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Title

Spatial dimensions of cooperation aimed at innovation[1]

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In the contemporary debate on innovation and economic development, innovation is associated with economic networks and co-operation between innovating firms. Moreover, innovation is associated with regional clustering of activities. Most research on clusters employs case study research. This research takes a different perspective by combining regional input-output data and results of the European Community Innovation Survey. On this empirical material, a model has been developed that aims to quantify regional dimensions of innovation. Conclusions focus on the character of clustering. The regional environment has a significant effect for the innovative output of innovators, innovating in partnership. Regional presence of innovators and regional thickness in the production chain, as measured through intermediate deliveries and supplies, do not have a significant effect on the innovative output of innovators, which do not innovate in partnership. International partnerships seem, compared to local networking, more decisive for innovation. Furthermore, we found indications that partnership is complementary to the use of external information.

Key words:
Innovation; Networks; Clusters; Structural Equation Models

[1] The empirical part of this paper has been carried out at the Center for Research of Economic Microdata (Cerem) at Statistics Netherlands. The opinions expressed in this report, however, are solely those of the author. I wish to thank Statistics Netherlands for the opportunity to use micro-economic data and the Cerem team for their daily support on-site.

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1 Introduction

With the enlargement of the European Union the urgency increases for relatively prosperous countries to focus on knowledge assets rather than on cost minimization in their competitive strategies. Countries like the Netherlands, Germany, the United Kingdom and France experience cost levels which are simply too high to compete with countries like Poland, the Baltic states and Hungary. All the more, this counts for manufacture. Three quarters of Dutch exports are accounted for by manufacturing industries (Statistics Netherlands, 2003). So, in order to improve, or at least keep up, its global position, exporting industries, need to compete on the basis of knowledge and innovation.

The Dutch Ministry of Economic Affairs supports this ambition through its innovation policy. Public support of knowledge infrastructure is justified since knowledge inhibits positive external effects. Since external effects carry no weight through the classical notions of the market, pure market allocation would lead to suboptimal levels in investments on research and knowledge (Zwan, 2001).

Since the mid-nineties, cooperation between innovating companies is an important feature of Dutch innovation policy (Ministry of Economic Affairs, 1997). Innovation is about the combination of various knowledge resources and (dynamic) competences (Dosi, 1988). Companies, which during the past decades have focused on their core competences to meet requirements of flexibility, increasingly need to look beyond their firm boundaries in their search for complementary capabilities and competences needed to fulfil their business strategies aimed at innovation. In the Netherlands, approximately one out of five companies innovates in partnership (Statistics Netherlands, 1998). In the Netherlands, companies which innovate in partnership are more innovative than their counterparts which implement their innovation strategies solely by own strength, and as a consequence, innovators innovating in partnership experience stronger effects of innovation on their competitive position (De Bruijn et al., 2003).

Small- and medium-sized companies are seen as an important target group in policy initiatives aimed at improving innovative capabilities. Despite their limited size these companies can still experience economies of scale and scope in their innovation trajectories. External economies exist on the level of the network of cooperating firms. At the same time these companies are still able to preserve some flexibility to a considerable extent (Piore and Sable, 1984).

2 Innovation and spatial clustering

From both theoretical as policy oriented approaches, much attention has been paid to spatial dimensions in networks of cooperating innovating companies. Insights in these dimensions are highly relevant for the spatial organization of innovation policy, in other words on what spatial levels innovation policy must be given shape.

Since market initiatives, according to the Dutch Ministry of Economic Affairs, have to form the basis for building economic policy instruments upon, insight in the cooperative spatial patterns in innovative networks can act as a strong focus for the organization of public initiatives aimed at boosting innovation.

