

The Geography of Innovativeness

- New product announcements in The Netherlands

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Abstract

Using the Literature Based Innovation Output indicator for innovation, we find that new product announcing firms in the Netherlands are spread geographically according to the eminence of the regional knowledge infrastructure and to localized agglomeration economies. By analysing similar relationships for younger firms, we are able to make a quite strong case about causation.

Keywords

Location factors, new product announcements, knowledge infrastructure, knowledge spillover

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1 Introduction

Due to continuous R&D efforts, innovative firms are allegedly highly competitive and fast growing in terms of employment and output (Geroski *et al.* 1993). Their R&D efforts and rate of growth constitute a relative comparative advantage for the countries of location and thus boost national economic growth. Some regions accommodate more innovative firms than others do. Despite regional efforts to attract innovative firms, the success stories are few in number. Regional characteristics are apparently important and cannot easily be changed. An important strand of research in the field of economic geography analyses regionalized economic activity. The regional accumulation of knowledge and locally occurring knowledge spillovers are major topics of such research (cf. Krugman 1995; Martin 1999). Three such knowledge-related elements, originating in the industrial district argument first developed by Alfred Marshall, are emphasized in the literature: the eminence of the regional labour market, agglomeration externalities, and characteristics of the regional knowledge infrastructure.

In this paper we examine the extent to which these three elements explain the spread of firms in innovative industries throughout the Netherlands. Some studies show that, in a technical sense, clusters of innovative firms do not exist in this country (Swann 1999; Wever & Stam 1999; Hoen 2001). We study the *tendency* to cluster: although there are no clusters, innovative firms tend to concentrate in particular regions (see Figure 1).

The Dutch case differs from other cases described in the literature. To anticipate the results to some extent, the Dutch case shows that, where physical distance is deemed less

important in location choices, *cognitive* distance becomes of greater significance (cf. Nooteboom 2000). This element, thought to be of increasing importance, is included in the study by examining the effects of the knowledge infrastructure on the geography of innovative economic activity. We show that material reasons for the spread of economic activity through the Netherlands, at least for innovative firms, become less important, indicating that the Netherlands is indeed an ‘urban field’; regional differences in material factor endowments do not seem to have any systematic impact on the location pattern of innovative entrepreneurial behaviour.

In section 2, the location factors deemed important in the literature are discussed. Section 3 presents the model with which the innovation location pattern will be explained. The results are discussed in section 4. Section 5 elaborates on the original model, testing the causality of relations between location factors and the location pattern. Section 6 concludes.

