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Knoben, J.; Ponds, R.; van Oort, F.G.

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Joris Knoben<sup>a</sup>; Roderik Ponds<sup>b</sup>; Frank van Oort<sup>c</sup>

<sup>a</sup> Organisation Studies, Tilburg, 5000 LE, The Netherlands <sup>b</sup> Netherlands Environmental Assessment Agency, The Hague, The Netherlands <sup>c</sup> Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands

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## **Employment from new firm formation in the Netherlands: Agglomeration economies and the Knowledge Spillover Theory of Entrepreneurship**

Joris Knobens<sup>a\*</sup>, Roderik Ponds<sup>b</sup> and Frank van Oort<sup>c</sup>

<sup>a</sup>*Organisation Studies, Warandelaan 2, Tilburg, 5000 LE, The Netherlands;* <sup>b</sup>*Netherlands Environmental Assessment Agency, PO Box 30.314, The Hague, The Netherlands;* <sup>c</sup>*Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands*

Within the recent literature on the geography of new firm formation, much attention is given to the role of regional knowledge sources based on the Knowledge Spillover Theory of Entrepreneurship. At the same time, several other studies show the importance of agglomeration economies for new firm formation. The goal of this study is to assess the relative importance of these determinants for differences in the share of employment creation from new firms at the level of municipalities for the period of 1999–2006 in the Netherlands. It is found that the traditional drivers of new firm formation, such as economic growth and agglomeration effects, have a much stronger effect on new firm formation compared to measures of the regional knowledge base. Moreover, it is shown that when not correcting for the presence of agglomeration effects, the role of local knowledge resources is easily over-estimated, pointing to the dangers of misspecifications of models. The results imply that the knowledge spillover theory of entrepreneurship should, at least for the Netherlands, not be exaggerated.

**Keywords:** new firm formation; entrepreneurship; knowledge spillovers; agglomeration effects

### **Introduction**

Entrepreneurship and new firm formation are increasingly being related to economic growth at both the national and regional level (Audretsch and Keilbach 2004; Van Stel and Suddle 2008). Based on these insights, national and regional governments in various countries try to stimulate new firm formation in order to promote economic growth (Gustavsen, Nyhan, and Ennals 2007). It is therefore not surprising that the interest in the possible determinants on regional differences in the rates of new firm formation has grown over the years.

Even though the policy interest in new firm formation revived relatively recently, regional differences in new firm formation have already been analysed for many years, resulting in the consensus that the regional dimension of new firm formation is indeed important (Reynolds, Storey, and Westhead 1994; Storey 1994). Traditionally much

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\*Corresponding author. Email: [j.knoben@uvt.nl](mailto:j.knoben@uvt.nl)

attention has been given to the role of the size of the regional market and the relation between localized unemployment rates and entrepreneurship.

According to Armington and Acs (2002), research on new firm formation was until the 1980s to a large extent motivated by an interest in reducing high levels of unemployment in lagging regions. Over the years, regional differences in entrepreneurship also drew the attention of researchers in the field of regional economics, leading to different studies analysing the role of agglomeration economies for regional differences in new firm formation (see for example Reynolds, Storey, and Westhead 1994 and Bosma, van Stel, and Suddle 2008).

Recently, increasing attention is given to the role of knowledge and innovation intensity for regional differences in new firm formation rates. This has led to several empirical studies testing the regional dimension of the Knowledge Spillover Theory of Entrepreneurship (Audretsch, Keilbach, and Lehman 2006; Audretsch and Keilbach 2007). The main premise of this theory is that R&D activities of firms and public research organizations such as universities are an important source of knowledge spillovers. These spillovers constitute new entrepreneurial opportunities, thereby leading to higher regional levels of entrepreneurship in regions with a high level of such knowledge resources. This view is also increasingly being embedded in policy initiatives such as the stimulation of localized spin-offs from universities through the establishment of incubators and science parks in their vicinity. None the less, the number of empirical studies at the regional spatial scale that test the knowledge spillover theory of entrepreneurship is relatively small. The studies that have been conducted mainly focus on larger European countries (Audretsch and Keilbach 2007; Brixy and Grotz 2007). Moreover, some of these studies focus on the role of local knowledge resources while neglecting the possible effect of more traditional drivers of new firm formation, such as agglomeration economies (for example Audretsch and Lehman 2005).

The goal of this paper is to analyse the impact of regional differences in local knowledge resources on differences in new firm formation in comparison to the role of agglomeration economies and other more traditional drivers of new firm formation. By doing so, this study is among the first to test the role of knowledge resources for entrepreneurship in the Netherlands. As such, it contributes to the empirical literature on the role of knowledge spillovers for new firm formation that has so far been dominated by research in large countries.

The role of different possible determinants for regional differences in the share of employment from new firms has been analysed for the period of 1999–2006 for three broad industries in the Netherlands (manufacturing, logistics, and business services). We utilize municipalities as the spatial level of analysis). This regional level of analysis has been adopted because municipalities play an important role in policies on labour-markets, housing and unemployment in The Netherlands. Within the literature there is no consensus on the relevant spatial scale of the regional determinants of new firm formation. Studies typically focus on the more aggregated spatial scales such as NUTS3 regions (Van Stel and Nieuwenhuijsen 2004) or NUTS 2 regions (Beugelsdijk and Noorderhaven 2004). Utilizing the level of municipalities, however, allows for a more fine-grained analysis of the determinants of spatial differences in new firm formation. In order to take the possible presence of spillovers of entrepreneurial activities between municipalities into account, spatial-econometric modelling techniques have been applied.

Our results show that the most consistent determinant across all industries is the existing local economic structure (in terms of self-enforcing agglomeration effects), suggesting that new firm formation is not likely to change existing patterns of employment in the short run. Given the importance of the regional sectoral structure, regional differences in entrepreneurship appear to be path-dependent in nature (Brenner and Fornahl 2008). These findings are in line with the more general notion that economic structures are very stable over time and that, once locational fundamentals such as natural resources, have established the spatial pattern, increasing returns leads to a reinforcing degree of spatial differentiation (Davis and Weinstein 2002). Furthermore, whereas traditional drivers of new firm formation such as economic growth and agglomeration effects have a strong effect on new firm formation, the strength of the regional knowledge base hardly has any effect at all. Interestingly, when agglomeration effects are excluded from the model, or when the effect of the strength of the regional knowledge base is analysed in isolation, it does have a significant effect. This implies that when excluding agglomeration economies or other traditional determinants of regional entrepreneurship, the effect of regional knowledge resources is easily overestimated.

