Employment 2004 – Employment 1994.*

3.3 Empirical Strategy

To examine the effect of start-ups on subsequent employment growth, we estimate the following general model:

$$\ln E_{r,t} - \ln E_{r,t-2} = \alpha + \sum_{\tau=0}^{5} \gamma_{t-\tau} S_{r,t-\tau} + \mathbf{x}'_{r,t-2}\boldsymbol{\lambda} + \varepsilon_r \quad (1)$$

where $E_{r,t}$ is employment in municipality r in period t, $S_{r,t-\tau}$ denotes the start-up rate in municipality r, and τ denotes lag length. We use data over a decade (1994-2004) and include five lags such that τ goes from 0 to 5. **x** is a vector of control variables. Table 2 describes the independent variables.[10]

Most studies that analyze the lag structure of new business formation on employment growth control for very few variables that are important for regional employment change. We account for this shortcoming by including a wider set of control variables. As can be seen in Table 2, we control for the average education level of the employees, which we expect to have a positive effect on employment growth. We include the employment share in manufacturing as a basic indicator of industry structure.

[10] In addition to the variables listed in the table, we have included median income in the estimations. This can be theoretically motivated but is correlated to education. When it is included in the model it has a negative parameter estimate and does not change the results presented in the sequel. Results from the estimations which include median income are available from the authors upon request.

Table 2: Description of variables in the empirical analysis

Variable	Description	Motivation
Start-up rate	Number of start-ups normalized by total number of employees	Focus variable
Education	Share of employees with long university education (≥ 3 years)	Local pool of knowledge labor Potential for knowledge and information flows Absorptive capacity
Education squared	Share of employees with long university education (≥ 3 years) squared	Non-linearities in the effect of education
Share of manufacturing	Manufacturing employees as a fraction of total number of employees	Basic indicator of industry structure
Municipal accessibility to value-added (GRP)	Value-added in the municipality weighted by time distances by car between zones within the municipality (exponential distance-decay)	Agglomeration effects Short-distance to large input and output markets
Extra regional accessibility to value-added (GRP)	Accessibility to value-added in municipalities outside the region to which the municipality belongs Computed as the sum of a municipality's accessibility to value-added in each municipality outside region (exponential distance-decay based on time-distances by car)	Spatial dependence and inter-regional effects

Note: All variables come from databases maintained by Statistics Sweden (SCB). Time distance between zones in municipalities and between municipalities comes from the Swedish Road Authority.

Moreover, we also include the distance-weighed value-added in each municipality as a further control variable. This variable is calculated according to $GRP_r \exp\{-\beta_1 t_r\}$, where GRP is the gross regional product (value-added) in municipality r, and β_1 is a distance-friction parameter. In the computation of municipal accessibility to GRP, we apply the distance-friction parameter Johansson et al. (2003) estimate based on intra-municipal commuting flows in Sweden. t_r denotes time-distances by car between zones within municipality r. This variable reflects the density of economic activities in the local economy. It aims to capture

agglomeration effects (cf. Ciccone and Hall 1996), and we expect that it has a positive influence on employment growth.[11] Such a conjecture is supported by, for example, Wennberg and Lindquist (2008), who found, using Swedish data, that firms located in agglomerations not only create more jobs but also pay higher wages. Braunerhjelm and Borgman (2004) also asserted that regional agglomeration characteristics are associated with region productivity change.

In addition, we include the accessibility to GRP in municipalities outside the region to which a given municipality belongs. For a municipality r belonging to region R, accessibility is given by $\sum_{s \notin R} GRP_s \exp\{-\beta_2 t_{rs}\}$ where t_{rs} is the time-distance by car between municipality r and s. For this variable, we use another distance-friction parameter, β_2, which is based on estimates of the sensitivity to time-distances with regard to inter-regional commuting (Johansson et al. 2003). This spatially weighed variable reflects the market potential as regards both inputs and outputs in municipalities outside the region to which a given municipality belongs. It is also likely to capture spatial dependence between municipalities in different regions (cf. Andersson and Gråsjö 2008).

Municipalities are heterogeneous, and our control variables described above only capture a part of the factors that can have an impact on employment change. In Section 3.1, we also argued for fixed effects based on the fact that we do not observe differences across municipalities in terms of type of start-up and start-ups in different sub-sectors. However, since several regional variables change slowly over time, several problems are associated with estimating a fixed effect model. We can deal with slowly changing variables in a fixed effects setting using a fixed effects vector decomposition (FEVD) model (Plümper and Troeger 2007). This model works in the following manner:

1. The model is estimated with a fixed effects estimator.
2. The unit fixed effects are decomposed into one part that can be explained by the time-invariant and slowly changing variables.
3. The model is re-estimated, including the part of the unit fixed effects that cannot be explained by the time-invariant and slowly changing variables.

[11] Most studies use population per square kilometer or similar as a density measure. Our accessibility measure is also a measure of density. It combines information of the magnitude of economic activity in a municipality with information about the time-distances in terms of travel by car between different zones within the municipality. In this sense it is a more precise density measure than density measures based on the geographical scope of a region (eg. square kilometers). Actual time-distances is a better description of actual interaction opportunities and proximity in a region than crude measures like square kilometer.

To correct for potential spatial dependence that may not be captured by the spatially lagged independent variable (extra-regional accessibility), we adjust the third step of the FEVD model. We estimate the third step with a spatial error model (ML estimator) instead of OLS. For this estimation, we employ a symmetric time-distance matrix in which the spatial weights are the inverse of the time-distance between municipalities if the time-distance $\leq$ 120 minutes and 0 otherwise. We exclude the island Gotland since it has no neighbors, which means that the number of yearly observations is reduced to 285.

