Are Local Milieus the Key to Innovation Performance?

Hanna L. Binz and Dirk Czarnitzki

ZEW

Zentrum für Europäische
Wirtschaftsforschung GmbH

Centre for European
Economic Research

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Non-technical Summary

Based on the general theory of location a new theory of economic geography, regional economic performance and growth has emerged. The focus of recent studies has shifted from analyzing performance of regions that varies because of naturally given resources towards analyzing factors affecting the development of regions. Besides, studies at the regional level, more recently, investigation has been further broken down to the firm level. Since the early days of location theory locational characteristics have been regarded as important for firm performance. However, it has also been argued that the importance of geographic proximity may decrease as industries become more knowledge intensive and as communication systems become highly sophisticated. Therefore, knowledge intensive activities such as innovation recently attracted more attention in this discussion. Yet, results from empirical studies aiming at providing a regional economics perspective on innovation performance, are often inconclusive or controversial. It appears challenging to identify regional factors driving innovation success at the firm level.

This study takes the approach of explaining success of firms in turning knowledge into marketable products by the firms' local innovation milieus. Thereby, we assume that agglomeration economies may play an important role for this transfer process. As suggested by the literature on regional innovation systems, some locational factors seem to be of special importance for firms' innovation activities. In particular, locational factors facilitating intended knowledge transfer and knowledge spillovers. Sources of knowledge spillovers may not only be universities and research institutions, but also qualified personnel in an industry, customers, suppliers or competitors, as well as collaboration partners that generate positive knowledge externalities.

Our objective is to identify the most important factors of the firms' local milieus for successful innovation activities. Further, we compare factors assumed to affect all firms uniformly to perception based factors as we assume that firms judge the attractiveness of locations by a heterogeneous set of criteria. This allows modeling of firms utilizing location factors to different extents.

We focus on firms in the region of Flanders, where survey data provide us with information on factors that were highly relevant for the firms' location decisions and well as information on their innovation performance. In addition, we use data at the regional level to construct regional indicators that may affect innovation performance. This allows comparing the two concepts of perceived location factors versus "real" geographical differences.

By taking firms' awareness of their location milieu and thus their utilization of the respective factors into account, we are able to identify effects of local availability of highly skilled labor force as well as effects of the proximity to suppliers in the region. Our results also show that locational factors obtained from the survey provide more accurate explanation on how local milieus facilitate innovation than regional characteristics that are assumed to affect all firms uniformly. Our results illustrate that perception - reflecting awareness and utilization - is important for explaining organizational behavior and also applies to how regional characteristics affect innovation success.

Das Wichtigste in Kürze (Summary in German)

Im Zuge wachsender Bedeutung wissensbasierter Industrien in entwickelten Volkswirtschaften wandelt sich der Fokus regional-ökonomischer Studien. Während in klassischen Untersuchungen Unterschiede in regionalen Entwicklungen eher auf die Verteilung natürlicher Ressourcen zurückgeführt wurden, werden heutzutage andere Faktoren wie Regionalpolitik, Firmennetzwerke, Humankapital, Infrastruktur etc. für die Entwicklung von Regionen berücksichtigt. Eine besondere Rolle werden auch Innovationen für den regionalen technischen Fortschritt beigemessen. Darüber hinaus gewinnen neben Studien auf regionaler Ebene mikroökonomische Analysen auf der Firmenebene an Bedeutung.

In der Diskussion über die Rolle regionaler Charakteristika für die Leistungsfähigkeit von Unternehmen wurde in der Literatur argumentiert, dass die Relevanz lokaler Gegebenheiten für wissensintensive unternehmerische Aktivitäten - auch in Anbetracht fortschrittlicher Informations- und Kommunikationstechnologien - geringer werden könnte. Aus diesem Grund ist der Einfluss lokaler Milieus insbesondere auf den Erfolg wissensintensive Aktivitäten von großem Interesse. Insbesondere stehen Faktoren im Fokus, die Wissenstransfer oder Wissensspillovers fördern. Empirische Studien liefern jedoch häufig keine schlüssigen oder gar kontroverse Ergebnisse bei der Identifizierung bedeutender Regionalfaktoren, die den Innovationserfolg auf der Unternehmensebene begünstigen.

Diese Studie verfolgt einen neuen Ansatz zur Untersuchung regionaler Einflussfaktoren auf den unternehmerischen Innovationserfolg. Ziel dabei ist es, die wichtigsten Faktoren lokaler Innovationsmilieus für die erfolgreiche Markteinführung innovativer Produkte zu identifizieren. Dabei berücksichtigen wir, anders als in früheren Studien, dass lokale Gegebenheiten nicht alle Unternehmen gleichermaßen beeinflussen müssen.

Unternehmensdaten aus Flandern (Belgien) geben uns dabei Informationen über den Innovationserfolg und die lokalen Faktoren, die nach subjektiver Einschätzung von besonderer Bedeutung für diese Unternehmen im Hinblick auf ihre Innovationsaktivitäten sind. Die zusätzliche Untersuchung „realer" regionaler Indikatoren ermöglicht den Vergleich der Konzepte von wahrnehmungsbasierten und regionaldatenbasierten Einflüssen.

Unter Berücksichtigung der individuellen Wahrnehmung und in Anspruchnahme regionaler Faktoren können in der Tat Effekte lokaler Milieus für wissensintensive Unternehmensaktivitäten, wie die geographische Nähe zu Zulieferern und die Verfügbarkeit hochqualifizierter Arbeitskräfte, identifiziert werden. Darüber hinaus zeigen wir, dass die auf Wahrnehmung basierenden Indikatoren größere Erklärungskraft hinsichtlich des Einflusses lokaler Milieus auf den Innovationserfolg haben als tatsächliche geografische Unterschiede, denen in regionalökonomischen Studien typischerweise die Annahme zugrunde liegt, dass sie die Leistung aller Unternehmen im gleichen Ausmaß beeinflussen. Unsere Ergebnisse verdeutlichen daher die Bedeutung wahrnehmungsbasierter Indikatoren für die Untersuchung von Einflüssen regionaler Faktoren auf Unternehmenserfolg.

Are local milieus the key to innovation performance?

Hanna L. Binz [a,b] and Dirk Czarnitzki [a,b,c]

a) K.U. Leuven, Dept. of Managerial Economics, Strategy and Innovation, Belgium
b) Steunpunt O&O Indicatoren at K.U.Leuven
c) Centre for European Economics Research (ZEW), Mannheim, Germany

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Abstract

This study investigates how local milieus foster innovation success of firms. We complement the common practice of linking firm performance indicators to regional characteristics with survey evidence on the perceived importance of locational factors. While the former approach assumes that location characteristics affect all firms in the same way, the survey allows us to model firms judging the attractiveness of locations by a heterogeneous set of criteria. It turns out that the availability of highly skilled labor and the proximity to suppliers matters for firms' innovation performance. Interestingly, location factors obtained from the survey provide a more accurate explanation on how local milieus facilitate innovation.