This paper continues as follows. The second part consists of an overview of the different factors that might influence regional differences in new firm formation rates. Section 3 describes the dataset. In the fourth section a descriptive analysis of the spatial patterns of employment effects on new firm formation is provided. The fifth part presents the econometric analysis of the regional determinants of these patterns and the final section provides a discussion of the results found.

### **Regional determinants of entrepreneurship**

Entrepreneurship is often considered to result from an individual's capability to recognize and exploit opportunities for profitable production of goods or services (Shane and Venkataraman 2000). Numerous theories and papers in this field are devoted to the explanation of why individuals differ in their ability to discover, value, and exploit these opportunities given a specific fixed set of exogenous opportunities (see for example Storey (1994) and Krueger (2003)). At the same time, increasing attention has been given to the sources of these entrepreneurship opportunities in relation to the differences in the rates of entrepreneurship between industries and regions/countries (see for example Beugelsdijk and Noorderhaven 2004). Studies at the aggregate level of regions, countries or industries assume the individual characteristics to be constant and analyse the effect of the different contexts on entrepreneurship rates. Differences in the rate of entrepreneurship are then interpreted as being the result of differences in available and recognizable opportunities. Empirical studies with a regional dimension are based on the idea that there are large regional differences in entrepreneurship opportunities, leading to regional differences in entrepreneurship rates. The main goal of empirical research in this area, and of this study as well, is the identification of the sources of these regional differences in entrepreneurship opportunities. This is typically done by relating regional differences in start-up rates to possible sources of entrepreneurship opportunities. Over the years, different types of these sources have been identified which will be briefly discussed in the order in which they entered the scientific literature subsequently.

### *Economic growth and unemployment*

The level of regional economic development is often argued to have a large influence on the rate of entrepreneurship (Davidsson, Lindmark, and Olofsson 1994; Guesnier 1994). Growth of economic output implies a growth of regional demand and consequently a growth in the general level of entrepreneurship opportunities. Empirical studies generally find a positive relation between the rate of entrepreneurship and economic growth (Garofoli 1994; Reynolds 1994). As a consequence, economic growth is considered to be one of the most important variables for empirical studies in this area.

In a similar way the unemployment rate of regions is typically taken into account as an important variable. Based on the idea that individuals without a job are likely to consider self-employment a feasible alternative, high unemployment rates are often associated with higher rates of start-ups. The empirical results of the effect of unemployment are, however, ambiguous (Audretsch and Fritsch 1994; Reynolds, Storey, and Werthead 1994). Some studies conclude that higher unemployment levels increase entrepreneurial activity (Evans and Leighton 1990; Reynolds, Miller, and Maki 1995), whereas others find that high unemployment levels are related to low levels of entrepreneurial activity (Audretsch and Fritsch 1994) or find no effect at all (Guesnier 1994; Naude et al. 2008).

### *Agglomeration effects*

In addition to regional differences in growth and unemployment, several studies have focused on the role of agglomeration economies for new firm formation as well (Audretsch and Fritsch 1994; Garofoli 1994; Guesnier 1994; Bosma, van Stel, and Suddle 2008). Agglomeration economies consist of advantages for a firm due to the fact that it is located in a concentration of other firms and organizations. These economies of scale usually have a limited spatial reach because of transaction costs of overcoming geographical distance, such as transport, commuting, and communication costs (Baranes and Tropeano 2003). Even though agglomeration economies can be grouped in different ways, the contemporary literature usually distinguishes between localization economies (Marshall-Arrow-Romer externalities) and urbanization economies (Jacobs' externalities) (Van Oort 2004). Localization economies refer to the effects that are produced by having many firms from the same industry in a single area, whereas urbanization economies refer to the effects of a concentration of firms from different industries in the area.

The concentration of firms of a similar sector (localization economies) might be beneficial due the presence of a specialized labour market and specialized suppliers (a so-called market thickening effect), which creates opportunities for highly specialized new start-ups (Audretsch and Fritsch 1994; Garofoli 1994). Urbanization economies are typically resulting from urban size related advantages such as a well-developed physical infrastructure and a larger consumer base. As a consequence, densely populated regions might exhibit a higher variety of demand leading to the presence of niche markets and more opportunities for success, which can lead to a higher rate of new firm formation (Van Stel and Suddle 2008).

Similar arguments regarding the positive effects of agglomerations on new firm performance have been put forward for different spatial scales, ranging from countries to neighbourhoods. On the level of the municipality – a close resemblance

to cities in the Netherlands – at which we will apply them, these lines of reasoning are embedded in the incubator hypothesis, which states that new firms prefer more urbanized and specialized areas because these facilitate access to resources such as knowledge and highly qualified labour (Leone and Struyk 1976; Acs and Armington 2004).

Besides the positive effects of agglomeration economies, the literature also emphasizes several downsides of being located in an agglomeration, mostly related to competition and congestion effects. When establishments agglomerate in space, there will be competition for land, which drives up land costs and creates a centrifugal force in the region (Flyer and Shaver 2003), possibly leading to a decrease in start-up rates. Furthermore, establishments will have to compete for qualified labour and other inputs. On the output side, spatial competition is likely to be an important force as well. If a market in a certain region is saturated, it will be more difficult for new establishments to get a foothold in that region (Sohn 2004). Despite these potential downsides of agglomeration effects, findings of empirical studies tend to indicate positive effects of agglomerations on new firm formation rates (Reynolds, Storey, and Westhead 1994).

### *Regional knowledge base*

Lately, increasing attention has been given to the role of regional knowledge sources as important factor for the growth of entrepreneurship. The Knowledge Spillover Theory of the Firm (Acs 2008) and Audretsch, Keilbach, and Lehman (2006) is based on the idea that knowledge spillovers are an important source of entrepreneurial opportunities and that entrepreneurship is the mechanism through which knowledge spillovers contribute to economic growth. In this theory, knowledge generation results from deliberate investments of firms (and other organizations such as universities). The expected economic value of this knowledge, as valued by the generating organization, determines the probability of further investments in the development and commercialization of this knowledge. Similar to the ability to recognize and exploit entrepreneurial opportunities, the ability to assess the economic value of new knowledge differs between organizations and individuals. The economic value attached to new knowledge by the generating firm might be lower than the expected cost to develop it into a new product or service. However, other economic agents might attach a higher value to the new knowledge and can therefore initiate an attempt to appropriate this value by starting a firm with the goal of exploiting this knowledge. To the extent that these new firms did not invest in the initial generation of this knowledge, entrepreneurship is considered to be a mechanism of knowledge spillovers. A large range of literature emphasizes the localized character of knowledge spillovers (see for example Jaffe, Trajtenberg, and Henderson 1993; Audretsch and Feldman 1996) and consequently the Knowledge Spillover Theory of Entrepreneurship holds that regions with more knowledge generating organizations and capacity will exhibit higher rates of entrepreneurship.