Most other studies that analyze the lag-structure effects of new business formations on regional employment change apply the Almon polynomial lag techniques to tackle the high correlation between start-up rates of subsequent years (e.g., Fritsch and Mueller 2008, van Stel and Suddle 2008, Baptista, Escária, and Madruga 2008). However, the major drawback of the polynomial lag model is the strong restrictions on the model's functional form (Greene 2005). For the data used in this analysis, we observe nearly the same resulting lag structure for the polynomial lag technique as well as for simple lagged start-up rates. The main difference is a typical smoothing effect. All estimated coefficients differ only slightly with respect to the underlying method. Therefore, we use the more intuitive method and simply include lagged start-up rates.

4 RESULTS

In this section, we present the estimated parameters for the variables in Equation 1 of main interest, i.e., the γ's associated with the start-up rates of different lag lengths. The estimated impact of start-up rates with different lag lengths are presented in figures, with the magnitude of the estimated parameter on the vertical axis and the lag length of the start-up rates on the horizontal axis. In this way, the lag structure is clearly observable. The estimates for all independent variables, as well as test statistics, are provided in tables in the Appendix.[12]

[12] As stated in the previous sections, we also tested models including start-ups with personal liability and also estimated the models with median income included among the regressors. Population density as an alternative density measures has been tested as well. The results presented here are robust to these alterations. The results with different model specifications, including polynomial lag estimates, are available from the authors upon request.

We begin by examining the estimated relationship between total start-up rates and total private employment.[13] Figure 1 presents the estimated impact of total start-up rates with different lag lengths on total private employment change.

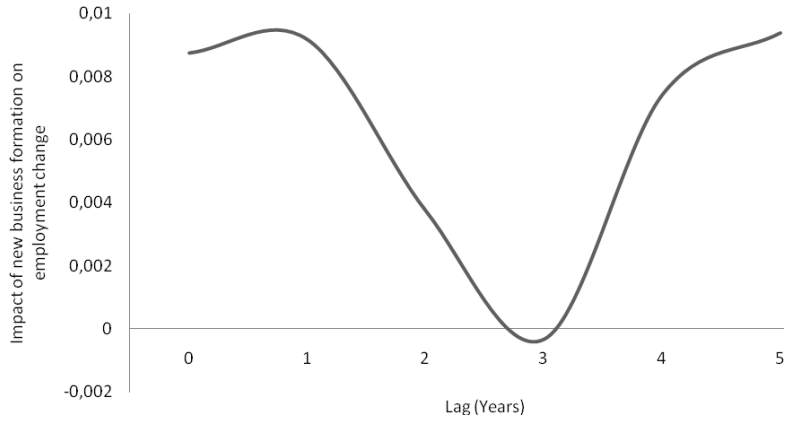

Figure 1. Estimated impact of total start-up rates on private employment change. The figure is based on estimated parameters of start-up rates with different lag lengths (see Equation 1).

The pattern of the effect of start-ups on employment growth described by the figure is consistent with the wave pattern found in several other studies. Start-ups initially have a positive effect, which is consistent with a direct employment effect as well as short-term demand effects. The decline in the effect between the second and fourth years (first and third lags) can be explained by increasing displacement effects, which lower the impact on employment change. Finally, the positive effect in the fourth and fifth years suggests positive indirect effects. The estimated effects are only significant in the first and second as well as fifth and sixth years (Table A1 in the Appendix). The lack of significant negative effects could be explained by the fact that negative displacement and positive effects counterbalance each other. Looking at the control variables, we find that they have the expected impact. The education of the workforce has a positive but declining impact. Moreover, both municipal and extra-regional accessibility to GRP have a positive impact. We also observe that municipalities with a higher share of employment in manufacturing have somewhat higher employment growth.

We now turn to the results regarding the impact of regional start-ups in a sector on regional employment growth in the same sector and on others. First, we present the results for manufacturing start-ups. Figures 2-4 present the estimated impact in a similar manner as Figure 1. However, while Figure 2 illustrates the impact of manufacturing start-ups on total

[13] The total number of start-ups is the sum of the start-ups in low- and high-end services as well as manufacturing.

employment, Figure 3 shows the effect on manufacturing employment only, and Figure 4, the effect on employment in service sectors (low- and high-end sectors).

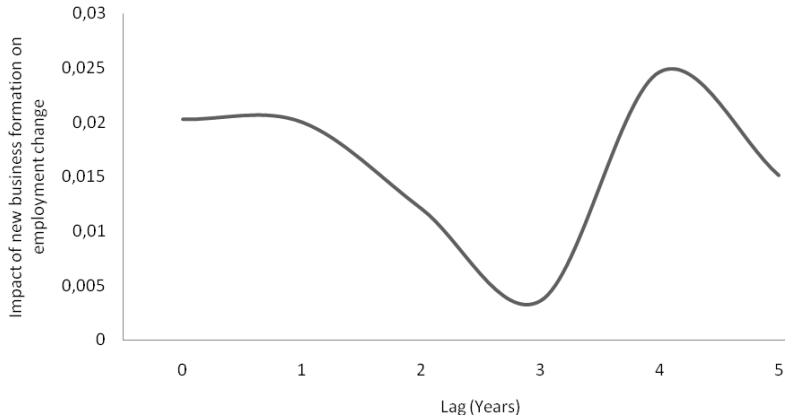

Figure 2. Estimated impact of manufacturing start-up rates on private employment change. The figure is based on estimated parameters of start-up rates in manufacturing with different lag lengths (see Equation 1).

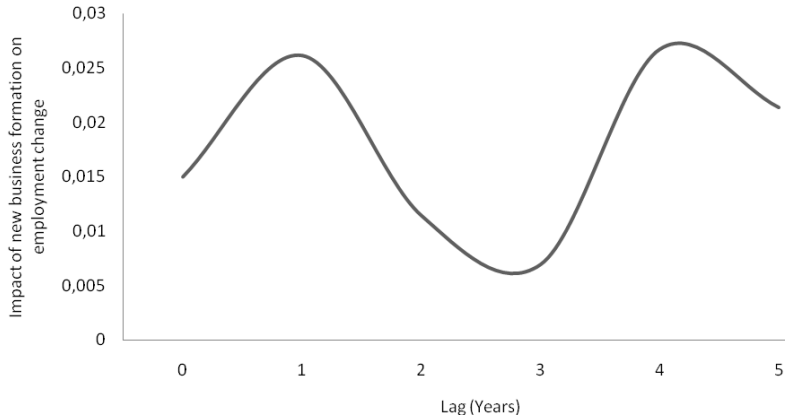

Figure 3. Estimated impact of manufacturing start-up rates on employment change in manufacturing. The figure is based on estimated parameters of start-up rates in manufacturing with different lag lengths (see Equation 1).