Hanna L. Binz   Dirk Czarnitzki
K.U.Leuven   K.U.Leuven
Steunpunt O&O Indicatoren   Dept. of Managerial Economics, Strategy and Innovation
Dekenstraat 2   Naamsestraat 69
3000 Leuven   3000 Leuven
Belgium   Belgium
Phone: +32 16 325 793   Phone: +32 16 326 906
Fax: +32 16 325 799   Fax: + 32 16 326 732
E-Mail: hanna.binz@econ.kuleuven.be   E-Mail: dirk.czarnitzki@econ.kuleuven.be

1   Introduction

Based on the general theory of location (e.g. Lösch, 1938), a new theory of economic geography, regional economic performance and growth has emerged (e.g. North, 1955, Shefer and Frenkel 1998, Acs 2000, Acs and Varga 2002, Fujita and Thisse 2000). The focus of recent studies has shifted from analyzing performance of regions that varies because of naturally given resources and the resulting comparative advantages in trade towards analyzing factors affecting the development of regions. Most prevailing, the development of new technologies, products or services (see Kleinknecht and Poot 1992, Roper and Thanki 1995, or Hassink 1993, Grossman and Helpman, 1990a,b, 1994). The main objective of this branch of research is to examine and understand locational factors that enable certain regions to develop better or faster than others. Besides, studies at the regional level, more recently, investigation has been further broken down to the firm level. Since the early days of location theory locational characteristics have been regarded as important for firm performance. However, it has also been argued that the importance of geographic proximity may decrease as industries develop towards being more knowledge intensive and as communication systems become highly sophisticated. Therefore, knowledge intensive activities such as innovation recently attracted more attention in this discussion (Feldman 1994, Audretsch and Feldman 1996, Audretsch 1998, Feldman and Audretsch 1999). Yet, results from empirical studies aiming at a regional perspective on innovation performance are often inconclusive or controversial. It appears difficult to identify regional factors driving innovation success at the firm level. For example Love & Roper (2001) find no effect from regional R&D intensity, R&D collaboration or industry employment on innovation activities for UK and Ireland.

This study focuses on regional characteristics affecting innovation performance of firms. Such factors external to the firm shape the 'local innovation milieu' (Shefer and Frenkel 1998) of firms and subsequently impact firms innovation performance in a region.

As suggested by the literature on regional innovation systems, some locational factors seem to be of special importance for firms' innovation activities. In knowledge-based economies the crucial resource is knowledge that can be generated and transmitted within and across industries. Thus, Locational factors facilitating intended knowledge transfer and knowledge spillovers may be relevant impact factors on firms' innovation performance. Sources of knowledge transfer may not only be universities and research institutions, but also qualified personnel in an industry, customers, suppliers or competitors, as well as actual and potential

collaboration partners that generate positive knowledge externalities to the R&D department. Inter- or intra-industry-spillovers, information and human resource advantages may increase firms' innovation propensity in some regions and if they innovate make their innovation outcome more successful, which finally enhances regional economic growth.

This study takes the approach of explaining success of firms in turning knowledge into marketable products by the firms' local innovation milieus. Thereby, we assume that agglomeration economies may play an important role for this transfer process. Our objective is to identify the most important factors of the firms' local milieus for successful innovation activities. Further, we compare factors assumed to affect all firms uniformly to perception based factors as we assume that firms judge the attractiveness of locations by a heterogeneous set of criteria. This allows modeling of firms utilizing location factors to different extents.

We focus on firms in the region of Flanders, where survey data provide us with information on factors that were highly relevant for the firms' location decisions and well as information on their innovation performance. In addition, we use data at the regional level to construct regional indicators that may affect innovation performance. This allows comparing them to the respective survey location factors of the perceived importance of those regional factors.

Section 2 of this article gives an overview of the literature, describes distinctive features of the region of Flanders and outlines the conceptual framework of this study. Section 3 describes our data and section 4 presents the econometric approach and estimation results. We conclude in section 5.

2   Background and conceptual framework

2.1   Literature review

The allocation of production and industry in geographical clusters is not a recent phenomenon. Many examples for industries that are concentrated in space can easily be found. In the early days of location theory, in principle consisting of the work of Thünen, Weber, Lösch and some others, the role of transport cost as (most) important part of relative cost of production in forming regional economic activities was strongly emphasized. In markets where the transportation of raw materials or goods is substantially costly, location of industrial activity is pre-determined by the location of natural resources. Therefore, export opportunities resulting from comparative advantages in the geographic area shape economic activity in regions. North (1955) analyzes regional economic growth based on the principles

of location theory, combining location theory and theory of regional economic growth. Thus, differences in production structure, spatial concentration of activity, and performance of regions were explained by underlying characteristics such as infrastructure, natural resources or the availability of labor. Based on the general theory of location, a new theory of geography, locational economic performance and growth emerged. While earlier studies aimed at explaining differences in growth between regions by differences in aggregated export activity, more recent contributions focus on determining which locational factors foster economic success of a region. Consequently, the focus shifted from analyzing conditions of regions that vary because of naturally given resources and the resulting comparative advantages in trade towards analyzing factors affecting the development of regions. Among such factors, the development of new technologies, products or services was prevailing. Recently, not only the performance of regions as a whole has been in the centre of interest. The matter of investigation has been further broken down to assessing the performance of firms or industries in a region given certain locational factors. Research in the field of regional economics has especially stressed the importance of locational factors such as the availability of input factors like labor force and capital as well as the efficiency of transportation systems. Most recently the efficiency of communication systems has been added to this list (for example, Shefer and Frenkel 1998, Acs 2000, Acs and Varga 2002, Fujita and Thisse 2000 or Ottaviano and Puga 1998 for a more extensive discussion of the literature).

The rather simple principles of the early contributions to location theory are put into question in times when intellectual property, human and financial capital are the most important input factors. Consequently, advances in communication technology and its role in the process of technological change and the diffusion of innovation have influenced the literature on the economics of location (for example Audretsch and Feldman 1996 or Autant-Bernard 2002). For some time it was argued that the importance of locational factors would decrease with the emergence of information and telecommunication technologies. Theoretical and empirical work has reacted to this preconception arguing that the importance of local proximity is not declining since global competition increases the value of knowledge-based economic activity (for example Audretsch 1998, Basevi and Ottaviano 2002, or Autant-Bernard 2002 for a discussion). Knowledge as opposed to information may be generated and transmitted less efficiently over longer distances so that innovation success may therefore still be to a great extent reliant on local factors (for example Baptista and Swann 1998, Cohen and Levinthal

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1989). While marginal cost of transmitting information across geographic space have in fact significantly decreased, the marginal cost of transmitting knowledge, and especially tacit knowledge, still rise with distance (for example Audretsch 1998 and von Hippel 1994).

Stuart and Sorenson (2003), explaining firm co-location in high-technology industries, suggest that industries cluster, because entrepreneurs may have difficulties to access essential resources and benefit from making use of social and professional ties. However, they find that locational factors that promote firm founding rates in a certain region may differ from those factors which are essential for firm performance in that region. Thus, analyzing firm performance and how it is affected by different locational conditions, leads to analyzing the direct effects of locational determinants. This includes also incentives set through governmental policies as well as investment incentives that stem from factors that are already a result of given locational productivity drivers.

A variety of theoretical and empirical studies show the effects of agglomeration and localization economies on production efficiency (Shefer 1973, Richardson 1974 or Sveikauskas 1975, Harhoff 1999 and Rosenthal and Strange 2001). Agglomeration economies can be described as positive returns to scale at regional level, e.g. the advantage to locate in a particular area increases with the number of firms in this area. Agglomeration economies can be the result of firms benefiting from more specialized suppliers in areas with a higher industry concentration (Marshall 1920) or of the existence of localized knowledge externalities (Jaffe et al. 1993, Ellison and Glaser 1999).[1]

The motivation for analyzing these questions lies in the relevance of such findings in the design of regional development policies aiming at fostering innovation in different regional settings.