### *Policy instruments*

Governments might influence the rate of new firm formation as well. Because new firms are one of the main sources of employment growth (Birch 1979), municipalities

often try to persuade new firms to locate within their boundaries by supplying ample land in the form of business estates (Siegel, Westhead, and Wright 2003). Besides supplying parcels of business estates, which would primarily attract larger firms that seek to a new location, municipalities are increasingly focusing on starting firms as well by supplying small and flexible units of space within a single building that is constructed on a business estate.

Furthermore, a large range of different local policy measures has been initiated aiming at the stimulation of new firms (Hart and Gudgin 1994; Johnson and Parker 1996). Unfortunately, in most countries there is hardly any reliable and exhaustive data available on such policy initiatives. Garofoli (1994) and Reynolds (1994), therefore, include local government spending as an indicator for spatial variation in the stimulation of new firm formation by governments. Alternatively, local tax rates have been included (Guesnier 1994) as an indicator as well, although the hypothesis of the effect of the latter indicator on local entrepreneurship can be formulated in two ways. On the one hand a higher tax rate might induce more new firm formation since local supportive services might be of a higher quality. On the other hand higher tax rates might reduce entrepreneurship due to higher costs of doing business (Guesnier 1994). Earlier research illustrates that local governments often try to compete for new firms on the basis of differentiated local tax rates in the USA (Neumark, Zhang, and Wall 2006). Given the fact that new firms are often small and have limited financial resources, these firms might be particularly sensitive to such incentives. Local tax rates, however, are not likely to be a very important factor in countries with a largely centralized tax system such as The Netherlands since the local tax rate is only a minor part of total tax rates for firms.

Cultural and political factors are sometimes used to explain differences in firm formation rates as well (Garofoli 1994; Beugelsdijk and Noorderhaven 2004). Even though such differences can play a role for entrepreneurial attitudes, they predominantly accrue between countries and do not a priori play a crucial role at the level of regions or municipalities within a country (Bosma and Schutjens 2007).

The role of the regional factors for entrepreneurship described above is likely to differ across industries since the relative importance of spatial proximity for a specific factor differs between sectors. The role of regional demand factors for example is related to the relative importance of the regional market for a specific sector. Industrial sectors have, in general, geographically more dispersed markets than services and it is therefore plausible that regional demand factors are more important for services than for other sectors. Therefore, it is important to distinguish between different types of sectors when analysing the regional determinants of differences in new firm formation.

### **Data and measurements**

In order to construct the dependent variable of our research, the regional employment resulting from new firm formation, the LISA-database has been utilized. This database contains longitudinal (1999–2006) information on the location, number of jobs, and type of economic activities (NACE-codes) for all establishments in the Netherlands. The LISA-database is constructed on an annual basis, in which each establishment is assigned a unique identification number that does not change over time. The appearance of a new establishment is coded as ‘entry’. It should be noted,



however, that the data does not allow us to distinguish true start-ups from spin-offs or new establishments of already existing firms.<sup>1</sup>

In this dataset, the municipality is used as the spatial level of analysis. In 2006, the Netherlands consisted of 458 municipalities.<sup>2</sup> This regional level of analyses has been adopted because municipalities play an important role in labour-market policy, housing policy and unemployment policy. Moreover, despite the lack of consensus on the spatial scale at which agglomeration economies become manifest, several authors provide empirical evidence for the presence of agglomeration economies at relatively low spatial scales, such as the zip code level (Rosenthal and Strange 2004; Van Oort 2004). By testing the possible effect of agglomeration economies on the level of municipalities, this study follows a large range of existing empirical studies (see for example Van Oort (2007) for the Netherlands, and Combes (2000) for France). Nevertheless, it cannot be excluded that (specific forms of) agglomeration effects manifest themselves at higher spatial levels. In order to allow for such effects at higher spatial scales, spatial econometric techniques have been applied, as will be discussed in the methods section of this paper.

On the basis of their NACE-codes, firms have been categorized into three broad economic sectors. The three economic sectors are: (1) manufacturing; (2) logistics; and (3) business services (Appendix 1 provides this classification in more detail).

### *Dependent variable*

In the context of this research, it is necessary to discuss the concept of new firm formation, and its measurement in particular, in more detail. Regional differences in new firm formation can be measured with a variety of indicators, mostly due to various ways of standardization. The absolute number of start-ups is not very informative since regions typically differ in (economic) size. Two approaches have generally been used to compare new firm formation across regions (Audretsch and Fritsch 1994; Garofoli 1994; Storey 1994). The first standardizes the number of new firms to the total number of firms and is typically referred to as the ecological approach. The second approach is called the labour market approach and is based on the standardization to the size of the (regional) work force or the size of regional employment.

The ecological standardization procedure relates the amount of new firms to the existing stock of firms. Although often applied, this indicator suffers from several deficiencies. In a special issue on regional variations in new firm formation in *Regional Studies*, Garofoli (1994) mentions the most important ones. First of all, since new firms are generally rather small and the existing stock of firms also consists of large firms, an indicator based on the ecological standardization procedure does not take into account differences in firm size. Second, and related to this, because the size distribution of firms can vary between different regions and between industries, the ecological approach does not provide a uniform basis for a normalized measure (see also Davidsson, Lindmark, and Olofsson 1994). Third, the ecological approach is based on the assumption that new firms are created from the existing stock of firms. This assumption is only valid in the case of new branches of a multi-store retail company or in the case of spin-off companies. Since these cases constitute only a minor part of all new firms (Wenting 2008) it seems justified to conclude that this is not a valid assumption.

These arguments favour the use of the labour market approach where the denominator consists of the total employment or the total workforce. Consequently, the indicator for regional differences in new firm formation typically consists of the number of new firms divided by the total employment or the size of the workforce. The labour market approach is also more applicable in the context of the knowledge spillover theory of entrepreneurship, since it can be related to the concept of entrepreneurship as an individual choice based on the recognition of business opportunities.