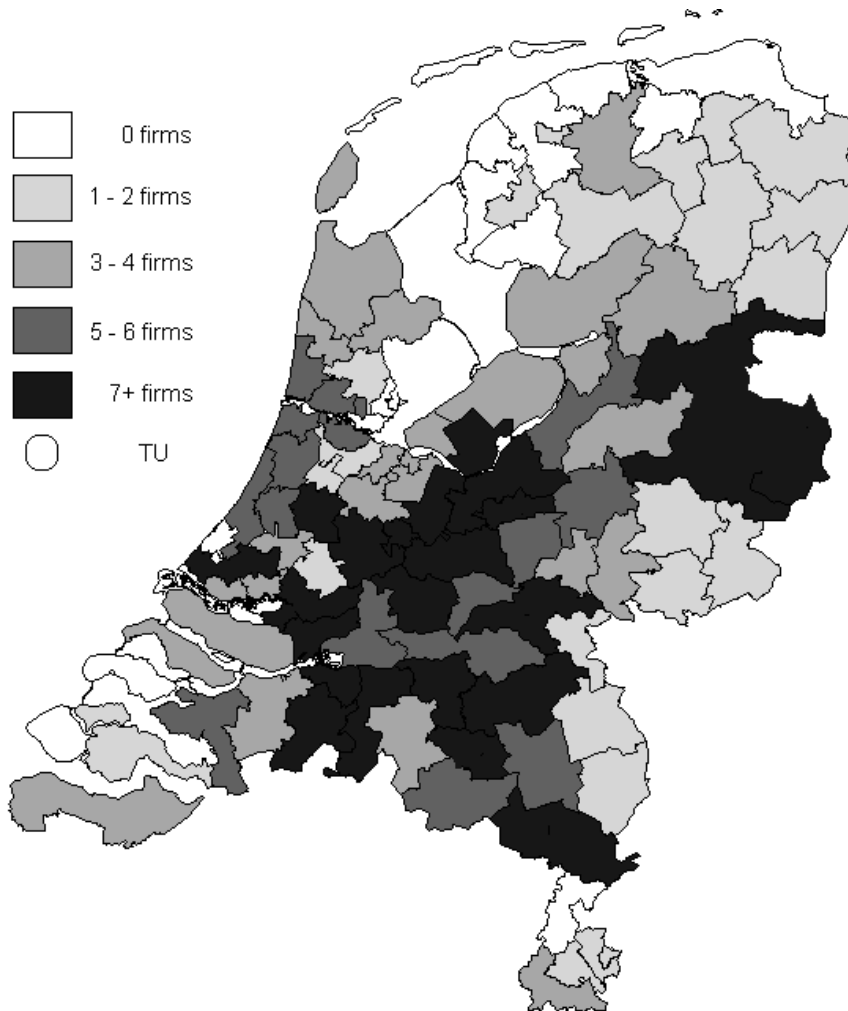
2 Location factors

Economic activity tends to have an uneven geographic spread. It is not surprising, therefore, that innovative firms are not evenly distributed across the Netherlands (see Figure 1). The literature generally recognizes three factors on the basis of which firms decide on their location. These are in line with Alfred Marshall’s (1920) industrial district argument. They are well understood nowadays and need little elaboration. Marshall has argued that the local labour market may have particular characteristics that are attractive to firms. The type of products and the production process used may require employees with particular skills and knowledge. Assuming that the labour market is not perfect and may be fragmented regionally as well as according to skills and knowledge, firms may not scatter evenly as would be the case in the perfect market of neoclassical economics. A second factor discussed by Marshall is that of agglomeration externalities. Suppliers to or buyers (customers) of a firm may be concentrated in a region. In the case of high transport costs, in

particular, agglomeration externalities may be strong. In what increasing numbers of observers call an (emerging) 'knowledge' economy, factors hinted at by Marshall, such as knowledge spillovers and things being 'in the air' in the context of a region, become more important.

In a knowledge economy, the first factor may take a different role. Various characteristics of potential employees in the region may become important. The need that they should respond adequately to the economic and technological dynamism has increased the demand for employees with a formal education. Professionalisation and the need for objective criteria regarding the selection of future employees illustrate the eminence of the regional labour market as a genuine location factor (Malecki 1991; Weiss 1995). Innovative firms in particular need professional employees who are trained in engineering. De Grip and Willems (1996) show that Dutch 'high-tech' firms indeed employ more professionals relative to medium- and low-tech firms.

Figure 1: Location pattern of new product announcing firms, by postal codes 2000-2002



Source: Delft University of Technology, 2002.

Agglomeration externalities may also differ in a knowledge economy. In addition to Marshall's industrial districts argument, agglomeration can offer a favourable environment for the innovating firm in which to create and sustain its knowledge base. As distance hinders the exchange of tacit knowledge (Jaffe 1989), the regionally-bound stock of tacit knowledge increasingly becomes a source of competitive advantage for the region (Maskell & Malmberg 1999). Moreover, proximity fosters collaboration (Fritsch & Schwirten 1999), which creates relations of trust among economic actors within the agglomeration (Harrison 1992). Hence, agglomerations not only offer the advantages of Marshall's 'traded linkages',

but possibly also the more elusive ‘untraded interdependencies’ (Storper 1997). As Hägerstrand (1967) has shown for Europe, innovations tend to be introduced in major cities and then spread across the urban hierarchy. More recently, it has been shown empirically that innovative activities tend to be concentrated in agglomerated milieux in the USA (Audretsch & Feldman 1996), the UK (Baptista & Swann 1998) and France (Carrincazeaux *et al.* 2001). As such, agglomerations are alleged breeding places for innovations (Brouwer *et al.* 1999). Geographical proximity may thus economise on communication and interpretation costs involved in the creation of new knowledge.