Strange et al. (2006) address the aspect of uncertainty-driven agglomeration. The need for skilled workers and technological innovativeness are prominent examples of such forces. Interestingly, they find that the agglomeration force of the latter is associated with city size while the former one relates to industry clustering. Thus, firms facing uncertain needs for specialized labor skills benefit from agglomeration while technological uncertainty

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[1] Rosenthal and Strange (2003a,b) provide an extensive overview on the literature on agglomeration economies. Essletzbichler and Rigby (2007) for an overview of the literature on economic geography and the regional dimension of technological change from an evolutionary perspective.

encourages agglomeration forces (see also Jaffe et al. 1993 and Audretsch and Feldman 1996). The authors use data from the 1999 Canadian Survey of Innovation that provides information on firms' perceptions of their competitive environments and success factors. The authors' approach differs from existing agglomeration studies (such as Henderson et al. 1995, Henderson 2003, and Rigby and Essletzbichler 2002) in the way that they incorporate firm perception. However, the aspect of innovation performance of firms has not been addressed in any of these studies.

The role of technological innovation and its positive impact on competitiveness, development and growth of regions has been of substantial interest in numerous articles (for example Davelaar and Nijkamp 1989, 1992, Feldman 1994a, Frenkel and Shefer 1997, Feldman and Kutay 1997, Davelaar and Nijkamp 1997, Ciccone and Hall 1996, Baptista and Swann 1998 and Porter 1998). Grossman and Helpman (1990a, and b, 1991, 1994) for example, state that regions with a high level of innovation grow faster than comparable regions with low innovation rates. Looking at the story from a firm perspective, the potential importance of a firm's locational environment for its innovation activities has increasingly attracted attention (for example Kleinknecht and Poot 1992, Hassink 1993, Roper and Thanki 1995). Among these studies Roper et al. (2000) find no support for the hypothesis that industry concentration positively influences innovation propensity of firms in the UK although they do find, besides industry R&D intensity, participation in inter-firm networks and regional industrial composition to be significant. Moreover, they find a positive impact of the share of regional employment in small firms on firms' innovation activity indicating the importance of smaller firms for regional innovation performance.

A firm's rate of innovation is likely to be affected by internal factors such as its age, size, industry and its R&D-intensity and by factors external to the firm. Shefer and Frenkel (1998) define the sum of external factors as the 'local innovation milieu'. These factors include the rate of local innovation, the degree of cooperation and collaboration among firms. They find that R&D-intensity and a skilled labor force have a significant positive affect on innovation propensity. Moreover, they find that young firms are more likely to innovate in high- but not in low-tech industries indicating that the effects of agglomeration and localization on the degree of innovation are stronger in industries were knowledge is presumably more codified or even tacit. Love and Roper (2001a) extend these analyzes by considering the influence of locational factors in outsourcing decisions in the innovation process. However, they find little evidence that locational factors play a role for such outsourcing decisions. Feldman and

Audretsch (1999) investigate the question whether diversity or specialization of economic activities in a region better promote innovation. They come to the conclusion that diversity across complementary industries, presumably gaining from inter-industry knowledge spillovers, best promotes innovation activity (see also Jacobs 1969).

Audretsch and Feldman (1996) emphasize that firms may consider the effectiveness of potential spillovers on their location decision and that this may be especially important in industries where generation of new economic knowledge is of relative high importance. This argumentation has also drawn the attention to university presence as locational factor (for example Anselin et al. 1997, 2000, Feldman 1994b and Fischer and Varga 2003, Varga 2000, 2001 or Huffman and Quigley 2002). Zucker et al. (1998) using data from the Californian biotechnology sector find a positive impact of research universities on firms located nearby. They conclude that this results not (only) from general R&D knowledge spillovers as suggested by "New Growth Theory", but particularly from collaboration and intended knowledge transfer between scientists and industry. They point out the fact that star scientists are not simply located geographically close to biotechnology clusters, but also frequently engaged in such companies as founders, employees or consultants. Audretsch et al. (2003) link locational choice as a strategic firm decision to knowledge externalities in general and spillovers from universities in particular. They conclude that geographic proximity may be important in accessing human capital embodied in university graduates who may serve as a spillover mechanism. Their results suggest that a firm's locational proximity to a university affects firm performance especially if knowledge generated in the university is codified and specific. Their results furthermore illustrate that geographic proximity to certain locational factors is a key element of firm strategy and that locational choice shapes firm performance, especially of young firms. Estimating innovation production functions for UK, German and Irish manufacturing plants, Love and Roper (2001b) find evidence that regional factors influence the efficiency with which R&D activities are translated into successful innovation. However, their analysis does not support the hypothesis that networking activities, R&D co-operation or agglomeration supports innovation performance, while intra-group links are important determinants of innovation success.

As pointed out by the literature in the field of knowledge transmission and innovation, the choice of location for a firm's innovation activity may be of special importance for its innovation performance. Duranton and Puga (2001) theoretically and empirically analyze how innovative activities, in particular process innovations, are affected by the role of diversified

urban environments. Their (French) data supports the idea that production moves from diversified to specialized locations over the product life cycle. This underlines the importance for industrial diversification in the early phase of any innovation activities. Thus, Duranton and Puga (2001) show, that firms' location for innovative activities underlie special requirements. They further illustrate how, if diversified and specialized urban areas coexist, the former type of cities serve as nursery for the latter by providing a fruitful experimentation environment. Although the authors conclude that neither diversification nor specialization alone can be identified as 'best urban economic structure', their findings can be interpreted with respect to innovation performance that diversification is more likely to promote innovation performance as it takes place in early stages the product life-cycle.

However, the importance may not only vary over the product life-cycle, but the perceived importance of certain locational characteristics may vary across firms and industries. Hellriegel and Slocum (1974) argue that perceptions are more important for explaining organizational behavior than objective conditions. Moreover, for example, Meester (2000) argues that "from a behavioral point of view, the willingness of entrepreneurs to move to a certain region is not depending on the real qualities of a region but on their perception, their image of those qualities". This aspect has so far been neglected in the literature in the context of 'local innovation milieus'. In the following analysis we explicitly take this aspect into account.

2.2 The region of Flanders and the history of its innovation policy

The region of Flanders, located in the north of Belgium, exhibits special characteristics that make it a particularly interesting region to study the interaction of local milieus and innovation performance.

First, its advantageous geographical location in Northwest Europe and its regional characteristics distinguish it from other European regions. Flanders covers an area of 5,221 square miles (13,522 km²) and is one of the densest populated areas in Europe with 1,160 people per square mile (455/km²). Flanders is divided into 5 provinces of (see table A3 in the appendix). Remarkably, these subareas are quite homogenous in terms of size, population density, physical infrastructure and number of universities. The region's attractiveness for foreign direct investment is also to great extent due to Flanders's geographical location in Europe (OECD 2005). Additionally, the harbor of the city of Antwerp is the largest harbor for non-containerized general cargo in Europe. According to the classification of international maritime traffic in 2005 the Port of Antwerp is the world's fifth largest harbor. Its location

contributes to the attractiveness of the region for companies that distribute their goods throughout Europe. This is due to the fact that a large share of the European Union's purchasing power is located in close distance (mainly Germany, United Kingdom, France and The Netherlands). Thus, the harbor ranks first in the 'centrality index for the ports of the Le Havre-Hamburg range'.