Besides the issue of standardization, the definition of a new firm is not unambiguously clear either. Typically the available data refers to new establishments rather than new firms. Given the fact that firms can have multiple establishments, not all new establishments can be regarded as truly new firms. Bosma, van Stel, and Suddle (2008) argue that this has implications for the standardization approach. In the case of new firms, the labour market approach seems conceptually the best way, whereas in the case of new subsidiaries the ecological approach is best since they stem from the stock of existing firms (also see Garofoli 1994). Unfortunately, data limitations often make this distinction impossible.

Based on the arguments presented in the above, we apply a modified version of the labour market approach and use the employment of new firm formation as a proportion of the total employment. The main reason for the interest in the employment effect follows from the fact that, following insights from Acs and Audretsch (1989), new firms differ strongly with respect to their size leading to a possible underestimating of the importance of new formation for local employment development in when the new firms are relatively large and a possible overestimating when the new firms are relatively small. By analysing the relative employment effect of regional differences of entrepreneurship, we stick closer to the main motivation of studying this phenomenon. Given the fact that a new firm can be started by more than one person, and also can have more employees from the start, the number of new firms is typically lower than the associated employment.

With the aforementioned database, the employment resulting from new firm formation could be determined per sector per municipality for every year in the dataset. However, this data has been averaged for the entire period to filter out business-cycle effects. Moreover, the year of first registration of an establishment is not always completely accurate. By averaging the data, a more reliable cross-sectional measurement of regional differences in employment generated by new firm formation is obtained. By dividing employment from regional new firm formation by the total employment of that region we created a relative measure that corrects for differences in regional sizes. Regions that score high on the resulting measure generate more jobs with new firm formation than would be expected based on their employment size.

Figure 1 shows the Dutch municipal distribution of the share of employment creation from new firm formation in total and for the three sectors distinguished. The municipalities in the regions around Amsterdam and Utrecht (both in the western core region of the country) have the highest new firm employment rates in logistic and service activities. The Eindhoven region in the South of the Netherlands (with its technical university and Philips) shows the most marked employment creation by new industrial firm formation.

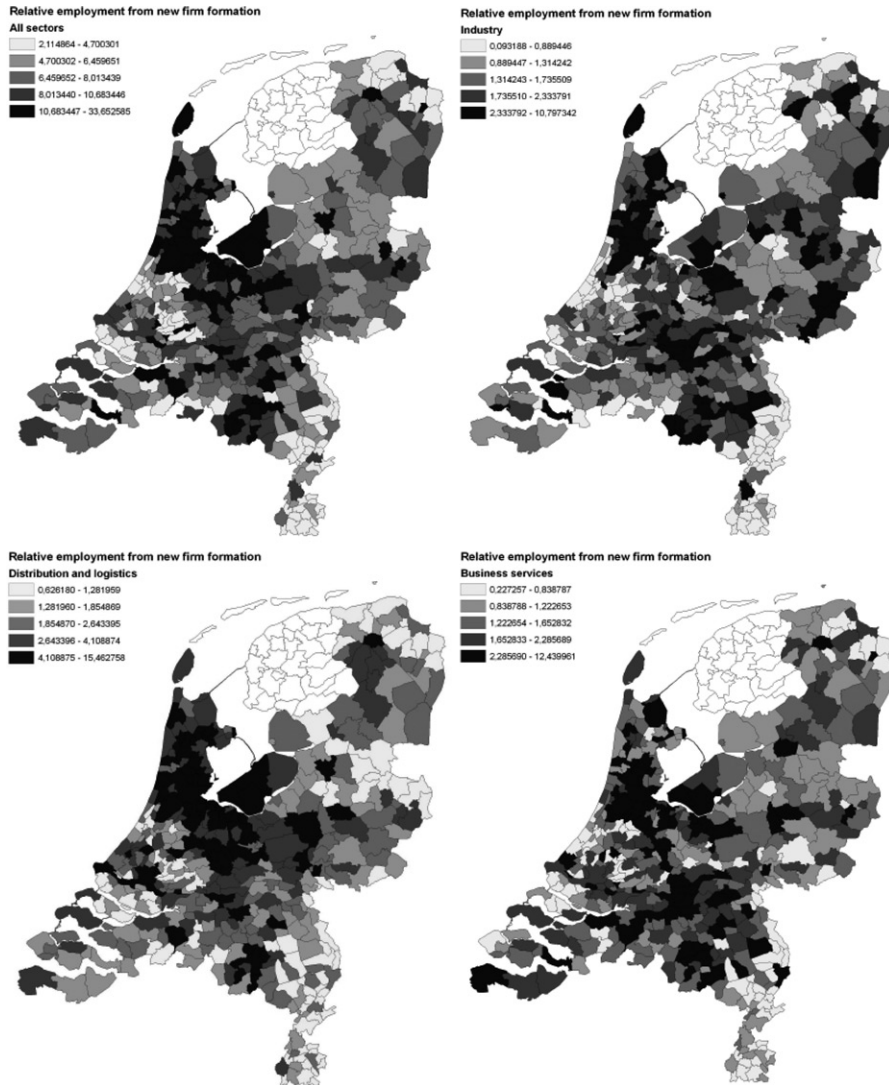


Figure 1. Geographical distribution of relative employment from new firm formation.

**Independent variables**

As discussed earlier, the goal of this study is to analyse the role of different possible determinants of local differences on new firm formation and to test whether the knowledge spillover theory of entrepreneurship holds for Dutch municipalities while controlling for the presence of agglomeration economies. In order to do so, local rates of employment from new firms are related to the different type of possible determinants as reviewed in Section 2.<sup>3</sup>

*Local growth of per capita income* and *local rate of unemployment* have been included to account for the ‘traditional’ determinants of economic growth and unemployment rates. Following the discussion in the theoretical section of this paper, two types of agglomeration effects are distinguished, namely urbanization

and localization effects. The level of urbanization of a region is measured as the total *number of jobs per square kilometre* within that region. A positive effect of this variable on the relative employment from new firm formation would indicate that more urbanized regions have, even after controlling for regional differences in size, a higher share of employment from new firm formation. The regional level of localization effects is measured by the *share of the three different sectors in total regional employment* (based on the longitudinal LISA-database discussed earlier). Moreover, to take into account possible effects of regional sectoral specialization in a general sense, the *sum of the squared terms of the sectoral employment shares* has been calculated (a modified Herfindahl-Hirschman Index). The higher this value, the higher the level of sectoral specialization. This measure reflects the effects of specialization in a general sense regardless of the particular sector in which a region specializes.