For innovative firms, particularly, the role of knowledge-creating and diffusing institutes such as universities and non-academic research centres, both private and public, could play an important role in understanding regional economic differences (c.f. Florax 1992). In line with other research, we conceive of (non-) academic research institutes as constituents of the regional knowledge infrastructure and as a separate location factor for innovative firms. Joint research projects, the spillover of research undertaken at these institutes, and the informal exchanges of (tacit) know-how are their main contributions to the regional knowledge base. As these effects are regional, innovative industries might benefit from knowledge spillovers if and when they locate nearby research institutes. Jaffe (1989), for instance, provides evidence that knowledge can spill over from university research to industrial R&D efforts (see also Audretsch & Feldman 1996; Mansfield & Lee 1996; and Anselin & Varga 1997). In Germany, the same holds for universities that engage in applied sciences (Engel & Fier 2000) as well as for non-academic research institutes (Fritsch & Schwirten 1999; Sternberg 1999). For our purposes, and from a theoretical point of view, it seems reasonable to separate knowledge infrastructure from the more general agglomeration effect. The course that modern economies in general take towards a knowledge economy is a more general argument in favour of including the knowledge infrastructure as an explanatory variable in our analysis.

Although our study is able to explain the location of innovative activity throughout the Netherlands, it should be clear that the set of location factors included is not exhaustive: the location pattern of innovative activity may also be affected by regional living amenities appreciated by qualified personnel, by the regional physical infrastructure and industrial zoning policies (cf. Ouwersloot & Rietveld 2000; Atzema 2001). These location factors reach beyond our interest, however.

3 The model

We use the Literature Based Innovation Output (LBIO) method as an indicator of innovation. By screening two successive volumes of 43 specialist trade journals for new product announcements, we count the number of announcing firms per Corop region.

Advertisements are precluded from the sample; only announcements published on the publishers' authority are counted. In the publishers' expert opinion, these products apparently embody surplus value over preceding versions or substitutes. To reduce the risk of counting spurious innovations even further, the announcements must report at least one characteristic feature from which the innovation adheres some superiority over preceding versions or substitutes (concerning either functionality, versatility or efficiency). Subsequently, the products' degree of innovativeness surpasses product differentiation. As we are concerned with innovative firms only, we excluded imported innovations from the sample by contacting the announcing firms to confirm the products domestic origin. Over the 2000-2002 period, this resulted in 398 valid counts of new product announcing firms.

In our model, we test whether the three sets of regional factors discussed in section 2 (labour market characteristics, agglomeration externalities and knowledge infrastructure) can explain the spread of new product announcing firms in the Netherlands, explaining the pattern in Figure 1. Malecki (1991) emphasizes the need for employees with a strong

technical background. We therefore use two indicators for the regional labour market: those who have a university degree (master's) or a degree from a polytechnic for vocational training (bachelor's) in a field of the natural sciences on the one hand, and those who have such a degree in a different field of study. Data provided by Statistics Netherlands are used for these indicators¹. Our hypothesis, deriving from the literature, is that the higher the proportion of BAs and MAs – technical or non-technical – in a region's labour force, the more likely it is that innovative firms will locate there. Although these labour market characteristics are correlated to some degree, tests show that this is not significant and does not preclude both variables from being included in the model².

In the literature, linkage-density parameters among proximate firms are used to catch the influence of agglomeration externalities (Richardson 1973). Inter-firm linkage density, however, is an inappropriate indicator for agglomeration. Agglomeration externalities enhance the local knowledge base, which is resembled by 'traded' linkage-density parameters to only a very limited extent (Malmberg & Solvell 1997). Indeed, for the Netherlands, it is acknowledged that inter-firm linkage density does not run parallel with physical proximity (Wever & Stam 1999; Atzema 2001; Heijs & Schmitz 2001). Rather than measuring linkage densities, we therefore test whether agglomerated regions accommodate more new product announcing firms compared to less agglomerated regions.

Manshanden's (1996) agglomeration index is used as an indicator of agglomeration externalities. It distinguishes five ordinal degrees of agglomeration externalities according to physical distances between a Corop region's central town and those in all other Corop regions, weighted by the region's population density. Similar to the linkage-density approach, this index does not capture all relevant dimensions of agglomeration externalities, e.g. the degree of specialisation, competition and diversity of the local production milieu (Ouwensloot & Rietveld 2000; Van Oort 2002). Nevertheless, the index

is used for reasons of data availability and comparability; other scholars in the field have also used it (Kleinknecht & Poot 1992; Manshanden 1996; Brouwer *et al.* 1999).