Second, besides these geographical traits, Flanders has demonstrated an increasing commitment towards fostering regional technological innovation over the past years that raise research interests in that field (Smits et al. 2006). The special focus on innovation policy is to be understood in the historical context of the region. In the sixties and early seventies, the Region experienced exogenous growth mainly through the arrival of multinational companies that chose the location of Flanders because of its central location in Europe. During that time governmental industrial policy dealt basically with the distribution of the capital inflows among the Flemish subregions with the help of a subsidy and infrastructure policy (expansion legislation of 1959). In the later seventies and eighties, however, traditionally strong Belgian industries, such as the steel, coal, textile, and ship-building industries, started to decline. Economic policy responded defensively trying to preserve employment by supporting these declining industries (Goorden 2004). Yet, this approach was ineffective, because market conditions could not be altered by these measures. Thus, many companies were closed in spite of government subsidies (see for example Coucke and Sleuwaegen 2008).

This experience had shown that there was a need for an offensive strategy directed towards structural innovation in the sense of new products, new markets, and new production methods to prevent further economic decline in the region.

In 1981 the Flemish government separated itself from the national government and obtained specific powers in the area of regional economic policy. This separation supported the introduction of a new Flemish innovation policy. In 1989, most of the powers relating to science and technology policy had been transferred to the Flemish government (until 1989, subsidies for research and development had remained federal). The new focus was explicitly emphasized in the 'DIRV Action, Vision of a Renewed Flemish Industrial Policy'-document, that was submitted in November 1983 and builds the basis of today's' innovation policy in Flanders (Goorden 2004).

Further, in the nineties, a cluster policy was initiated to stimulate endogenous growth in Flanders. This cluster policy intended to encourage trans-sectoral platforms and the cooperation among companies as in the past the industrial landscape of the Flemish region

was characterized by isolated companies and branches of multinationals. Firms followed their own corporate restructuring strategies and local firms had no tradition of cooperation. In 1999 the so-called 'Innovation Decree' provided a legal framework to expand research and development policy to a broader, more integrated innovation policy (Goorden 2004).

Thus, Flanders's historically based focus on promoting knowledge intensive industries and technological innovation, its autonomy in innovation policy in combination with its geographical characteristics and delineation, make it an interesting region to study the impacts of the local innovation milieu on innovation performance of firms in that region.

2.3 Conceptual framework

While most of the literature focuses on regional characteristics and regional development, fewer studies consider how regional factors shape firm-level behavior. Of course, firm performance is driven to a large extent by internal conditions such as factors of production and their efficient combination. However, the literature has shown that factor use at the firm level depends to a certain extent on regional resource endowment. Our study combines scholarly research on the importance of regional milieus with the innovation performance at the firm level, as innovation is often seen as key determinant for long-term economic growth and employment. As one of the few existing studies, Love and Roper (2001b) investigate how innovation at the firm level is linked to regional factor resources.

We extend this research in two dimensions. Love and Roper employ several regional variables, such as networking, R&D collaboration, agglomeration and intra-group spillovers, which may determine innovation performance. However, we hypothesize that conditional on a firm's specific resource requirements, the perceived importance of single elements of the portfolio of locational endowments in a region varies. Therefore, it may not be sufficient to link firm performance broadly to geographic characteristics. Consequently, we argue that location factors may have important consequences for the innovation performance of firms, but that these factors may not equally important for all firms.

Thus, in line with findings in new economic geography, we hypothesize that the local innovation milieu affects firm i's innovation performance in a way that

$$innovation\ performance_i\ =\ f\left(firm\ characteristics_i,\ survey\ factors_i,\ regional\ indicators\right).$$

We consider six different variables highlighting heterogeneity in the firm specific importance of such characteristics in a firm's vicinity. In our survey data, firms indicated the importance

of factors such as the availability of skilled labor[2], the vicinity of suppliers[3], the presence of universities, local fiscal incentives, quality of infrastructure and existing firm clusters for networking. The survey questions explicitly focus on the relevance of locational factors with respect to innovation capabilities. In addition to the *survey factors*, we also construct *regional indicators* from other data sources as respective counterparts that allow us to compare the effects of our survey indicators to the respective regional-level variables (see following section).

3 Data

The data base for our analysis is the Flemish part of the Fourth Community Innovation Survey (CIS). It has been carried out by the Steunpunt O&O Indicatoren at KU Leuven in 2005 collecting data for the time period 2002 to 2004. The database is a cross-section of firms active in the manufacturing sector and in selected business services, and is a representative sample of the respective sectors in the Flemish economy.[4] The final sample includes 1,265 observations. We complement this database with information from the BELFIRST database on the population of Flemish firms that allow us to construct indicators approximating regional industry diversification and industry employment. Moreover, we use the earlier CIS III survey for measuring R&D intensity and R&D collaboration in a region in our period of interest. We draw information on governmental and EU innovation subsidies on the regional level from the ICAROS database.

3.1 Variable description

Our dependent variable, the measure of innovation performance, is the share of total sales due to new products (*NEWSALES*).[5] New products are either market novelties or new products that are new to the firm, but were on the market beforehand. As outlined in the previous section, we argue that location factors may have important consequences for the innovation performance of firms. Moreover, we suggest, that these factors may not be equally important

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[2]The relationship of worker skills, agglomeration and wage effects has recently been investigated by Bacolod et al. (2007) in greater detail (see also Glaeser 1999).
[3]Helsley and Strange (2002) show in a theoretical framework how important a network of input suppliers is for innovation as it reduces cost of innovating.
[4]A detailed survey description can be found in Czarnitzki (2006).
[5] New products are defined in concordance with the guidelines in the OSLO-Manual (OECD/Eurostat, 2005).

for all firms. Therefore, we consider six different survey-based variables that account for this fact. The CIS IV survey asked respondents to indicate the importance of following location characteristics for their innovation activities:

- the availability of skilled personnel (*SKILL*),

- the presence of a university (*UNI*),

- the presence of main suppliers (*SUPPLY*),

- the presence of a relevant cluster of firms for networking (*NET*)

- the infrastructure (*INFRA*),

- the presence of local fiscal incentives (*FIS*).

Originally these variables were surveyed as ordinal variables on a 3-digit scale (very important, some importance, not important). We use a set of six dummy variables that indicate whether the respondent firm evaluated the corresponding characteristic as very important.

Additionally, we include a number of regional characteristics that allow us to compare the effects of our six survey indicators to the respective regional-level counterparts. In particular, we use the regional employment in a firm's relevant industry *(INDEMP)* as measure for skilled labor supply in the area. We calculated *INDEMP* based on the population of firms in Flanders as the average number of employees in a region per sector. Industries are determined by 2-digit NACE[6] code and we divided Flanders in regions by 2-digit zip codes. Moreover, we calculate the industry diversification *(DIVERS)* in a firm's region based on 2-digit zip codes as the Herfindahl index of employment concentration across NACE 2-digit industries. This models the regions' specialization, which proxies the firms' network of suppliers in the region. Thus, the most diversified regions would achieve an index close to zero, while more specialized industry landscapes in a region show higher values of *DIVERS*. Both measures, *INDEMP* and *DIVERS*, are conventionally used in urban economics to measure agglomeration.

Furthermore, we calculate the regions' shares of total government and EU R&D-subsidies granted in the pre-sample period 1999-2001 (*REGSUBS*). As counterpart for the survey factor

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[6] NACE is the European standard industry classification.

UNI, we create a dummy variable indicating whether firms are located close to university on a 2-digit zip code level (*UNICLOSE*).