In order to test the Knowledge Spillover Theory of Entrepreneurship several variables have been included that denote the strength of the regional knowledge base. First, the *regional investments (in €) in research and development (R&D)* per employee is used as a measurement of innovation intensity (adopted from Van Oort 2002). Second, the average municipal *level of education* of the workforce in a region is taken as human capital indicator.<sup>4</sup> Third, a dummy-variable is included that captures whether the municipality is home to a *university or a polytechnic*.

Furthermore, two variables have been included to analyse the possible effect of local policy. First the *supply of business estates* is included. This is measured by total amount of land (in acres) available as non-occupied business estates per municipality in 1999. Second, the *average level of local taxes* for firms is included.

In order to prevent endogeneity problems, all independent variables have been measured for the year 1999 unless otherwise noted (this is a similar approach as proposed by Reynolds, Storey, and Westhead 1994). Besides, as Rosenthal and Strange (2004) argue, employment growth due to new firm formation in particular is not endogenous on previous employment decisions of firms (in regions). Therefore, endogeneity is much less of a problem when analysing new firm formation as compared to the growth of existing firms.

Descriptive statistics for all the variables discussed can be found in Table 1, whereas bivariate correlations between the variables can be found in Table 2. Table 2 reveals that, from a multicollinearity perspective, no problematic correlations are present. This is also reflected in the Variance Inflation Factors (VIFs) of all variables, which remain well below the threshold level of 10 and do not even exceed the value of 5 (Table 1). Therefore, multicollinearity does not pose a problem in the analyses.

## Methods

On the basis of Figure 1 as well as on theoretical reasoning it was expected that the regional distribution of relative employment from new firm formation could be characterized by spatial autocorrelation. This means that observations in one region are correlated with observations from its neighbouring regions. If this correlation is positive, high and low values concentrate in space, whereas negative correlation implies almost perfect separation of high and low regional values (a checkerboard pattern). Spatial autocorrelation implies that the municipal observations used in the

Table 1. Descriptive statistics.

	Min	Max	Mean	SD	VIF
<i>Dependent variables</i>					
Relative employment from new firm formation (all sectors)	2.11	33.65	8.13	4.28	–
Relative employment from new firm formation (manufacturing)	0.09	10.80	1.76	1.16	–
Relative employment from new firm formation (logistics)	0.63	15.46	2.90	2.22	–
Relative employment from new firm formation (business services)	0.23	12.44	1.74	1.39	–
<i>Independent variables</i>					
Regional unemployment rate	0.00	9.74	0.15	0.61	1.04
Regional growth of income	–0.06	0.07	0.01	0.02	1.15
Regional employment per square kilometre	0.11	27.52	2.78	4.05	2.18
Share of industry in regional employment	0.05	0.72	0.33	0.11	2.94
Share of transport and logistics in regional employment	0.06	0.61	0.23	0.10	3.91
Share of business services in regional employment	0.06	0.55	0.21	0.08	1.57
Regional sectoral specialization	0.25	0.55	0.29	0.04	1.24
Regional R&D intensity	0	69.93	1.48	4.99	1.02
Regional level of education	1.75	2.21	1.92	0.08	3.01
Presence of polytechnic or university	0.00	1.00	0.09	0.29	1.75
Average local taxes	1636	11451	5277	1536	1.31
Supply of business estates	0	924	26.76	71.32	2.21

analyses are not independent, which leads to mis-specified models. Spatial econometric modelling techniques can control for spatial autocorrelation. In order to check whether this problem occurred in our dataset, tests for spatial autocorrelation were conducted (Table 3). By showing the level of spatial dependency of the municipal data, Moran's I test indicates whether or not spatial dependency is present (Anselin and Bera 1998).<sup>5</sup> The significant and positive values of Moran's I for all models indicate that spatial autocorrelation is indeed present in the data. Hence, the ordinary (non-spatial) model estimations for the models are potentially biased. Lagrange Multiplier tests indicate that for these models, a spatial lag model, rather than a spatial error model, is the most appropriate way of controlling for this spatial autocorrelation. Spatial lag models were estimated using Maximum Likelihood specifications rather than regular OLS-regressions. All models were checked for heteroskedasticity problems, which did not occur.

## Results

In total, spatial lag models have been estimated for four different rates of new firm formation. One for the total relative employment from new firm formation and one for each sector separately. For each rate of new formation, two types of models have been estimated. The first one includes the 'traditional' local determinants of income growth and unemployment, together with the knowledge-related

Table 2. Bivariate correlations ( $n = 427$ ).

	1	2	3	4	5	6	7	8	9	10	11
1 Regional unemployment rate	–										
2 Regional growth of income	0.00	–									
3 Regional employment per square kilometre	-0.10	-0.13	–								
4 Share of industry in regional employment	0.08	-0.09	-0.33	–							
5 Share of transport and logistics in regional employment	-0.08	0.03	0.55	-0.70	–						
6 Share of business services in regional employment	-0.06	0.22	-0.08	-0.23	-0.17	–					
7 Regional sectoral specialization	0.04	-0.12	0.07	0.31	-0.07	-0.26	–				
8 Regional R&D intensity	0.03	0.03	-0.19	0.08	-0.16	0.02	0.02	–			
9 Regional level of education	-0.12	-0.13	0.61	-0.54	0.74	-0.19	-0.08	-0.17	–		
10 Presence of polytechnic or university	-0.07	-0.17	0.55	-0.15	0.38	-0.19	0.06	-0.07	0.44	–	
11 Average local taxes	0.02	-0.19	0.35	-0.01	0.16	-0.11	0.04	-0.08	0.35	0.30	–
12 Supply of business estates	-0.06	-0.07	0.27	-0.04	0.17	-0.02	0.00	-0.07	0.22	0.39	0.32

Table 3. Spatial autocorrelation diagnostics.

Test	All sectors	Manufacturing	Logistics	Business services
Moran's I	4.022***	2.366**	5.694***	3.915***
Lagrange Multiplier (error)	7.842***	0.339	18.950***	5.672**
Robust LM (error)	0.084	1.063	1.169	0.0415
Lagrange Multiplier (lag)	12.585***	1.379	35.909***	7.423***
Robust LM (lag)	4.827**	2.594*	18.129***	2.167

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ .

variables (specification 1). The main goal is to determine whether regional differences in the presence of knowledge resources have an influence on local rates of new firm formation. The second model also includes variables that measure the presence of agglomeration economies and aims at testing whether the knowledge spillover theory of entrepreneurship holds when controlling for the presence of agglomeration economies (specification 2).