An analysis of past empirical research does not provide us with unambiguous results. On the one hand, case studies of successful examples of innovative clusters like Silicon Valley or Emilia-Romagna (Scott, 1990) point to the importance of proximity and regional clustering in innovation trajectories. On the other hand, in more general designed surveys, the importance of regional cooperation, opposed to international network links, appears to be less convincing (see, for example Beugelsdijk and Cornet, 2001). Contributions which emphasize the role of proximity are often accused of a focus solely on successful clusters. Extending this conception of cluster approaches, the explanatory value of these contributions equals zero. In this sense, policy initiatives based on a preoccupation with the regional level do not seem to be very promising and are sometimes even accused of indulgence in navel-gazing. However, things are never as black as they may seem at first sight. Much of the research efforts on clusters focus on the question why clusters of small- and medium-sized companies in some cases can provide an alternative competitive strategy against more traditional organization structures of innovation and entrepreneurship, based on internal economies of scale and scope within a single firm. Next to differences in the applied methods, the differences in research outcome scan also be explained by differences in the definitions of the concepts used in the underlying theoretical framework. Innovation involves a broad spectrum of economically relevant changes and improvements, from mergers to technological improvements in product design in a diversity of sectors within from traditional manufacturing to service industries. Not only innovation is a multidimensional phenomenon. Space also is conceptualized in diverse ways. In Weber’s en Von Thünen’s classical location theory space is being analysed as a geometrical concept. However, in most modern cluster-based approaches space is treated as a social and cultural phenomenon. Oinas (1997) even states that in these territorial innovation models relational and geometrical conceptions of space are put on a par with each other. therefore, it is not surprising that cooperation in innovation trajectories is mostly associated with the regional level, because innovation is characterized by high levels of uncertainty and, therefore, benefits from mutual confidence and cultural ‘proximity’ of innovating partners.

Cooperative agreements in innovation trajectories are often connected to spatial clustering of economic activities. Clustering literally refers to the grouping of activities which share common properties on one or several aspects. From the literature, however, we can derive several classifications into which spatial clustering is classified. In the so-called territorial innovation models a strong emphasis is put on structural cooperative relationships between neighbouring innovators. Institutional, cultural and geometrical proximity offers external economies of scale and scope in innovation processes. In the conception of Scott and Storper (1986) regional production networks of delivery and outsourcing are of crucial importance. Regional thickness in the production chain is considered to be connected to innovation. However, clustering does not necessarily have to imply a direct relationship between neighbouring innovators.

According to the definition of Hospers (1999) the concept of clustering also relates to potential links between partners in the production chain. In the literature this concept of clustering is commonly referred to as formation. Clustering also includes companies, which are not necessarily engaged in direct partnerships with each other, but which make use of the same assets in their production environment, as, for example, highly skilled labour or the availability of venture capital to finance investments which are characterized by high levels of uncertainty in returns on investment.

Central question in this empirical contribution is to what extent these different conceptions of clustering manifest themselves in innovation practices. The Community Innovation Survey provides numerous leads to get further insight in the various dimensions of clustering and their role in innovation processes. For the analysis we had the opportunity to make use of micro-economic data on the Netherlands part of the second Innovation Survey (CIS 2.0), which covers the period from 1994 to 1996.

3 Spatial patterns in cooperative partnerships aimed at innovation

When domestic and international partnerships are compared (table 1), it follows that the majority of Dutch companies, innovating in partnership, innovates with a domestic partner. Almost 90 percent of the firms, innovating in partnership, innovates in cooperation with a domestic partner. Approximately 40 percent cooperates on international scale. Small- and medium-sized firms are relatively more oriented towards domestic partners than their larger counterparts with more than 200 employees.

Table 1 Partnership in innovation processes by origin of the partner and company size as a share in the total number of innovators (partnership) or the total number of firms innovating in partnership (domestic and international partnerships) (absolute figures between brackets), 1994 to 1996

	Partnership	Domestic partnership	International partnership
Total number of innovators	24 (4180)	88 (3689)	39 (1638)
between 10 and 50 employees	20 (2582)	90 (2313)	32 (839)
between 50 and 200 employees	30 (1007)	85 (858)	45 (456)
more than 200 employees	51 (591)	88 (518)	58 (343)

Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey

Although most innovators, innovating in partnership, cooperate with domestic partners, innovation must firstly be associated with international linkages. The output of efforts in innovation processes, in terms of the shares of revenues from products which can be classified as technologically new or improved, is 33 percent for companies which cooperate on international scales in their innovation trajectories, compared to 25 percent for firms which solely cooperate on domestic levels. This positive connection between scalarity of network links and innovative output exists for both small and large firms. However, these figures do not tell us anything about the direction of causal effects. Just as international orientation can have a positive effect on innovative output through having access to a wider range of complementary capabilities and competences, innovativeness can have a positive effect on orientation in the sense that innovative companies have more information on their international network environment and, in addition, are themselves more attractive and well-known as potential partners for innovators, based abroad.