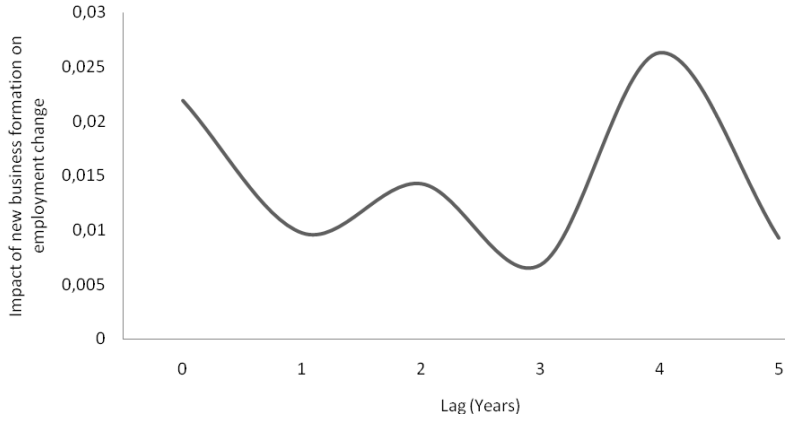

Figure 4. Estimated impact of manufacturing start-up rates on employment change in service sectors. The figure is based on estimated parameters of start-up rates in manufacturing with different lag lengths (see Equation 1).

The estimated impact of manufacturing start-up rates on employment change is positive and significant for most of the lags considered in the analysis (Figure 2 and Table A2 in the Appendix). It is only insignificant in the fourth year (third lag). The overall effects on employment change are positive. As with the result in Figure 1, the initial positive effect is consistent with a direct effect on employment, followed by weaker and insignificant effect that is likely due to displacement effects. The significant positive effect in later years could be attributed to positive indirect effects. The absence of a significantly negative effect on employment can be explained by a demand effect, originating, for instance, from manufacturing demand for service input, which outweighs the negative displacement effect. Another explanation is that displacement effects are weak in manufacturing due a large share of sales in distant markets among incumbent manufacturers. If incumbents export a large fraction of their sales, an entrant that mainly serves the local market is not likely to generate displacement effects among incumbents through product market competition.

Regarding the effect of manufacturing start-ups on manufacturing employment (Figure 3), we see a similar pattern. The estimated parameters for the start-up rates are significant for most of the lags, i.e., the first and second years as well as the fifth and sixth years. There is thus no major deviation from the effect on total employment change. This is verified by Figure 4, which presents the estimated impact of manufacturing start-ups on employment change in other sectors. Overall, the effect is positive but only significant for a few lag lengths. With respect to the effects of new business formation in manufacturing on employment change in other sectors, we also observe an overall positive effect. In the year of entry, the impact is even larger than the effect on manufacturing employees itself. For the five lags considered in

this analysis, the overall impact of new business formation in manufacturing on employment change is larger in the manufacturing sector than in other sectors.

Table A2 in the Appendix shows that education has a positive but decreasing effect on regional employment growth in manufacturing. The coefficient associated with the employment share in manufacturing is negative for the growth in manufacturing employment but positive for employment growth in other sectors. This might be an indication of ongoing structural change. As expected, we find that both accessibility variables have positive parameter estimates.

Figures 5-7 present results for low-end services. With respect to the overall effect, the impact on other sectors is smaller compared to the employment effects on the same sector. As for manufacturing, Figure 5 illustrates the impact of low-end start-ups on total employment; Figure 6, the effect on low-end service employment only; and Figure 7, the effect on employment in other sectors (manufacturing and high-end services). Estimated coefficients and test statistics are presented in Table A3 in the Appendix.

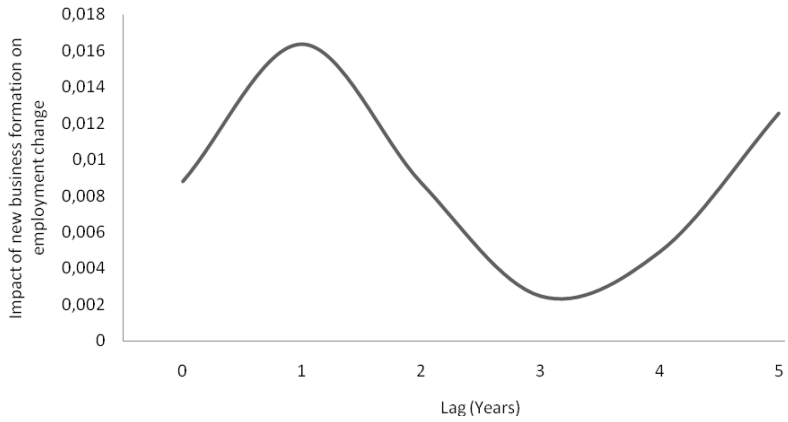

Figure 5. Estimated impact of low-end service start-up rates on total employment change. The figure is based on estimated parameters of start-up rates in low-end services with different lag lengths (see Equation 1).