The percentage of firms in the region that engaged in innovation collaborations in the past (*COREG*) is taken into our analysis to model a counterpart to networking activities. In addition, we employ the regions' innovation intensity (defined by ZIP-codes) in the past to account for overall innovativeness (*INNOREG*). Both *INNOREG* and *COREG* are constructed from data of the third CIS survey, i.e. data corresponds to the year 2000.

Using the survey factors, we are able to explicitly model the firms' awareness of regional characteristics and, hence, we do not only rely on correlations of regional characteristics and performance indicators. In addition, we are able to compare the two measurement concepts. It should be noted, that our survey factors and regional variables are not perfect pairs and must therefore be understood as best-available proxies given our data. However, we expect the data to be sufficient to compare the different concepts of regional indicators.

As firm-level control variables, we consider the most important factors for innovation activity: innovation intensity is measured as total innovation expenditure divided by total sales (*INNOINT*). Total innovation expenditure is defined according to the Oslo-Manual (OECD/Eurostat, 2005), and comprises intramural R&D expenditure, extramural R&D expenditure, the acquisition of machinery in combination with innovation projects, the acquisition of other external knowledge such as licenses, expenditure for training in combination with innovation projects, and market introduction cost for new products. Furthermore, we include capital intensity (*KAPINT*) measured as total physical assets per employee, as more capital-intensive firms are usually expected to be more innovative than labor-intensive firms. Referring to Love and Roper (2001b), we use a dummy variable indicating whether the firm is associated with a group (*GROUP*) to model intra-firm spillovers which may be crucial for innovation success. We also use firm size measured as the number of employees as control variable. Due to the skewness of the distribution the variable enters in log-linear form: ln(*EMP*). Note that we also tested non-log-linear relationships, but those turned out as insignificant in all specifications. Finally, 9 industry dummies are included to model heterogeneous innovation patterns across industries (see table A1 in the appendix).

3.2 Timing of control variables

In order to avoid a simultaneity bias in our regressions we use lagged values whenever possible. The dependent variable taken from the CIS IV is measured in the year 2004. We are

able to lag the firm level controls *EMP* and *KAPINT* by two years as the CIS IV collected data for the time period 2002-2004. It is not possible to lag the innovation intensity, though. This is only available for the year 2004. Due to possible feedback effects of product market success to investment, we instrument *INNOINT* with three dummy variables. We use three dummy variables measured at the firm level, namely indicators for the receipt of R&D subsidies during 2002 to 2004 by 1) the Flemish government (*FUNFG*), 2) the national government (*FUNNG*), or 3) the European Union (*FUNEU*). R&D subsidies will affect the innovation investment of a firm directly, but cannot have a direct effect on product market success as this is a function of the actual level of investment and its outcome. Age is, of course, not lagged. We consider that as exogenous. Furthermore, the group indicator and the survey factors are time-invariant in the survey, as the CIS collects such information on a cross-sectional basis.

For the regional characteristics, we can use deeper lags as they are obtained from other sources. *COREG* and *INNOREG* were calculated from the CIS III conducted in 2001, and therefore correspond to the year 2000. *REGSUBS* were obtained from the ICAROS database and cover the CIS IV pre-sample period, i.e. 1999-2001. *INDEMP* and *DIVERS* were calculated from the BELFIRST database where we can account for longer lags. We used the average values of the time period 1994-2001. Thus, we allow for a sufficient time lag so that knowledge capital due to the regions' industry composition may induce spill-over effects that benefit a firm's production process. The variable *UNICLOSE* is time constant as there were no recent foundations of universities.

Table 1 presents descriptive statistics of the variables used in the model. On average firms in our sample achieve 8.2% of total sales with products introduced to the market between 2002 and 2004. Average firm size amounts to 96 employees. However, 75% of firms in our sample have less than 68 employees (median employment equals 27). Average innovation intensity is about 2.9% and roughly 44% of firms are part of a group. The descriptive statistics of our location decision variables already show that the perceived importance of factors differs substantially. For instance the availability of qualified personnel (16%) or infrastructure (12%) in the region as well as the proximity to suppliers (14%) are regarded as far more important than being located closely to an university (4%), fiscal incentives (8%) or the possibility for networking (8%). On average, 22% of the firms in a region were engaged in R&D collaboration in the year 2000 as indicated in the CIS III survey. About 24% of the

firms in our sample are located close to university on a 2-digit zip code level (see appendix table A3).

Table 1: Descriptive Statistics (1265 observations)

Variable	Unit	Mean	Std. Dev.	Min.	Max.
Dependent variable					
$NEWSALES_{2004}$	in % of total sales	8.231	17.996	0	100
$NEWMARKET_{2004}$	in % of total sales	3.766	10.999	0	100
Firm level controls					
EMP_{2002}	head counts	95.970	274.608	1	5820
$INNOINT_{2004}$	in % of total sales	2.907	8.050	0	65.161
$KAPINT_{2002}$	(fixed assets in thousand EUR)/EMP	32.279	43.200	0.327	376.143
$GROUP_{2004}$	dummy	0.443	0.497	0	1
AGE_{2004}	years	28.310	23.927	1	169
Location factors obtained from survey					
$SKILL$	dummy	0.164	0.370	0	1
UNI	dummy	0.039	0.193	0	1
$SUPPLY$	dummy	0.144	0.351	0	1
$INFRA$	dummy	0.117	0.322	0	1
FIS	dummy	0.067	0.250	0	1
NET	dummy	0.031	0.173	0	1
Regional characteristics constructed from other data sources					
$INDEMP_{1994-2001}$	# of employees in a firm's industry in the region (in thousands)	2.065	2.934	0.002	20.730
$DIVERS_{1994-2001}$	Herfindahl index of regional industry concentration measured by employment	0.087	0.023	0.060	0.310
$INNOREG_{2000}$	innovation intensity per region	0.062	0.035	0.009	0.263
$COREG_{2000}$	% of firms engaged in R&D collaboration per region	0.217	0.093	0	0.667
$UNICLOSE$	dummy	0.241	0.427	0	1
$REGSUBS_{1999-2001}$	regions share of total government and EU R&D subsidies granted in the pre-sample period	0.035	0.046	0	0.156
Instruments					
$FUNFG_{2002-2004}$	dummy for R&D subsidy receipt from Flemish government	0.092	0.289	0	1
$FUNNG_{2002-2004}$	dummy for R&D subsidy receipt from national governmenr	0.053	0.224	0	1
$FUNEU_{2002-2004}$	dummy for R&D subsidy receipt from the European Union	0.026	0.159	0	1

Note: 9 industry dummies omitted.