Table 2 Shares of revenues from technologically new or improved products in total revenues for innovators which innovate by themselves and companies which innovate in partnership by origin of partner(s) and firm size (size of subpopulations between brackets), 1994 to 1996.

	Partnership		Scale of cooperation		
	no	yes	domestic	international	both domestic and international
Total number of innovators	22 (6229)	28*** (1847)	25 (1008)	33*** (237)	33*** (601)
between 10 and 50 employees	22 (4586)	26*** (972)	23 (649)	33** (99)	31*** (224)
between 50 and 200 employees	22 (1366)	33*** (528)	29 (245)	34 (86)	37*** (197)
more than 200 employees	21 (276)	28*** (346)	23 (114)	29 (53)	31 (180)

Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey

** Statistically significant with $\alpha = 0.01$
*** Statistically significant with $\alpha = 0.001$

Statistical significance of differences is calculated for shares of revenues from technologically new or improved products in total revenues for innovators, which innovate in partnership against the figures for innovators that innovate by themselves. For innovators which innovate in partnership with international partners, significance is related to the shares of revenues from technologically new or improved products in total revenues for innovators which innovate solely with domestic partners.

Innovators, innovating in cooperation with internationally based partners, are more innovative than innovators, cooperating solely on domestic scales. However, firms which cooperate with domestic partners are still more innovative than innovators which do not innovate in partnership at all. Considering the fact that the majority of innovators which innovate in partnership, innovates in cooperation with one or several domestic partners, we can draw the conclusion that domestic partnership can certainly be an important asset in innovation processes.

According to the extent in which different kinds of partners are deployed in innovation trajectories, partners in the production chain are most important. Differences between the use of various kinds of partners are largest in extent for partnerships on international scales. These results, depicted in table 3, are somewhat surprising, considering the fact that that cooperation in innovation processes is often associated with regional production networks.

Table 3 Degree of deployment of partners in innovation processes by character of partners as a share in the total number of partnerships (absolute figures between brackets)

Partner	Total	Domestic partners	International partners
Total number of partnerships	100 (4180)	100 (3689)	100 (1638)
Customers	44 (1827)	40 (1484)	39 (642)
Suppliers	47 (1961)	40 (1477)	48 (780)
Competitors	35 (1449)	35 (1276)	16 (264)
Knowledge organizations	40 (1653)	40 (1491)	22 (362)

Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey

4 Spatial connections in production networks

Insight in intermediate deliveries and supplies within production chains can be derived from input-output tables. On the basis of regionally divided input-output tables of the Netherlands (University of Groningen/Statistics Netherlands, 1999) we are able to gain insight in the internal and external connections of Dutch provinces (NUTS-II level regions) by sector in terms of intermediate deliveries and supplies. For each region, the se tables describe the production value of intermediate supplies and deliveries within and between sectors. Furthermore, the data distinct between deliveries and supplies within the same province and intermediate links which cross the region's border and have their origin or destination in other parts of the Netherlands. The figures apply to the year 1992 and distinguish between 37 industries. On the basis of these figures we calculated, for both general deliveries as deliveries within the same sector, the share of intraregional deliveries in the sum of deliveries that have their origin in the Netherlands as a measure for regional clustering on the input side of the production chain.

Equally, we measured regional clustering on the output side as the share of intraregional supplies in the sum of supplies which have their origin in the province and their destination in the Netherlands. The figures are corrected for the area of the region by dividing them through the land area of the province (Statistics Netherlands, 2002). The resulting indicators are attached to the individual respondents to the CIS questionnaire as a group variable based on location (province) and economic activity (industry). By coupling these figures to the CIS data we assumed clustering in the production chain to be constant during the period 1992 to 1996.

Table 4 depicts the results of our analysis. The positive connection between clustering in regional production networks and innovation, as theoretically described by Storper and Scott, does not find an empirical base in our descriptive analysis. We even found a negative connection between regional thickness in the production chain and innovation. All indicators of regional thickness in the production are higher for non-innovators than they are for innovating firms. In the relation between the shares of revenues from products which can be classified as technologically new or improved in total revenues and spatial clustering in the production chain on both the input and the output side of the innovating company, we found a weak, but statistically significant negative connection.

Table 4 Spatial clustering in the production chain of innovators and other companies (size of subpopulations between brackets), 1994 to 1996.