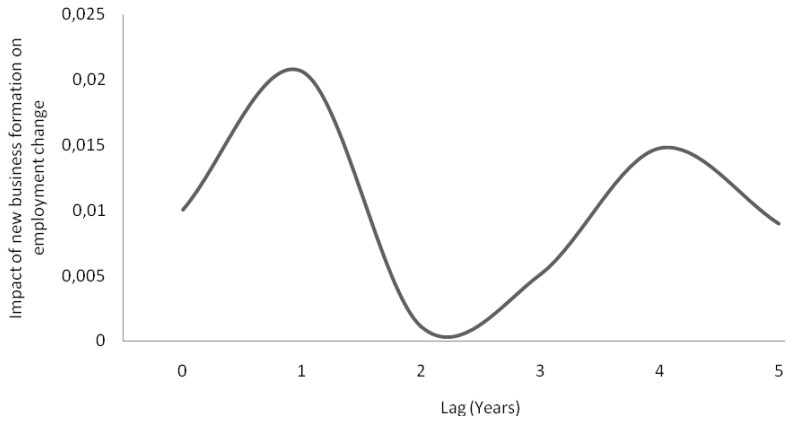

Figure 6. Estimated impact of low-end service start-up rates on employment change in low-end services. The figure is based on estimated parameters of start-up rates in low-end services with different lag lengths (see Equation 1).

The figures show that the pattern is similar between the different estimations. There is a significant positive direct effect in the year the start-ups are established and the first year after firm formation, i.e., lag 0 and lag 1. In the next two years after firm formation, we find no significant effect. In the fourth and fifth years, a significant positive contribution can be observed again. This result pertains for growth in total employment, in employment in low-end services, and in other sectors.

Hence, the results for low-end services are relatively similar to those we obtain for manufacturing: An initial positive effect in the first years and then an insignificant effect followed again by a significant and positive effect. The aggregate figures showed that these two sectors also experienced a similar employment change over the period considered in this analysis.

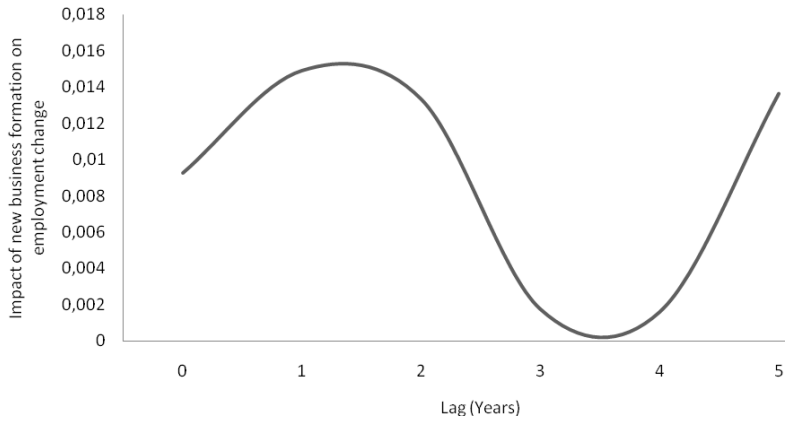

Figure 7. Estimated impact of low-end service start-up rates on employment change in other sectors. The figure is based on estimated parameters of start-up rates in low-end services with different lag lengths (see Equation 1).

Let us now turn to high-end services. We have argued that this sector is especially interesting for several reasons:

- The total employment has grown significantly over the period of our analysis (1994-2004).
- They have a higher knowledge-content and can thus be expected to have a more pronounced effects on employment in the regions (cf. Baptista and Preto 2008).
- A vast literature suggests that high-end services (KIBS, in particular) can boost the productivity of the regional industry (e.g., Muller and Zenker 2001, Czarnitzki and Spielkamp 2003, Makun and McPherson 1997).
- An increasing employment share in knowledge-intensive services has been described as a characteristic feature of the structural change process in advanced economies.
- An increasing share of the total number of start-ups in Sweden is in high-end services.

Figures 8-10 present our results for high-end sectors. As for the other sectors, Figure 8 presents the impact of high-end start-ups on total employment; Figure 9, the effect on high-end service employment only; and Figure 10, the effect on employment in other sectors (manufacturing and low-end services). Estimated coefficients and test statistics are presented in Table A4 in the Appendix.

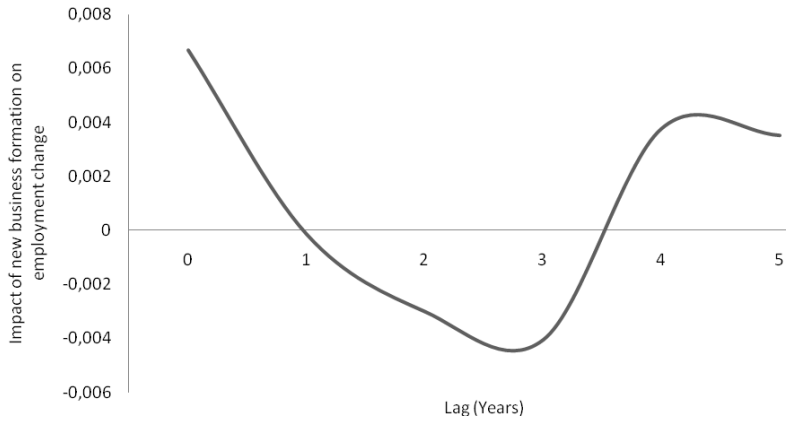

Figure 8. Estimated impact of high-end service start-up rates on total employment change. The figure is based on estimated parameters of start-up rates in high-end services with different lag lengths (see Equation 1).

With respect to total employment change, the impact of start-ups in high-end services is only significant in the year of entry. All later lags reveal the expected S-shaped pattern but remain insignificant. This result can be attributed to different lag patterns for the impact of start-ups in high-end services on employment change in the same sector and employment change in other sectors.

The impact of start-ups in high-end services on employment change in high-end services is positive but decreasing (Figure 9). In the year of firm formation and the first and fourth years, we observe a significant positive impact. From Table A4, it is also evident that the impact of the regional level of education on employment change in high-end services is larger compared to the impact on manufacturing and low-end service employment change (considering the decreasing character of the impact). Since the regional human capital resources can be expected to be most important for industries in high-end services, this is in line with our expectations. The significant positive coefficient for the regional share of employees in manufacturing indicates again regional structural change. In contrast to the estimations for employment change in manufacturing and low-end services, the estimated parameters for municipal and extra-regional accessibility to GRP are insignificant.