4 Econometric Analysis

We estimate Tobit models on innovation performance as not every firm in our sample shows positive share of sales with new products, that is, *NEWSALES* is left censored. The model to be estimated can be written as

$$NEWSALES^* = X'\beta + \varepsilon,$$

where NEWSALES is the unobserved latent variable. The observed dependent variable is equal to

$$NEWSALES = \begin{cases} NEWSALES^* & \text{if } X'\beta + \varepsilon > 0 \\ 0 & \text{otherwise} \end{cases}.$$

X represents the matrix of regressors, β the parameters to be estimated, and ε the random error term. The equation to be estimated is

$$E\left(NEWSALES_{2004}^*\right) = \beta_0 + \beta_1 \ln(EMP_{2002}) + \beta_2 INNOINT_{2004} + \beta_3 KAPINT_{2002} + \beta_5 GROUP_{2002-2004}$$

$$+ \beta_6 \ln(AGE_{2004}) + \beta_7 INDEMP_{1994-2001} + \beta_8 DIVERS_{1994-2001} + \beta_9 RDREG_{2000}$$

$$+ \beta_{10} COREG_{2000} + \beta_{11} UNICLOSE + \beta_{12} REGSUBS_{1999-2001} + \sum_{k=13}^{18} \beta_k LOC_k + \sum_{s=19}^{28} \beta_s SECTOR_s$$

where LOC_k refer to our six location factors obtained from the survey and $SECTOR_s$ to the 9 industry dummies. The standard Tobit model requires the assumption of homoscedasticity; otherwise the estimates are inconsistent (cf. Greene, 2005). We conducted several tests on heteroscedasticity (Wald tests and LR Tests) using a heteroscedastic specifications of the Tobit model where we replaced the homoscedastic standard error σ with $\sigma_i = \sigma \exp(Z'\alpha)$ in the likelihood function. We included size class dummies based on the number of employees and industry dummies to model group-wise multiplicative heteroscedasticity. The tests find evidence for heteroscedasticity, and thus we only present the estimation results obtained from our heteroscedastic-consistent estimations.

As most explanatory variables are lagged, we can treat these as predetermined, that is, we avoid direct simultaneity between our dependent and the explanatory variables. The only problem arises for the innovation intensity. Unfortunately, we cannot lag it with our data at hand. Therefore, we instrument this variable to avoid a simultaneous equation bias. As

instruments we consider innovation subsidies (*FUNFG, FUNNG, FUNEU*), as these should determine the innovation intensity of a firm positively. However, the subsidies should not have a direct effect on the sales with new products. Subsidies rather influence the investment into innovation projects, and then innovation efforts will affect the market outcome as measured by new product sales. We implement the IV estimation as Full Information Maximum Likelihood estimator where two equations are estimated simultaneously. The main equation is the new product sales equation as shown above. In addition, innovation intensity is regressed on all explanatory variables and the instruments. Wald-tests in the IV-Tobit model do indeed reject that the innovation intensity is exogenous. See Wooldridge (2002: 530-533) for details on the IV Tobit model.

Our estimations take into account a possible correlation of error terms within regions by computing regionally clustered standard errors.

Table 2 presents the regression results of six specifications: First, we display three heteroscedastic Tobit models where the innovation intensity is considered as exogenous. One model represents the full specification using both the perceived location factors and the "real" regional characteristics. As robustness check, we then present two models where we omitted the perceived factors in one model, and the real characteristics in the other. Besides interpreting the sign of the coefficients and their significance levels, we are interested which kind of location factors have higher explanatory power with respect to the firm-level performance. For this, we present Wald-test on joint significance of the regional variables. The other three specifications are analogous to the former, but now we account for the potential endogeneity of *INNOINT* using the IV-Tobit models.

Turning to the results, we find that the "real" regional characteristics are individually and jointly insignificant in all regressions. This coincides basically with the weak performance of such variables in previous studies. The perceived location factors, however, are jointly highly significant in all models. As the results show, the presence of skilled labor and the vicinity to suppliers have a positive effect on the innovation performance of firms. Further, though weaker as not robust across all models, we find a positive impact of networking and the availability of physical infrastructure. Note that in the IV Tobit all three indicators describing innovation subsidies positively affect innovation intensity (first stage results not presented in detail in the Table).

With respect to innovation performance, our results illustrate that perceived factors seem to capture effects from the local innovation milieu better than general characteristics calculated at the regional level. We would like to point that the reason for this may be the fact that a regression analysis restricts the effect of regional characteristics in the sense that all variables affect the firms in the same region by the same magnitude. The perceived location factors, however, allow to model that firms within a region may rely on a heterogeneous set of characteristics as survey respondents indicate only a selection of all factors as important.

The control variables show the expected effects. Consistent with findings in the literature, firm size and capital intensity have a positive effect on innovation performance. Also the innovation intensity is naturally an important determinant for innovation outcome. For firms' age we also find indications of a positive influence on innovation performance. This is confirmed in the IV models where all firm-level control variables remain positively significant. In line with findings of Love and Roper (2001b), it turns out that intra-firm spillovers as modeled by the *GROUP* variable are a source of important advantages for innovation.

Table 2: Heteroscedastic Tobit and IV Tobit on *NEWSALES* (1265 observations)

Variable	Heteroscedastic Tobit			Heteroscedastic IV Tobit[+]		
	Full Model	**Regional Indicators only**	**Survey Factors only**	**Full Model**	**Regional Indicators only**	**Survey Factors only**
$INNOINT_{2004}$	1.158***	1.539***	1.178***	4.658***	5.186***	4.664***
	(0.157)	(0.169)	(0.155)	(1.273)	(0.999)	(1.264)
$\ln(EMP)_{2002}$	3.715**	4.713***	3.658**	2.944*	3.685**	2.933**
	(1.651)	(1.630)	(1.597)	(1.528)	(1.462)	(1.497)
$KAPINT_{2002}$	0.067**	0.075**	0.068**	0.068**	0.071**	0.067**
	(0.033)	(0.033)	(0.0833)	(0.031)	(0.033)	(0.066)
AGE_{2004}	3.289*	3.387*	3.209*	3.983**	3.977**	0.031**
	(1.844)	(1.860)	(1.835)	(1.899)	(1.940)	(1.838)
$GROUP_{2004}$	7.922***	9.458***	7.873***	6.794**	7.452**	7.026**
	(3.024)	(3.220)	(3.006)	(3.187)	(7.359)	(3.106)
Regional Indicators:						
$INDEMP_{1994-2001}$	0.233	0.090		0.570	0.426	
	(0.381)	(0.484)		(0.520)	(0.591)	
$DIVERS_{1994-2001}$	-87.182	-61.783		-42.012	-20.889	
	(56.171)	(50.425)		(56.822)	(55.176)	
$INNOREG_{2000}$	0.782	5.048		2.453	1.407	
	(31.648)	(30.777)		(36.713)	(37.068)	
$COREG_{2000}$	-16.684	-13.416		-16.080	-11.370	
	(12.857)	(12.299)		(14.376)	(13.453)	
$UNICLOSE$	0.131	-2.268		-1.219	-4.413	
	(4.735)	(4.253)		(4.54)	(4.024)	
$REGSUBS_{1999-2001}$	24.114	47.136		18.474	48.885	
	(39.229)	(43.872)		(36.155)	(39.425)	

Table 2 continued

	(1)	(2)	(3)	(4)	(5)	(6)
Survey Indicators:						
SKILL	17.404***		17.646***	13.099***		13.264***
	(3.017)		(3.051)	(3.665)		(3.586)
UNI	9.344		8.724	0.696		0.067
	(6.308)		(6.348)	(6.623)		(6.730)
SUPPLY	13.786***		13.867***	12.058***		12.437***
	(2.431)		(2.431)	(3.152)		(3.338)
INFRA	9.410*		9.184*	3.827		3.573
	(5.268)		(5.097)	(6.312)		(6.220)
FIS	1.036		1.259	3.464		3.087
	(4.301)		(4.188)	(5.365)		(5.287)
NET	11.735**		10.865*	3.932		3.528
	(5.567)		(5.689)	(6.796)		(7.003)
Intercept	-41.242***	-43.844***	-50.163***	-50.875***	-53.007***	-55.718***
	(9.423)	(10.476)	(9.762)	(11.619)	(12.136)	(10.741)
Test of joint significance of *REGIONAL INDICATORS*, χ^2 (6)	5.32	4.04		4.48	3.66	
Test of joint significance of *SURVEY FACTORS*, χ^2 (6)	88.62***		89.96***	33.30***		32.45***
Test of joint significance of *SECTOR dummies*, χ^2 (8)	38.61***	41.98***	35.24***	57.66***	51.96***	58.01***
Test on heteroskedasticity	24.26***	36.70***	24.14**	1,714.53***	1,758.13***	1,838.36***
Wald-test of exogeneity				8.88***	16.48***	9.00***
Log-Likelihood	-2,324.91	-2,381.90	-2,326.70	-6,177.17	-6,255.56	-6,183.28