Our third hypothesis is that the regional knowledge infrastructure, measured by number of knowledge institutions in Corop regions, is conducive to innovative economic activity in a region. We delved more deeply into what it is about the knowledge infrastructure that attracts innovative firms to locate in one region rather than another. In particular, we test whether the presence in a region of a university, a technological university or non-academic private research institutes³ (for agricultural, medical, scientific and societal research) makes a difference in terms of innovative activity. The Netherlands has 11 universities without any clear focus on technology and a further 4 universities of technology in Delft, Enschede, Eindhoven and Wageningen. Non-academic private research institutes add up to 1820 in total.

Estimation results hinge on the level of aggregation applied, especially regarding agglomeration externalities (Van Oort 2002). We analyse both dependent and explanatory variables at the regional level of Corop, distinguishing 43 regions that are relatively homogeneous though aggregated in economic terms. Alternatively, the focus might be on a more local level, such as city or postal code. It does not seem, however, that such more disaggregated geographical demarcations are more economically homogeneous. Moreover, as the Corop level is the prevailing level of analysis in Dutch research on economic geography, its use makes this analysis more comparable to other studies.

The data used allow for use of count data-technique, which is consistent with the Poisson-distributed counts of new product announcing firms per Corop region (N=43). The explanatory variables relate directly to the factors deemed important in the theory. Table 1 presents the results of our count model:

$$E(y_i | \mathbf{x}_i) = \exp(\mathbf{x}_i\beta) \text{ for } y_i = 0, 1, 2, \dots$$

where y_i = number of new product announcing firms per Corop region

where \mathbf{x}_i ' = [share of technicians in regional labour force, share of bachelors and professionals in regional labour force, degree of agglomeration, number of private research institutes, presence of university, presence of technological university]

Table 1: Count model explaining the number of new product announcing firms per Corop region

		Number of new product announcing firms (Fig. 1)		percent change in expected count
		Beta	z-value	
Labour market	Technicians	-0.042	-1.00	n.s.
	Bachelors and professionals	-0.001	-0.07	n.s.
Agglomeration externalities	Agglomeration Index			
	category 1	-	-	
	category 2	1.897	1.80*	+ 567
	category 3	2.540	2.50**	+ 1167
	category 4	3.007	2.94**	+ 1923
	category 5	2.722	2.60**	+ 1421
Knowledge infrastructure	Private research institutes	0.004	3.27**	+ 0.4
	University	0.368	2.18**	+ 45
	University of technology	0.989	5.45**	+ 169
Adjusted R-squared		0.37		

* significant at 10% level ** significant at 5% level n.s. not significant

4 Results

The eminence of the regional labour market does not prove explanatory; the supply of highly skilled labour (technicians or non-technicians) does not add to the regions' innovativeness. As other studies indicate that labour markets are an important factor in deciding the attractiveness of various regions (c.f., Malecki 1991, Weiss 1995), the Netherlands stand out in this respect. Observations on the Amsterdam region, with relatively many new product announcing firms as shown by Figure 1, corroborate our results about the labour market: a third of Amsterdam's labour force does not live in the region and commutes to and fro (Van der Vegt *et al.* 2000). Indeed there was in the Amsterdam region during 1988-1993 an increase in numbers of 'higher technicians, mathematicians and natural scientists' (Van der Vegt *et al.* 1995). Indicating considerable

willingness to commute, this is consistent with our finding that regional labour market characteristics are not explanatory.

Contrary to the above, agglomeration externalities do explain the location of innovative activity: the coefficients are positive and increase as the agglomeration advantages materialize. This agrees with results obtained by Brouwer *et al.* (1999) using the same indicator of innovation. For specific sectors, however, its explanatory power may not hold. For the Dutch ICT sector for instance, agglomeration externalities are found to arise almost throughout the Netherlands (Atzema 2001).

In addition, a region's knowledge infrastructure does make a significant difference. The positive effect of the presence of non-academic research institutes is consistent with Winter's (1984) argument that innovative economic activity is science-based. This finding contradicts partly with Engel & Fier (2000), who observe that regions with non-academic research institutes do not accommodate many high-tech start-ups. With respect to the academic knowledge infrastructure, we find that universities of technology add to the regional innovativeness far more significantly compared to universities without a clear focus on exact sciences. This contrasts with international research (Engel & Fier 2000), but corroborates results obtained by Ouwersloot & Rietveld (2000) for the Dutch case.