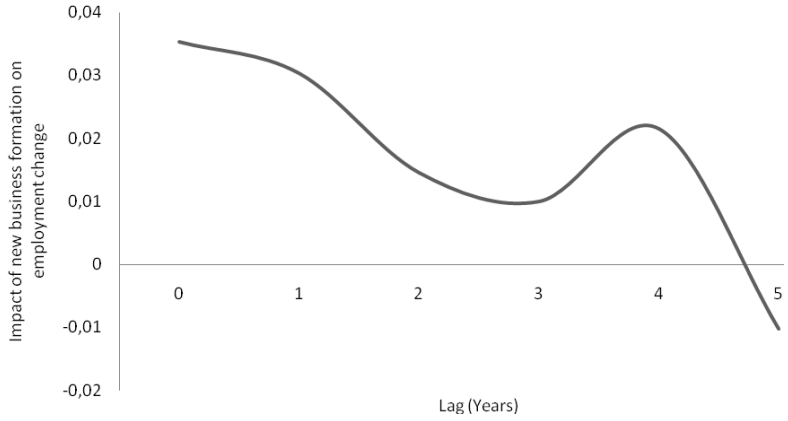

Figure 9. Estimated impact of high-end service start-up rates on employment change in high-end services. The figure is based on estimated parameters of start-up rates in high-end services with different lag lengths (see Equation 1).

Regarding the effect of high-end start-ups on employment change in other sectors, we find a negative effect in the short run (Figure 10). The start-up rate in high-end services is significantly negative for the first, second, and third years after firm birth. The effect of start-ups in high-end service industries on regional employment in other sectors is the only negative effect of start-up rates that we observe for the Swedish case. Five years after firm formation, the effect turns significantly positive. These results are similar to those obtained by Baptista and Preto (2008) for knowledge-based start-ups. They find that knowledge-based start-ups have an initial negative effect on employment change, followed by significant positive indirect effects occurring from the fourth and fifth periods onward, depending on the type of region considered.

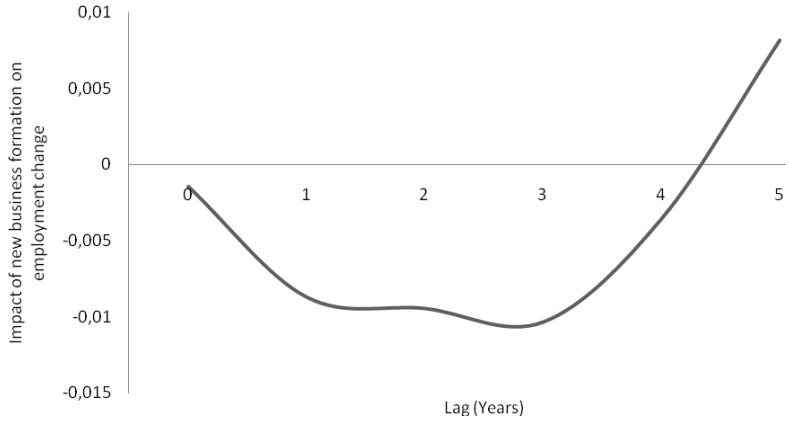

Figure 10. Estimated impact of high-end service start-up rates on employment change in other sectors. The figure is based on estimated parameters of start-up rates in high-end services with different lag lengths (see Equation 1).

The lag structure of the impact of start-ups in high-end services reveals some important differences in comparison to start-ups in manufacturing and low-end services. While the overall effect suggests that the impact of start-ups in high-end services on total employment change also follows the known S-shaped pattern, the results here show that it comes from the different effects of start-ups on employment change in the same and other sectors. For high-end services, the first positive effect stems entirely from the effect on employment in the same sector. The positive effect more than outweighs the negative effect on other sectors. As the positive effect of start-ups on employment change in the same sector fades, the negative effect on other sectors dominate (between years 1 and 3 in this case). In the later years (year 5 in our analysis), there is a positive effect on employment in other sectors, which outweighs negative effects.

Where does the negative and later positive effect of high-end services start-ups on employment in other sectors come from? As discussed previously, high-end start-ups can be understood as a major driver of structural change in a region. The negative effect on other sectors can thus reflect an overall shift in industry structure toward an increasing share in knowledge-intensive services, which is particularly pronounced in regions with high start-ups rates in high-end services. High-end service start-ups can be a vehicle for changes in the regional industry composition.[14] The positive effect in later years can be explained by the fact that the local presence of high-end service firms has a positive effect on remaining firms in other sectors. A vast amount of literature suggests that knowledge-intensive services play an important role in the innovation and growth processes of regions and that they stimulate the productivity and innovation of regional industry. Our results are consistent with the finding that such positive effects on other sectors are significant in the long run.

[14] The general shift towards high-end service employment may partly be attributed to outsourcing activities of established firms, which means that high-end start-ups can be driven by strategic decisions of incumbents. This would imply ambiguities regarding the causality of the relationship between start-ups in high-end services and employment change in other sectors. A Granger causality test showed that lagged values of start-up rates in high-end services contribute to explain employment change in other sectors while lagged values of employment change in other sectors does not predict start-ups in high-end services.

5 CONCLUSIONS

In this paper, we used longitudinal data over a decade on start-ups and employment in Swedish regions and analyzed the effect of start-ups on subsequent employment growth. We distinguished between three broadly defined sectors and examined the respective impact of start-ups on employment change in the same and other sectors.

The results illustrate that the known S-shaped pattern can be attributed to the different effects that start-ups in a sector have on employment change in the same and other sectors. We find differences between sectors with regard to the effect of start-ups on subsequent employment change. The effect of start-ups on employment change in high-end services seems to have the largest impact on the regional economy. The results are, in this sense, consistent with the argument that knowledge-based start-ups are more likely to have strong impacts on regional development since they introduce novelties with higher knowledge-content and as such boost innovation. High-end services are knowledge-intensive services and comprise those sectors normally associated with KIBS.