	Innovators	Other companies
Clustering on the input side for the total number of supplies	55 (15436)	58 (31479)
Clustering on the input side for intra-sectoral supplies	59 (15413)	66 (31419)
Clustering on the output side for the total number of deliveries	52 (15436)	59 (31479)
Clustering on the output side for intra-sectoral deliveries	59 (15413)	65 (31419)

Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey and University of Groningen/Statistics Netherlands (1999), regionally divided input-output tables of the 12 Dutch provinces

Differences between the figures of innovators and remaining firms are all statistically significant with $\alpha = 0.001$.

5 Spatial proximity to innovating firms

Clustering does not necessarily have to imply direct relations between neighbouring innovators. Neighbouring companies which gain advantage of the same elements in their production environment are clustered in so-called formations. Regional presence of innovators can have important on the innovative capabilities of companies because of the attraction these clusters form for important assets in innovation processes. Innovating companies, for example, make use of the same pools of skilled labour, research infrastructure and availability of venture capital.

Table 5 Presence of innovators active in the same sector in the production environment of innovators and remaining firms by firm size of the innovating and remaining firms (size of subpopulations between brackets), 1994 to 1996.

	Innovators	Other firms
Total number of firms	42 (15348)	28 (31499)
between 10 and 50 employees	41 (11231)	28 (27474)
between 50 and 200 employees	44 (3118)	31 (3468)
more than 200 employees	45 (1089)	33 (556)

Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey

Differences between the figures of innovators and remaining firms are all statistically significant with $\alpha = 0.001$.

Regional presence is calculated as the presence of innovators within Dutch provinces as a share in the total number of firms. The figures are calculated for the total number of firms as well as for the 37 industries distinguished in the previous paragraph. Again, the figures are attached to the micro-level data as a group variable connected to the individual respondents on the basis of their location and principal economic activity. For the regional presence of the total number of innovators we did not find any significant differences between innovating and remaining firms. Table 5 depicts the regional presence of innovators within the same sector in the production environment of innovating firms and remaining companies. On the basis of group comparison between innovators and other companies we can draw the conclusion of a positive connection between presence of innovators in the production environment and innovation. Furthermore, in the connection between shares of revenues from products which can be classified as technologically new or improved in total revenues and regional presence of innovators, we found a weak positive correlation ($r = 0.17$) between regional presence of innovators and innovativeness of the innovating firms. The relation is statistically significant with $\alpha = 0.01$. The relation between regional presence of innovators in terms of the total number of innovators and the shares of innovative products in turnover is marginal ($r = 0.04$).

The descriptive analyses point to the indication that intra-sectoral clustering of innovators is especially relevant for innovation compared to the general presence of innovators.

6 Modelling regional clustering in innovation processes

The above described analyses are descriptive. In this sense, the analyses do not offer us much insight in the role of spatial clustering in innovation processes in terms of causal effects. They also do not correct for mutual correspondence between the various conceptions of spatial clustering and between cluster indicators and other relevant factors in innovation processes such as expenditures on research and development. Insights in these aspects can be obtained through simultaneous incorporating of several (possibly) relevant factors explaining the innovative capabilities of individual firms. Apart from cluster indicators, innovation efforts within the firm are relevant. Because the literature puts great emphasis on knowledge exchange and diffusion, also in a spatially differentiated sense (see for example Maskell and Malmberg, 1999), the importance respondents attach to externally derived information is also included in the analysis. On the output side of innovation, next to the the shares of revenues from products which can be classified as technologically new or improved in total revenues, the effect of innovation on competitive strength, as it is estimated by respondents themselves, is included. Clustering in the production chain is only included as far as it relates to the input side of production. On the output side, we are confronted with interpretation problems in what sense the figures relate to the servicing character of industries for their surroundings or to innovative clustering and knowledge exchange in regional production chains. All variables included in the analyses are summed up in table 6.