The results of these analyses are presented in Table 4. The results show that the explained variance is relatively high for cross-sectional models (up to 66%) with the exception of the model for the manufacturing sector. Moreover, the spatial lag variable is significant for the logistics model, the business services model and for the aggregated (total) model. In all of these cases, the clustering of successful municipalities is highest in the Amsterdam and Utrecht areas. In the case of logistics, this clustering is likely to be caused by the proximity of Schiphol Airport.

### *Economic growth and unemployment*

Growth of the local per capita income has a positive and highly significant effect for each individual sector as well as for the sum of all sectors. These findings indicate that increases in local demand stimulate new firm formation. New firms often derive a large proportion of their turnover from their local environment. Therefore, it comes as no surprise that an increase in local per capita income, which implies an increase in potential local demand, induces higher levels of employment from new firm formation (see for similar findings Guesnier (1994) and Audretsch and Fritsch (1994)). It should be noted, however, that even though this interpretation is valid for the broad economic sectors we distinguish, this is not necessarily the case for all sub-sectors. Especially for mass-production and process industries, local demand is much less relevant. In such sub-sectors, however, start-ups are very rare in the Netherlands as entry barriers are high and many of these activities have been relocated to low-wage countries over the last decade.

Local unemployment rates have a negative significant effect in the aggregated model. This finding contradicts the idea of unemployment serving as a supply factor for entrepreneurship (Devereux, Griffith, and Simpson 2007) but is in line with the idea that high levels of unemployment reflect relatively weak local economic conditions hampering the new firm formation (as also suggested in Guesnier (1994) and Garofoli (1994)). In the case of the three sectoral models, this negative significant effect is only found in Specification 1 for the business services. This finding points at the fact that the negative sign on the aggregated model is possibly caused by differences in sectoral composition between municipalities. Regions with

Table 4. Model results.

	Relative employment from new firm formation in:															
	All sectors				Manufacturing				Logistics				Business services			
	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	Specification	
Constant	-7.926*	-9.152	8.365***	2.999	-12.351***	2.249	-0.456	-7.315***	0.461***	0.369***	0.214*	0.145	0.610***	0.449***	0.314***	0.199**
<i>Economic growth and unemployment</i>																
Regional unemployment rate	-0.642***	-0.494**	-0.131	-0.127	-0.132	-0.141	-0.214**	-0.129	41.832***	33.344***	6.107**	8.918***	15.578***	13.733***	15.207***	10.240***
<i>Policy 'instruments'</i>																
Local taxes	0.001**	0.000	0.001***	0.000	0.000	0.000	0.000	0.000	0.008***	0.006**	0.001*	0.001*	0.004***	0.003***	0.002**	0.001
Supply of business estates																
<i>Regional knowledge base</i>																
Regional R&D intensity	-0.128	-0.052	-0.045	-0.037	-0.032	0.012	-0.033	-0.027	5.071**	-0.842	-4.179***	-1.909	6.697***	-2.477*	0.457***	2.069**
Regional level of education	1.624**	0.222	0.537**	0.318	0.477**	-0.379	0.058**	-0.009								
Presence of polytechnic or university																
<i>Agglomeration effects</i>																
Urbanization: Local employment density	-	0.206***	-	0.033**	-	0.103***	-	0.045***								
Localization: Employment share of manufacturing	-	6.797***	-	3.409***	-	-	-	-								
Localization: Employment share of logistics	-	15.579***	-	-	-	9.734***	-	-								
Localization: Employment share of business services	-	18.243***	-	-	-	-	-	9.984***								
Regional sectoral specialization	-	13.363***	-	0.312	-	3.178**	-	6.657***								
<i>Regional fixed effects</i>																
N	427	427	427	427	427	427	427	427	427	427	427	427	427	427	427	427
Adjusted R <sup>2</sup>	50.60%	59.80%	20.30%	27.40%	58.00%	66.40%	24.70%	47.30%								
Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000								

\*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.



large shares of employment from the manufacturing sector also show, on average, relatively high unemployment rates due to the decline in employment in this sector over the last decades; because the manufacturing sector also has lower start-up rates, the aggregated model might yield a negative relation between unemployment and employment from new firm formation. Such sectoral differences in the role of unemployment rates for new firm formation might partially explain the mixed findings regarding the impact of this variable in existing research (see for example Reynolds, Storey, and Westhead 1994).

### ***Policy instruments***

As expected for a country with a largely centralized tax system, the level of the local tax rate does not have a significant impact on the relative level of employment from new firm formation. Apparently, low local taxes do not stimulate new firms at the level of municipalities in the Netherlands. It is likely that the differences in local taxes are simply too small to influence the location choice of new firms. Studies that do find that local tax rates form an effective instrument for the stimulation of new firms are based on countries with a more decentralized tax-system (Neumark, Zhang, and Wall 2006).

The supply of business estates does have a significant effect with the expected positive sign. This indicates that supplying business estates either stimulates new firm formation on the municipality or attracts entrepreneurs that want to establish a new business from other municipalities. The only exception is the business service sector, for which no effects are found. This is likely to be due to the fact that business estates in the Netherlands are traditionally meant to house manufacturing and logistic firms. It should be noted, however, that the impact of supplying business estates is rather modest. Moreover, maintaining a large supply of business estates also comes at sizeable costs for the municipality (both in monetary as well as in land-use terms). Therefore, the efficiency of supplying business estates as a tool to stimulate new firm formation and economic development more in general is not very high (compare Neumark, Zhang, and Wall 2006).

### ***Regional knowledge base***

The first type of model (i.e. Specification 1) includes the knowledge base related variables but does not correct for agglomeration effects. In these models, the local R&D intensity does not have a significant effect on the overall and sectoral levels of new firm formation. Positive and significant effects of the presence of a polytechnic or university are found. This indicates that such higher education institutes positively influence the start-up rates in the municipality in which they are located. On the one hand this could be due to spin-off mechanisms; employees or (ex-)students of these institutes who start new firms. Often such firms have strong ties to the spin-out institute and therefore locate in its vicinity (Weterings and Koster 2007). On the other hand, start-up firms could also locate close to a university in the hope of getting access to knowledge and highly qualified labour.