The results for high-end services indicate that high-end service start-ups can be a vehicle for changes in the regional industry composition in favor of the industry in which start-ups are established. The effect of start-ups in high-end service industries on regional employment in other sectors is the only negative effect of start-up rates that we find in our analysis. For manufacturing and low-end services (the other sectors in our analysis), we find no significant negative effect on employment. Several scholars have maintained that an increasing employment share in knowledge-intensive services is a characteristic feature of the structural change process of advanced economies. Our results indicate that start-ups play an important role in such a process.

REFERENCES

Acs, Zoltan J. and David B. Audretsch (1987): Innovation, Market Structure and Firm Size, *Review of Economics and Statistics*, *69*(4), 567–575.

Acs, Zoltan J. and Pamela Mueller (2008): Employment Effects of Business Dynamics: Mice, Gazelles and Elephants, *Small Business Economics, 30*, 85-100.

Albæk Karsten, Mahmood Arai, Rita Asplund, Erling Barth, and Erik Strøjer Madsen (1998): Measuring Wage Effects of Plant Size. *Labour Economics*, *5*, 425-448.

Andersson, Åke E. and Ulf Strömquist (1988): *K-Samhällets Framtid* (The Future of the K-Society), Prisma, Värnamo.

Andersson, Martin (2006): Co-location of Manufacturing and Producer Services – a Simultaneous Equations Approach, in Karlsson, C., B. Johansson, and R. R. Stough (eds.), *Entrepreneurship and Dynamics in the Knowledge Economy*, Routledge, London: 94-124.

Andersson, Martin and Urban Gråsjö (2008): Spatial Dependence and the Representation of Space in Empirical Models, *Annals of Regional Science*, forthcoming.

Andersson, Martin and Sierdjan Koster (2008): Persistence in Start-up rates – Evidence from Sweden, Paper presented at the ERSA Congress in Liverpool, 2008.

Arauzo Carod, Josep Maria, Liviano Solís, and Mònica Martín Bofarull (2008): New Business Formation and Employment Growth: Some Evidence for the Spanish Manufacturing Industry, *Small Business Economics*, *30*, 73-84.

Audretsch, David B. and Michael Fritsch (1994): On the Measurement of Entry Rates, *Empirica*, *21*, 105-113.

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

Baptista Rui, Vítor Escária, and Paulo Madruga (2008): Entrepreneurship, Regional Development and Job Creation: The Case of Portugal, *Small Business Economics*, *30*, 49-58.

Baptista, Rui and Miguel Torres Preto (2008): New Firm Formation and Employment Growth: Regional and Business Dynamics, *Small Business* Economics, Forthcoming

Baumol, William J. (1967): Macroeconomics of Unbalanced Growth – The Anatomy of Urban Crisis, *American Economic Review*, *57*, 415-426.

Borgman, Benny and Pontus Braunerhjelm (2007): *Entrepreneurship and Local Growth – a Comparison of the US and Sweden*, CESIS WP 103, Royal Institute of Technology, Stockholm.

Braunerhjelm, Pontus (2008): Entrepreneurship, Knowledge and Economic Growth, *Foundations and Trends in Entrepreneurship*, *4*, 451-533

Braunerhjelm, Pontus and Benny Borgman (2004): Geographical Concentration, Entrepreneurship, and Regional Growth – Evidence from Regional Data in Sweden 1975–1999. *Regional Studies*, *38*, 929–947.

Carree Martin A and Roy Thurik (2003): The Impact of Entrepreneurship on Economic Growth, in Acs, Zoltan J. and David B. Audretsch (eds.), *Handbook of Entrepreneurship Research*, Kluwer, Boston: 437-471.

Carree, Martin A. and Roy Thurik (2008): The Lag Structure of the Impact of Business Ownership on Economic Performance in OECD Countries, *Small Business Economics*, *30*, 101-110.

Christensen, Clayton M. and Richard S. Rosenbloom (1995): Explaining the Attacker's Advantage: Technological Paradigms, Organisational Dynamics, and the Value Network, *Research Policy*, *24*, 233—257.

Ciccone, Antonio and Robert E. Hall, (1996): Productivity and the Density of Economic Activity, *American Economic Review*, *86*, 54–70.

Czarnitzki, Dirk and Alfred Spielkamp (2003): Business services in Germany: bridges for innovation, *The Service Industries Journal*, *23*(1), 1-30.

Davidsson, Per, Leif Lindmark, and Christer Olofsson (1994): New Firm Formation and Regional Development in Sweden, *Regional Studies*, *28*, 395-410.

Davidsson, Per, Leif Lindmark, and Christer Olofsson (1998): The Extent of Overestimation of Small Firm Job Creation--An Empirical Examination of the Regression Bias, *Regional Studies*, *11*, 87-100.

Fölster, Stefan (2000): Do Entrepreneurs Create Jobs?, *Small Business Economics*, *14*(2), 137-148.

Fritsch, Michael (1996): Turbulence and Growth in West Germany: A Comparison of Evidence by Regions and Industries, *Review of Industrial Organization*, *11*, 231-251.

Fritsch, Michael (2008): How Does New Business Formation Affect Regional Development? Introduction to the Special Issue. *Small Business Economics*, *30*, 1-14.

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

Fritsch, Michael and Pamela Mueller (2008): The Effect of New Business Formation on Regional Development over Time: The Case of Germany, *Small Business Economic*s, *30*, 15-29.

Fuchs, Victor. (1968): *The Service Economy*, NBER/Columbia University Press, New York.

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

Hansen, Niles (1993): Producer Services, Productivity and Urban Income, *Review of Regional Studies*, *3*, 255-264.

Henrekson, Magnus and Dan Johansson (2008): Gazelles as Job Creators - A Survey and Interpretation of the Evidence, IFN Working Paper No. 733.

Johansson, Börje, Johan Klaesson, and Michael Olsson (2003), Commuters' Non-Linear Response to Time Distances, *Journal of Geographical Systems*, *5*, 315-329.