The model presented in Table 1 explains nearly 40 percent of total variance in the expected regional count of new product announcements. The remaining unexplained variance may be accounted for by additional location factors earlier-mentioned, such as living amenities, physical infrastructure and industrial zoning policies.

5 Discussion: causation

Statistical significance is not synonymous to scientific significance (cf. McCloskey & Ziliak 1996). In order to stand on firmer ground in our claim that the pattern for the spread of innovative activity throughout the Netherlands can be explained by the presence or

absence of either of three variables, we shall present some additional tests. Our data allow us to discriminate among ages of firms and to disentangle the process of cumulative causation that underlies geographical clustering. Is an economic activity located in a particular region because of its specific characteristics, or does the region apparently have attractive characteristics (partly) as a result of the firms that are located there? Assuming that the decision to start a firm at a specific location is a rational one, weighing all important costs and benefits, it makes sense to study the clustering of younger firms. The model presented earlier has been regressed for firms younger than 10 years (145 firms). Ten years is a threshold as during that period a knowledge base or absorptive capacity of some kind can be assumed to have been established. Subsidiaries of foreign firms in the Netherlands, for instance, irrespective of sector, move to another location in the Netherlands within few years in order to take advantage of the knowledge infrastructure in the new location (Wintjes 2001).

Table 2: Count model explaining the number of young new product announcing firms per Corop region

		Number of new product announcing firms (Fig. 1)		percent change in expected count
		Beta	z-value	
Labour market	Technicians	-0.042	-0.64	n.s.
	Bachelors and professionals	0.011	0.68	n.s.
Agglomeration externalities	Agglomeration Index			
	category 1	-	-	
	category 2	1.243	1.12	n.s.
	category 3	1.210	1.16	n.s.
	category 4	1.624	1.53	n.s.
	category 5	1.459	1.29	n.s.
Knowledge infrastructure	Private research institutes	0.005	2.30*	+ 0.5
	University	0.124	0.41	n.s.
	University of technology	1.326	4.49*	+ 276
Adjusted R-squared		0.31		

* significant at 5% level n.s. not significant

Regional labour market characteristics are clearly not relevant, as is the case for the whole sample of firms. The importance of agglomeration externalities however does discriminate against age; whereas older firms do appreciate the heavier agglomerated milieu (Table 1), young innovative firms are by no means attracted by agglomeration externalities (Table 2). Apparently, innovative firms do not reside in heavier agglomerated milieu to take advantage of agglomeration externalities. We therefore reject any claim of causality on this matter.

A strong case about causality can be made for two constituents of the regional knowledge infrastructure. Both non-academic research institutes and, particularly, universities of technology attract young innovative firms. Whereas the impact of universities of technology for the whole sample is already quite impressive - 170 percent increase in expected regional counts (Table 1) - for young firms the increase amounts to 280 percent (Table 2). As Corop regions that accommodate universities without a clear focus on

technology do not attract young innovative firms, these universities do not prove causal for new innovative initiatives.

6 Concluding remarks

Of the three factors recognised in the literature – labour market, agglomeration externalities and knowledge infrastructure –, the first is not explanatory for the spread of new product announcing firms throughout the Netherlands. On this matter, we agree with other research that the Netherlands is an ‘urban field’.

Agglomeration externalities however do discriminate against the number of new product announcing firms per Corop region. As the agglomeration externalities materialize, the more the environment is favourable for innovative entrepreneurial behaviour. We cannot prove causality though: as opposed to older firms, younger innovative firms seem to locate irrespective of regional agglomeration externalities.

The eminence of the regional knowledge infrastructure - with non-academic research institutes, universities and technological universities as its constituents - proves explanatory for the spread of new product announcing firms throughout the Netherlands. For two of these elements we have indications of causality: non-academic private research institutes and technological universities favour the foundation of innovative firms within the region.

As proximity appears relevant only for specific knowledge relations, the role of proximity in those relations can be considered odd.

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1 Survey Labour Force / Enquête beroepsbevolking (CBS 1999).

² Variance Inflation Factors (VIF) are below critical levels. This also applies to the correlation between labour market characteristics and the regional knowledge infrastructure.

³ Data are provided by Marktselect plc (2002).