For the aggregated model, the logistics model, and the business services model, significant positive effects of the regional level of education are found. For the manufacturing sector, however, we find a negative significant effect of the regional

level of education. This latter effect is likely to be caused by the fact that the largest share of manufacturing employment, and therefore of new manufacturing firms, is found in regions with relatively low levels of education, because these firms often utilize (large amounts of) low-skilled labour.

Altogether these results suggest that the knowledge spillover theory of entrepreneurship seems to hold to a large extent at the level of municipalities for the Netherlands. As predicted by this theory, regions with stronger knowledge bases, evidenced by the presence of a university, polytechnic or a high regional level of education, are indeed characterized by higher rates of employment from new firm formation.

### *Agglomeration effects*

The picture drastically changes, however, when the different variables for agglomeration economies are included in the model as well (Specification 2). With respect to urbanization effects, strong positive effects are found for all sectors as well as for the aggregated model. These findings indicate that highly urbanized regions do not only have more absolute employment from new firm formation, but also have higher levels of relative employment from new firm formation. This finding is in-line with the predictions of the incubator hypothesis as well as with findings of other studies for the Netherlands (Van Oort and Atzema 2004; Bosma, van Stel, and Suddle 2008). New firms indeed seem to prefer urban environments.

With respect to localization effects (i.e. specialization), strong positive effects are found as well. For each sector, it holds that a higher regional share of employment in a sector is beneficial for the regional relative employment from new firm formation in that sector. This implies that sectoral specialization is a self-enforcing process. Moreover, a higher level of regional specialization in general (in terms of the HHI-index) has a significant positive effect on the level of relative employment from new firm formation in both the aggregated model and the business services model. This implies that new business service firms are more often started in specialized regions, regardless of the sector in which the region is specialized.

Strikingly, the variables measuring local knowledge resources seem to have little effect when taking the presence of agglomeration economies into account. In contrast to the results of the models estimated with Specification 1, high regional levels of education now only have a positive effect on employment from new firms in business services, which is likely to reflect the fact that new firms in the business services are often set up by highly educated professionals. High regional levels of education have a weak negative effect, however, on employment from new firms in logistics.

Moreover, the presence of a university or polytechnic no longer has a positive effect, whereas it did in Specification 1. These results indicate that omitting the agglomeration variables has a large effect on the outcomes. Whereas the knowledge spillover theory of entrepreneurship seemed to hold in the first type of models, the effects of the strength of the local knowledge base disappeared when analysed simultaneously with indicators for agglomeration economies. This implies that empirical studies that do not take into account regional differences in terms of agglomeration effects can erroneously attribute effects to differences in the regional knowledge infrastructure.<sup>6</sup> With regard to the empirical validity of the Knowledge

Spillover Theory of Entrepreneurship at lower spatial scales, it seems necessary to disentangle the role of knowledge resources as source of entrepreneurial opportunities from agglomeration economies in general before conclusive statements can be made.

### **Discussion**

The research presented in this paper analyses the relative importance of different regional determinants of employment from new firm formation. In order to do so, we analysed the role of groups of possible determinants of regional differences in the share of employment of new firms for the period of 1999–2006 at the level of Dutch municipalities by applying spatial-econometric techniques. In this analysis several types of determinants have been included. Next to the ‘traditional’ factors such as income growth and unemployment rates, special attention has been given to the role of the strength of the regional knowledge base in order to empirically test The Knowledge Spillover Theory of Entrepreneurship and the role of agglomeration economies.

The most consistent determinants across all industries were found to be agglomeration economies and local economic growth. Both findings combined lead to the conclusions that economically strong regions reinforce their position both in terms of economic size as well as in sectoral structure. This implies that new firm formation is not likely to change existing (sectoral) patterns of employment, at least in the short run. The importance of the regional sectoral structure suggests that regional differences of entrepreneurship are largely a path-dependent process, which is in line with earlier findings (Brenner and Fornahl 2008). Furthermore, this finding is in line with a growing literature on the role of spin-offs as mechanism for the growth of agglomeration as initiated by Klepper (2007). In this line of research, former employees that start a new firm are considered to be an important element of new firm formation. Since these spin-offs tend to locate nearby their parent organization, new firm formation by spin-offs tends to reinforce existing spatial patterns of sectoral employment (Weterings and Koster 2007). These communalities in findings can be explained by the more general notion that economic structures are highly stable over time (path-dependent) and that, once locational fundamentals such as natural resources, have established the spatial pattern, increasing returns leads to a reinforcing degree of spatial differentiation (Davis and Weinstein 2002).

With regard to The Knowledge Spillover Theory of Entrepreneurship, it is found that the positive effects of the strength of the local knowledge base largely disappear when including variables for agglomeration economies. The results imply that the knowledge spillover theory of entrepreneurship does not seem to hold for the Netherlands and the role of the strength of the regional knowledge base should, at least for the Netherlands, consequently not be exaggerated. Furthermore, our results show that underspecified modelling in empirical studies can easily lead to over-estimating the role of the strength of the regional knowledge base. Therefore, future studies that aim at testing the knowledge spillover theory of entrepreneurship should take into account the traditional drivers of new firm formation and agglomeration effects as well; because not all studies found support for this theory have done so (Audretsch and Lehman 2005) and because the empirical support

for this theory is largely based on research in large countries, more empirical research in a different context is required before the final verdict regarding the validity of this theory can be given.

It is hard to pinpoint why the knowledge spillover theory of entrepreneurship does not seem to hold for the Netherlands. It is unlikely, however, that this is caused by the fact that regional differences within small countries, such as the Netherlands, are too small to matter. Earlier research has indicated that regional differences in such countries do have profound effects on the behaviour and performance of firms (Van Stel and Nieuwenhuijsen 2004; Boschma and Weterings 2005). More cross-national research is required to solve this issue. For the time being, however, our findings show that The Knowledge Spillover Theory of Entrepreneurship does not necessarily hold for all countries and regions. Therefore, (local) governments in countries where the knowledge spillover theory has not (yet) been proven to hold should be cautious when building their policy initiatives on the premises of this theory.