Keeble, David, John Bryson, and Peter Wood (1991): Small Firms, Business Service Growth and Regional Development in the United Kingdom: Some Empirical Findings, *Regional Studies*, *25*, 439-57.

Klaesson, Johan and Börje Johansson (2008): Agglomeration Dynamics of Business Services, CESIS WP 153.

Makun, Paul and David MacPherson. (1997): Externally-Assisted Product Innovation in the Manufacturing Sector: the Role of Location, In-House R&D and Outside Technical Support, *Regional Studies*, *31*(7), 659-668.

Marshall, Neill J., Peter Damesick, and Peter Wood. (1987): Understanding the Location and Role of Producer Services in the United Kingdom, *Environment and Planning A*, *19*, 575-595.

Miner, Anne (1997): Idiosyncratic Jobs in Formalized Organizations, *Administrative Science Quarterly*, *32*, 327-351.

Miles, Ian (2003): Services and the Knowledge-Based Economy, in Tidd, J. and F. M. Hull (eds.), *Service Innovation, Organizational Responses to Technological Opportunities &Market Imperatives*, Kluwer, London: 81-112.

Miles, Ian, Nikos Kastrinos, Rob Bilderbeek, and Pim den Hertog (1995). *Knowledge-Intensive Business Services - Users, Carriers and Sources of Innovation*. PREST, Manchester.

Mueller, Emmanuel and Andrea Zenker (2001): Business Services as Actors of Knowledge Transformation: The Role of KIBS in Regional and National Innovation Systems, *Research Policy*, *30*, 1501–1516.

Mueller, Pamela, André van Stel, and David J. Storey (2008): The Effects of New Firm Formation on Regional Development over Time: The Case of Great Britain, *Small Business Economics*, *30*, 59-71.

Noyelle, Thierry . J. and Thomas M. Stanback (1984): *The Economic Transformation of American Cities*, Totawa, NJ: Rowman & Allanheld.

Noyelle, Thierry. (1982): The Implications of Industry Restructuring for Spatial Organization in the United States, in Moulaert, F. and P. W. Salinas (eds.), *Regional Analysis and the New International Division of Labor*, Kluwer Nijhoff, Boston.

Nyström, Kristina (2008a): Is Entrepreneurship the Salvation for Enhanced Economic Growth?, CESIS WP 143, Royal Institute of Technology.

Nyström, Kristina (2008b): Entry, Market Turbulence and Industry Employment Growth, *Empirica*, forthcoming.

Peneder, Michael, Serguei Kaniovsky, and Bernard Dachs (2003): What Follows Tertiarisation?: Structural Change and the Role of Knowledge-Based Services, *The Service Industry Journal*, *23*, 47–66.

Persson, Helena (2004): The Survival and Growth of New Establishments in Sweden 1987-1995, *Small Business Economics*, *23*, 423-440

Plümper, Thomas and Vera Troeger (2007): Efficient Estimation of Time-Invariant and Rarely Changing Variables in Finite Sample Panel Analyses with Unit Fixed Effects, *Political Analysis, 15*, 124-139.

Sassen, Saskia (2006): *The Global City: New York, London, Tokyo*, Princeton University Press, Princeton, 2nd ed.

Schettkat, Ronald (2007): The Astonishing Regularity of Service Employment Expansion, *Metroeconomica*, *58*, 413-435

Schettkat, Ronald and Lara Yocarini (2006): The Shift to Services Employment: A Review of the Literature, *Structural Change and Economic Dynamics*, *17*(2), 127-147.

Schumpeter, Joseph (1911), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle,* Harvard University Press, Cambridge.

Storey, David J. (1994): *Understanding the Small Business Sector*. London: Routledge.

van Stel, André and Kashifa Suddle (2008): The Impact of New Firm Formation on Regional Development in the Netherlands, *Small Business Economics*, *30*, 31-47.

van Praag, Mirjam and Peter Versloot (2007): What is the Value of Entrepreneurship? A Review of Recent Research, *Small Business Economics*, *29*, 351-382,

Venables, Anthony J (1996): Equilibrium Locations of Vertically Linked Industries, *International Economic Review*, *37*(2), 341-360.

Wennberg, Karl and Göran Lindqvist (2008): The Effects of Clusters on the Survival and Performance of New Firms, *Small Business Economics*, forthcoming.

APPENDIX

Table A1: The impact of start-up rates on regional employment change

	Total employment change
Start-up rate, total, t=0	0.00874***
	(0.0021)
Start-up rate, total, t-1	0.00916***
	(0.0023)
Start-up rate, total, t-2	0.00375
	(0.0024)
Start-up rate, total, t-3	-0.000326
	(0.0022)
Start-up rate, total, t-4	0.00741***
	(0.0022)
Start-up rate, total, t-5	0.00937***
	(0.0020)
Ln education, t-2	0.232***
	(0.029)
Ln education squared, t-2	-0.0559***
	(0.0057)
Ln share of manufacturing, t-2	0.0567*
	(0.029)
Ln municipal accessibility to	0.00325**
GRP, t-2	(0.0013)
Ln extra regional accessibility to	0.00806***
GRP, t-2	(0.0016)
Constant	-0.310***
	(0.058)
Lambda (spatial autocorrelation)	-0.00118
	(0.011)
Lagrange multiplier- Test	13.32**
Variance ratio	0.367

Robust maximum likelihood estimation controlling for unit fixed effects; Robust standard errors in parentheses. Statistically significant at ***1%, **5%, and *10% levels. The number observations=1710.