Notes: Standard errors in parentheses are clustered to allow for correlations within regions; *** (**, *) indicate a significance level of 1% (5%, 10%),
[+]*INNOINT* is instrumented with three dummy variables indicating the receipt of innovation subsidies at the firm level by origin: 1) Flemish government, 2) national government, 3) European Union.
The heteroscedasticity term includes the eight industry dummies and four size class dummies based on firms' employment in all regressions. Note that the test on heteroscedasticity in the IV Tobits refers to heteroscedasticity in both estimated equations, the *NEWSALES* and the *INNOINT* equation, simultaneously.

Robustness checks

Instead of *NEWSALES,* we also use a stricter definition of innovation performance, that is, the success in introducing a market novelty. Analogous to our firm dependent variable, this is measured as the share of sales achieved with market novelties. New product sales include products that were already on the market and the firm in question is imitating an existing product, i.e. a new product may just be new to the firm but not to the market. The variable *NEWMARKET*, however, accounts only for true market novelties which may be considered as more radical or original innovations as it excludes the mere imitation of products.

Table 3 shows the regressions results. Basically, we come to the same conclusions as in our less strict *NEWSALES*-model. In the full model specification the perceived location factors from the survey are jointly significant, while the "real" regional characteristics have no joint impact on the sales with market novelties. When we look at the individual impact we also find that the presence of skilled labor and the vicinity to suppliers matter. The availability of physical infrastructure is weakly significant in the standard Tobit model. Interestingly, however, we find that the region's innovation intensity is positively significant in the regressions. This is the only computed regional characteristics where we find a positive effect on firms' innovation performance that is significant at the 5% level. It seems that the regional endowment with R&D capital matters for more radical innovations, as firms may absorb cutting-edge knowledge for introducing market novelties. In contrast, there is no such effect when all innovation were considered in the previous *NEWSALES* regressions.

It should also be noted that the real regional characteristics are weakly jointly significant in the regression where the perceived factors are excluded. In the fully specified models, however, the perceived factors render the "conventional" characteristics jointly insignificant.

Table 3 Heteroscedastic Tobit and IV Tobit on *NEWMARKET* (1265 observations)

Variable	Heteroscedastic Tobit			Heteroscedastic IV Tobit[+]		
	Full Model	**Regional Indicators only**	**Survey Factors only**	**Full Model**	**Regional Indicators only**	**Survey Factors only**
$INNOINT_{2004}$	0.939***	1.099***	0.943***	2.831***	3.102***	2.860***
	(0.166)	(0.181)	(0.165)	(0.664)	(0.636)	(0.646)
$\ln(EMP)_{2002}$	2.877**	2.735**	2.610**	2.333**	2.072**	2.148**
	(1.158)	(1.331)	(1.193)	(1.055)	(1.039)	(1.072)
$KAPINT_{2002}$	0.015	0.023	0.016	0.010	0.014	0.009
	(0.016)	(0.019)	(0.016)	(0.016)	(0.017)	(0.016)
AGE_{2004}	0.744	1.525	0.916	1.057	1.834	1.138
	(1.284)	(1.287)	(1.304)	(1.363)	(1.331)	(1.388)
$GROUP_{2004}$	3.126	4.912**	3.318	2.732	4.067**	2.994
	(1.994)	(2.178)	(2.131)	(1.984)	(2.015)	(2.122)
Regional Indicators:						
$INDEMP_{1994-2001}$	0.286	0.280		0.461	0.393	
	(0.360)	(0.345)		(0.344)	(0.351)	
$DIVERS_{1994-2001}$	-46.411	-40.166		-21.455	-9.127	
	(35.289)	(35.658)		(34.210)	(34.412)	
$INNOREG_{2000}$	63.138***	65.705***		60.482**	57.673**	
	(24.192)	(22.723)		(23.615)	(22.727)	
$COREG_{2000}$	-11.644	-13.647		-11.391	-11.788	
	(13.168)	(11.624)		(13.084)	(10.985)	
$UNICLOSE$	-3.709	-4.756		-3.918	-5.555*	
	(3.181)	(3.612)		(3.612)	(3.276)	
$REGSUBS_{1999-2001}$	4.201	7.587		-0.153	9.238	
	(32.985)	(53.388)		(29.482)	(30.914)	

Table 3 continued

Survey Indicators:						
SKILL	10.370***		10.104***	7.789***		7.397***
	(1.961)		(2.039)	(2.288)		(2.278)
UNI	5.220		5.329	0.702		0.697
	(3.277)		(3.394)	(3.621)		(3.932)
SUPPLY	10.071***		10.568***	8.485***		9.124***
	(2.317)		(2.312)	(2.739)		(2.789)
INFRA	5.721*		6.304	2.805		3.222
	(3.156)		(3.359)*	(3.285)		(3.440)
FIS	-2.102		-2.199	-0.550		-1.016
	(3.314)		(3.188)	(3.521)		(3.387)
NET	1.283		0.965	-2.791		-3.147
	(3.966)		(3.951)	(4.373)		(4.490)
Intercept	-32.328***	-30.000***	-35.025***	-36.129***	-34.507***	-36.832***
	(7.356)	(8.369)	(7.568)	(7.534)	(7.883)	(7.528)
Test of joint significance of *REGIONAL INDICATORS*; χ^2 (6)	8.59	10.90*		8.14	13.32**	
Test of joint significance of *SURVEY FACTORS*; χ^2 (6)	93.37***		95.03***	30.27***		32.38***
Test of joint significance of *SECTOR* dummies; χ^2 (8)	28.76***	41.51***	27.83***	45.25***	50.12***	48.92***
Test on heteroskedasticity	46.64***	45.28***	44.12***	2,293.25***	1,427.92***	1,494.55***
Wald-test of exogeneity				10.11***	13.18***	10.02***
Log-Likelihood	-1,647.30	-1,690.19	-1,651.46	-5,504.29	-5,569.16	-5,512.54

Notes: Standard errors in parentheses are clustered to allow for correlations within regions; *** (**, *) indicate a significance level of 1% (5%, 10%),
[+]*INNOINT* is instrumented with three dummy variables indicating the receipt of innovation subsidies at the firm level by origin: 1.) Flemish government, 2) national government, 3) European Union.
The heteroscedasticity term includes the eight industry dummies and four size class dummies based on firms' employment in all regressions. Note that the test on heteroscedasticity in the IV Tobits refers to heteroscedasticity in both estimated equations, the *NEWSALES* and the *INNOINT* equation, simultaneously.