This study also suffers from some limitations, some of which can have an influence on our conclusions. First of all, we have measured the relative employment from new firm formation on the level of the municipality. By applying spatial econometrics, we have controlled for potential spatial autocorrelation. Implicitly, we hereby correct for the fact that the spatial level of aggregation of our analyses (i.e. the municipality) might be too low. In other words, our method of estimation does take into account the possibility that agglomeration effects operate at the super-municipal scale. However, we cannot correct for the fact that our spatial level of aggregation might be too high. Therefore, we cannot control for differences in knowledge bases and local entrepreneurship policies at work at lower spatial scales (e.g. the neighbourhood level). Moreover, we analyse only three broad economic sectors. It might be that regional differences in knowledge bases only have an effect on very specific, for example knowledge-intensive, sectors. Such nuanced effects might be crowded out by our aggregation of economic activities into four sectors.<sup>7</sup>

Finally, due to limitations of the dataset we decided to aggregate the data over the period 1999–2006. Even though we tried to minimize endogeneity problems by measuring all of our independent variables for 1999, this approach makes it difficult to establish the chain of causality. In order to make stronger inferences regarding causal relations between different variables it would be better to utilize the data as a panel-dataset. Doing so would allow us to relate changes in independent variables to changes in the relative employment from new firm formation (with time lags if appropriate). Given the fact that the LISA-databases are updated retrospectively, future versions of the dataset are likely to allow us to do so.

Despite these limitations, the main conclusion of this paper, that the traditional determinants of new firm formation, and agglomeration effects in particular, explain regional differences in relative levels from new firm formation better as compared to differences in the regional knowledge base, is robust and adds interesting insights to the literature on regional differences in new firm formation rates. This study especially emphasizes the need to incorporate different sets of determinants simultaneously in order prevent possible model under-specification. Moreover, it emphasizes the need to validate the knowledge spillover theory for entrepreneurship in more different contexts as well.

## Notes

1. For the province of Friesland in the Netherlands the dataset is unreliable regarding new firm formation. This is due to the fact that, during the time period under investigation, several changes in the registration procedure were adopted in this province. Therefore, this relatively peripheral province – with only few linkages to other locations in the Netherlands – has been dropped from the analyses.
2. Due to the exclusion of the province of Friesland, 427 municipalities are used in the analyses.
3. Unless otherwise noted, all explanatory variables are based on data obtained from the Dutch Central Bureau of Statistics ([www.cbs.nl](http://www.cbs.nl)).
4. This measure is calculated by taking: (1) the amount of employees with basis education only; (2) twice the number of employees with secondary education; and (3) thrice the number of employees with a tertiary education, summing these three numbers and dividing it by three (based on Raspe and Van Oort 2006). The resulting variable ranges from 1 (regions with only employees with basic education) to 3 (regions with only employees with tertiary education).
5. Testing and controlling for spatial dependency in municipal data has been done with an inverse quadratic distance weight matrix, which reflects the squared term of all centroid-to-centroid inter-municipal distances as the crow flies. Tests with other weight definitions (e.g. non-quadratic weight specifications) do not result in different outcomes (e.g. compare with Van Oort 2004).
6. The bias towards validating the knowledge spillover theory of entrepreneurship becomes even bigger when other groups of variables are excluded from the models as well as is evidenced by the alternative specifications reported in Appendix 2.
7. Similar analyses for only high-tech or knowledge intensive sectors cannot be performed due to the fact that the number of firms as well as start-ups in these sectors is too low to provide a suitable dataset for such analyses (i.e. too many zero's and very small denominators when calculating the relative employment from new firm formation).

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Appendix 1. Sector classification.

NACE-code	Description	Sector	NACE-code	Description	Sector
15	Food and beverage industry	Manufacturing	35	Transport industry (excluding cars)	Manufacturing
16	Tobacco industry	Manufacturing	36	Furniture industry	Manufacturing
17	Textile industry	Manufacturing	37	Recycling industry	Manufacturing
18	Clothing industry	Manufacturing	40	Electricity and water supply	Manufacturing
19	Leather goods industry	Manufacturing	45	Building and construction	Manufacturing
20	Timber industry	Manufacturing	51	Wholesale trade	Logistics
21	Paper industry	Manufacturing	60	Distribution over land	Logistics
22	Publishing and reproduction	Business services	61	Distribution over water	Logistics
23	Oil processing industry	Manufacturing	62	Distribution by air	Logistics
24	Chemical industry	Manufacturing	63	Distribution services	Logistics
25	Synthetic and rubber industry	Manufacturing	64	Telecommunications and postal services	Business services
26	Glass and ceramic industry	Manufacturing	65	Banks	Business services
27	Primary metal industry	Manufacturing	66	Financial services	Business services
28	Metal products industry	Manufacturing	70	Real estate intermediates	Business services
29	Machinery industry	Manufacturing	71	Moveable estates intermediates	Business services
30	Computer industry	Manufacturing	72	Computer-services	Business services
31	Electronics industry	Manufacturing	73	R&D	Business services
32	Audio and telecom industry	Manufacturing	74	Other business services	Business services
33	Medical instruments industry	Manufacturing			
34	Car industry	Manufacturing			



Appendix 2. Models per group of variables.

	Relative employment from new firm formation in:				
	All sectors	All sectors	All sectors	All sectors	All sectors
Constant	2.10***	2.49***	0.11	-9.46**	-11.48***
Spatial lag	0.46***	0.44***	0.48***	0.47***	0.37***
<i>Economic growth and unemployment</i>					
Regional unemployment rate	-	-0.86***	-	-	-
Regional growth of income	-	25.28***	-	-	-
<i>Policy 'instruments'</i>					
Local taxes	-	-	0.003***	-	-
Supply of business estates	-	-	0.011**	-	-
<i>Regional knowledge infrastructure</i>					
Regional R&D intensity	-	-	-	-0.05*	-
Regional level of education	-	-	-	6.05***	-
Presence of polytechnic or university	-	-	-	1.87***	-
<i>Agglomeration effects</i>					
Urbanization: local employment density	-	-	-	-	0.24***
Localization: Employment share of manufacturing	-	-	-	-	8.23***
Localization: Employment share of logistics	-	-	-	-	17.52***
Localization: Employment share of business services	-	-	-	-	20.92***
Regional sectoral specialization	-	-	-	-	12.12***
<i>Regional fixed effects</i>					
	yes	yes	yes	Yes	yes
N	427	427	427	427	427
Adjusted R <sup>2</sup>	36.9%	41.2%	44.8%	43.1%	56.0%
Significance	0.000	0.000	0.000	0.000	0.000

\*p < 0.10; \*\*p < 0.05; \*\*\*p < 0.01.