Table A2: The impact of start-up rates in manufacturing on regional employment change

	Total employment change	Employment change in manufacturing	Employment change in other sectors
Start-up rate, manufacturing, t=0	0.0203***	0.0150**	0.0219***
	(0.0048)	(0.0065)	(0.0064)
Start-up rate, manufacturing, t-1	0.0200***	0.0261***	0.00975
	(0.0059)	(0.0080)	(0.0075)
Start-up rate, manufacturing, t-2	0.0121***	0.0114*	0.0143**
	(0.0045)	(0.0066)	(0.0066)
Start-up rate, manufacturing, t-3	0.00362	0.00694	0.00681
	(0.0053)	(0.0070)	(0.0069)
Start-up rate, manufacturing, t-4	0.0246***	0.0267***	0.0263***
	(0.0052)	(0.0068)	(0.0069)
Start-up rate, manufacturing, t-5	0.0151***	0.0213***	0.00929
	(0.0046)	(0.0060)	(0.0069)
Ln education, t-2	0.0606***	0.102***	0.0909
	(0.014)	(0.020)	(0.056)
Ln education squared, t-2	-0.0129***	-0.0269***	-0.0136
	(0.0035)	(0.0057)	(0.010)
Ln share of manufacturing, t-2	-0.0622***	-0.141***	0.0857**
	(0.015)	(0.018)	(0.034)
Ln municipal accessibility to	0.00830***	0.00660***	0.00880***
GRP, t-2	(0.0015)	(0.0016)	(0.0016)
Ln extra regional accessibility to	0.00622***	0.00897***	0.00424**
GRP, t-2	(0.0015)	(0.0015)	(0.0020)
Constant	-0.00232	-0.00304	-0.124
	(0.0088)	(0.0083)	(0.096)
Lambda (spatial autocorrelation)	-0.378***	-0.485***	-0.0288
	-0.14	(0.14)	(0.068)
Lagrange multiplier- Test	12.46***	16.76***	12.83***
Variance ratio	0.366	0.469	0.451

Robust maximum likelihood estimation controlling for unit fixed effects; Robust standard errors in parentheses. Statistically significant at ***1%, **5%, and *10% levels. The number observations=1710.

Table A3: The impact of start-up rates in low-end services on regional employment change

	Total employment change	Employment change in low-end services	Employment change in other sectors
Start-up rate, low-end services, t=0	0.00880**	0.0100**	0.00924*
	(0.0037)	(0.0045)	(0.0049)
Start-up rate, low-end services, t-1	0.0164***	0.0206***	0.0149***
	(0.0037)	(0.0048)	(0.0048)
Start-up rate, low-end services, t-2	0.00872**	0.00108	0.0133***
	(0.0036)	(0.0053)	(0.0046)
Start-up rate, low-end services, t-3	0.00249	0.00509	0.00173
	(0.0038)	(0.0048)	(0.0050)
Start-up rate, low-end services, t-4	0.00492	0.0147***	0.00158
	(0.0035)	(0.0046)	(0.0047)
Start-up rate, low-end services, t-5	0.0125***	0.00896**	0.0136**
	(0.0039)	(0.0039)	(0.0055)
Ln education, t-2	0.111***	0.135***	0.0381*
	(0.027)	(0.038)	(0.022)
Ln education squared, t-2	-0.0239***	-0.0261***	-0.0107*
	(0.0051)	(0.0078)	(0.0056)
Ln share of manufacturing, t-2	0.016	0.129***	-0.0383
	(0.029)	(0.031)	(0.026)
Ln municipal accessibility to GRP, t-2	0.00399***	0.00353**	0.00546***
	(0.0013)	(0.0015)	(0.0019)
Ln extra regional accessibility to GRP, t-2	0.00790***	0.00985***	0.00764***
	(0.0016)	(0.0015)	(0.0021)
Constant	-0.127**	-0.216***	-0.00302
	(0.055)	(0.059)	(0.011)
Lambda (spatial autocorrelation)	-0.0155	-0.0199	-0.407***
	(0.033)	(0.022)	(0.14)
Lagrange multiplier- Test	13.56***	17.81***	13.38***
Variance ratio	0.36	0.3 16	0.288

Robust maximum likelihood estimation controlling for unit fixed effects; Robust standard errors in parentheses. Statistically significant at ***1%, **5%, and *10% levels. The number observations=1710.

Table A4: The impact of start-up rates in high-end services on regional employment change

	Total employment change	Employment change in high-end services	Employment change in other sectors
Start-up rate, high-end services, t=0	0.00669*	0.0353***	-0.00145
	(0.0038)	(0.0085)	(0.0039)
Start-up rate, high-end services, t-1	-0.000141	0.0303***	-0.00871**
	(0.0039)	(0.0093)	(0.0039)
Start-up rate, high-end services, t-2	-0.00301	0.0145	-0.00946**
	(0.0045)	(0.010)	(0.0040)
Start-up rate, high-end services, t-3	-0.00406	0.00993	-0.0103***
	(0.0039)	(0.011)	(0.0036)
Start-up rate, high-end services, t-4	0.00378	0.0215*	-0.00357
	(0.0039)	(0.011)	(0.0037)
Start-up rate, high-end services, t-5	0.00352	-0.0103	0.00817**
	(0.0041)	(0.011)	(0.0037)
Ln education, t-2	0.0861***	0.373***	-0.00466
	(0.013)	(0.087)	(0.026)
Ln education squared, t-2	-0.0210***	-0.0936***	0.00134
	(0.0032)	(0.018)	(0.0058)
Ln share of manufacturing, t-2	-0.0762***	0.221***	-0.160***
	(0.015)	(0.070)	(0.017)
Ln municipal accessibility to	0.00309**	0.00171	0.00414***
GRP, t-2	(0.0014)	(0.0034)	(0.0013)
Ln extra regional accessibility to	0.00440***	0.00194	0.00611***
GRP, t-2	(0.0015)	(0.0044)	(0.0013)
Constant	0.00319	-0.531***	0.183***
	(0.0073)	(0.16)	(0.040)
Lambda (spatial autocorrelation)	-0.426***	-0.00685	-0.0104
	(0.13)	(0.020)	(0.016)
Lagrange multiplier- Test	13.58***	15.60***	11.88***
Variance ratio	0.353	0.349	0.415

Robust maximum likelihood estimation controlling for unit fixed effects; Robust standard errors in parentheses. Statistically significant at ***1%, **5%, and *10% levels. The number observations=1710.