5 Conclusion

This study investigated how local milieus foster innovation success of Flemish firms. In particular we focus on firms' new product sales and their success in introducing market novelties. We compare the impact of location factors that were indicated as important by firms themselves with measures of regional characteristics that were constructed from other data. Thus, we contrast the common practice of linking firm performance indicators to regional characteristics with survey evidence on locational factors. While the former approach assumes that location characteristics should affect all firms in the same way, the survey allows us to model firms judging the attractiveness of locations by a heterogeneous set of criteria. It turns out that locational factors obtained from the survey which allow the importance of regional factors to be perceived differently across firms, provide more accurate explanation on how local milieus facilitate innovation than regional characteristics that are assumed to affect all firms uniformly. Thus, our results illustrate that the argument that perceptions are more important for explaining organizational behavior than objective conditions (Hellriegel and Slocum 1974) also applies to how regional characteristics affect innovation success.

Further, our results show that the availability of production factors, in particular skilled labor and proximity to a network of suppliers, is crucial for regional innovation performance. Our findings are in line with other research, as for example by Basevi and Ottaviano (2002), Helsley and Strange (2002), or Bacolod et al. (2007), showing the importance of such factors for different performance indicators.

Interestingly, our robustness test using a stricter concept of innovation success, i.e. sales with market novelties excluding imitations, shows that the regions' innovation intensity matters for individual firm performance. This highlights the importance of knowledge spillovers for more radical innovation projects, which may suggest to account for the heterogeneity of innovation activity in further research.

In conclusion, this study shows that characteristics of local milieus which are not naturally given, matter for innovation performance and thus for economic growth and future employment opportunities. For the small economic area of Flanders this identifies channels for innovation policy, especially on the background of relatively high foreign ownership in the Flemish business sector. It may be in the government's interest to design regional

innovation policy conducive to agglomeration of highly skilled labor and high-tech industry to remain competitive in the process of further globalization.

In order to complement our findings, it would be interesting to analyze how policy may foster the development of regional innovative clusters. In order to do so, it would be necessary to build a panel of firms which can be traced over a certain time period so that their evolution may be linked to regional dynamics. Policy changes over time could then be linked to innovation performance due to regional factor endowments, and thus to the effects of governmental actions fostering the development of highly innovative clusters.

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Appendix

Table A1: Industry description (full sample, 1265 obs.)

Number	Industry	Industry definition according to NACE sectors	Obs.
1	Textiles, Paper, Wood	17, 18, 19, 20, 21, 22	123
3	Chemical, Plastics	23, 24, 25	78
4	Metal	27, 28	100
6	Electronics, Machinery, Vehicles	29, 34, 35, 30, 31, 32, 33	152
7	Other Industries	1, 14, 15, 16, 26, 36, 37, 40, 41, 45	228
8	Trade	50, 51, 52	233
9	Transport	60, 61, 62, 63, 64	118
10	Information Services	72, 73, 74.2, 74.3	105
11	Other Services	65, 66, 67, 74 (except 74.2, 74.3), 85, 90	128
			1,265

	NEWSALES	ln(EMP)	AGE	GROUP	SKILL	UNI	SUPPLY	INFRA	FIS	NET	INNOINT	KAPINT	INDEMP	DIVERS	RDREG	COREG	UNICLOSE	REGSUBS
NEWSALES	1																	
ln(EMP)	0.1173	1																
AGE	0.0756	0.2157	1															
GROUP	0.1176	0.4415	0.0100	1														
SKILL	**0.2823**	**0.1605**	**0.0387**	**0.1428**	**1**													
UNI	**0.1375**	**0.0573**	**-0.0158**	**0.0682**	**0.2877**	**1**												
SUPPLY	**0.1744**	**0.0035**	**0.0032**	**0.0285**	**0.2205**	**0.0695**	**1**											
INFRA	**0.2075**	**0.0441**	**0.0067**	**0.0414**	**0.2911**	**0.0799**	**0.3974**	**1**										
FIS	**0.0802**	**0.0269**	**-0.0094**	**0.0337**	**0.1800**	**0.0770**	**0.2139**	**0.3149**	**1**									
NET	**0.1148**	**0.0809**	**-0.0252**	**0.0249**	**0.1436**	**0.2012**	**0.1614**	**0.1058**	**0.1896**	**1**								
INNOINT	0.3119	-0.0309	-0.0791	0.0048	0.2109	0.2258	0.1163	0.1884	0.0713	0.1220	1							
KAPINT	0.0761	-0.0127	-0.0250	0.0382	-0.0083	0.0207	0.0431	0.0258	0.0035	0.0248	-0.0058	1						
INDEMP	-0.0188	0.0485	-0.0033	0.1138	-0.0208	-0.0350	-0.0287	-0.0338	-0.0268	0.0002	-0.0875	-0.0715	1					
DIVERS	-0.0275	0.0325	0.0341	0.0666	-0.0131	0.0189	0.0137	-0.0366	-0.0485	0.0172	-0.0930	-0.0604	0.1513	1				
RDREG	0.0431	0.0057	-0.0162	0.0736	0.0329	0.0620	0.0238	0.0576	0.0130	0.0103	0.0522	-0.0310	-0.0293	0.0044	1			
COREG	0.0682	0.0481	-0.0216	0.0752	0.0632	0.0702	-0.0105	0.0399	0.0296	0.0594	0.1012	0.0040	-0.0723	-0.2817	0.2860	1		
UNICLOSE	0.0518	0.0348	0.0135	0.0789	0.0463	0.0117	-0.0197	-0.0090	0.0190	-0.0040	0.0319	-0.0094	0.2998	-0.0780	0.2581	0.2733	1	
REGSUBS	0.0419	0.0600	0.0368	0.1606	0.0523	0.0252	-0.0090	-0.0156	0.0149	-0.0036	0.0271	-0.0147	0.4052	-0.0350	0.2523	0.3056	0.7305	1

Table A2: Correlation matrix (full sample, 1265 observations)

Table A3: Description of Districts and Regions within Flanders (1265 observations)

2-digit zip code	# of firms in our sample, 2-digit level	%	1-digit zip code level	name of province	aggr. # of firms in sample per one digit zip code level	%	size by population	size in km²	population density	University presence	Universities' 2-digit zip code
15	2	0.16									
16	10	0.79									
17	38	3	1	Flemish-Brabant	114	0.09	820,272	2,422	339	KU Brussels FU Brussels	10
18	30	2.37									
19	34	2.69									
20	70	5.53									
21	31	2.45									
22	36	2.85									
23	56	4.43									
24	21	1.66	2	Antwerp	380	0.30	1,694,475	2,908	583	U Antwerp	20
25	30	2.37									
26	44	3.48									
28	67	5.3									
29	25	1.98									
30	36	2.85									
31	6	0.47									
32	9	0.71								KU Leuven	30
33	9	0.71									
34	2	0.16	3	Flemish-Brabant-Limburg	230	0.18	1,052,467	2,106	500		
35	66	5.22									
36	48	3.79									
37	12	0.95								U Hasselt	35
38	10	0.79									
39	32	2.53									

80	26	2.06									
82	10	0.79									
83	8	0.63									
84	13	1.03									
85	66	5.22	4	West Flanders	274	0.22	1,130,040	3,125	362	KUL Campus Kortirjk	85
86	21	1.66									
87	46	3.64									
88	58	4.58									
89	26	2.06									
90	66	5.22									
91	60	4.74									
92	33	2.61									
93	13	1.03									
94	11	0.87	5	East Flanders	267	0.21	1,389,199	2,991	464	U Ghent	90
95	2	0.16									
96	8	0.63									
97	9	0.71									
98	46	3.64									
99	19	1.5									
								(5221/sq mi)	(1166/sq mi)		
Total	1,265	100			1,265	1.00	6,086,453	13,552	449		

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