For the analyses on which the model is built we used a statistical technique known as structural equation modelling (Arbuckle en Wothke, 1993, Kline, 1998, Byrne, 2001; Ullman, 2001). Important advantage of this technique is the possibility to correct the analysis for measurement errors in the indicators included in the model, through distinguish between latent and observed variables. Latent variables are not directly measured, but assessed indirectly using different indicators of that factor. In fact, structural equation modelling is a simultaneous combination of multiple regression and factor analysis on the basis of an iterative process of testing and modifying a model structure which is initially drawn beforehand on the basis of past research and theoretical arguments. Before setting up causal model structures it deserves recommendation to test the factors on homogeneity. In this way, the risk of gross measurement errors influencing the estimates in causal structures is minimized. Variables, which do not relate in a significant way to the factor to which they are supposed to belong, can be excluded from the analysis. Of course, changes in the initial model structures, however, need strong attention and theoretical argumentation. Because of homogeneity issues, the variables which in table 6 are characterized by an asterisk are not included in the causal model structure. The initial causal model structure is depicted in figure 1.

Table 6 Variables included in the modelling of the relational between regional clustering and innovation

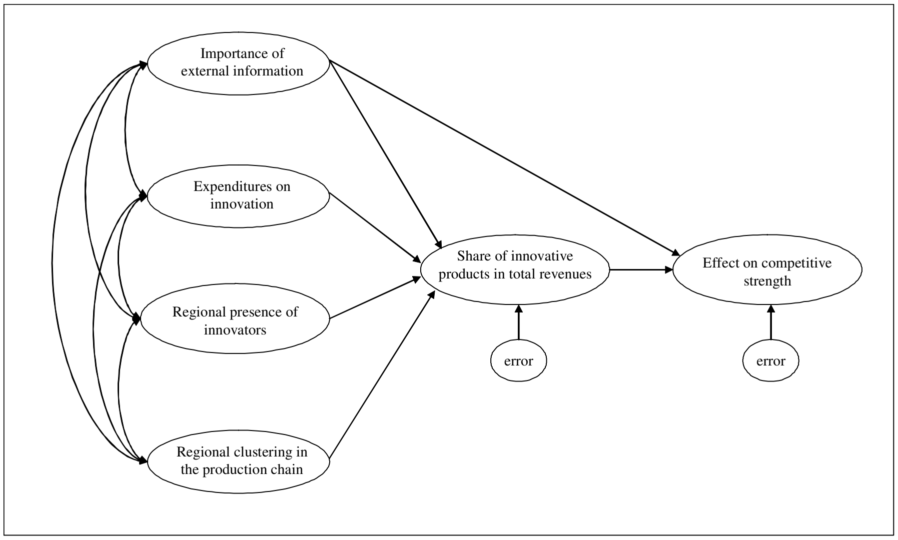
Concept	Variable
Expenditures on innovation	Expenditures on intramural research and development per employee, 1994 to 1996
	Expenditures on extramural research and development per employee, 1994 to 1996
	Expenditures on obtaining licences and patents per employee, 1994 to 1996
	* Expenditures on acquisition of advanced machinery and equipment obtaining licences and patents per employee, 1994 to 1996
	* Expenditures on training and education per employee, 1994 to 1996
Importance of external information	Estimated importance of information derived from customers, 1994 to 1996
	Estimated importance of information derived from suppliers, 1994 to 1996
	Estimated importance of information derived from competitors, 1994 to 1996
	Estimated importance of information derived from knowledge organizations (universities, consultancy and governmental technological institutes, 1994 to 1996
Regional presence of innovators	Share of innovators in the total number of firms for the total number of companies located in the regional environment (NUTS-II) of respondent's location, 1994 to 1996
	Share of innovators in the total number of firms for manufacturing companies located in the regional environment (NUTS-II) of respondent's location, 1994 to 1996
	Share of innovators in the total number of firms for companies active in the sector in which respondents deploy their principal economic activity and located in the regional environment (NUTS-II) of respondent's location, 1994 to 1996

Table 6 is continued on the next page…

Table 6 Variables included in the modelling of the relational between regional clustering and innovation (continued from page 10)

Concept	Variable
Regional clustering in the production chain	Share of deliveries, that have both origin and destination in the regional environment (NUTS-II) of respondent's location and their destination in the sector in which the respondent deploys its principal economic activity, in the sum of deliveries that have their origin in the Netherlands and their destination in the sector in which the respondent deploys its principal economic activity for the total number of deliveries, 1992
	Share of deliveries, that have both origin and destination in the regional environment (NUTS-II) of respondent's location and their destination in the sector in which the respondent deploys its principal economic activity, in the sum of deliveries that have their origin in the Netherlands and their destination in the sector in which the respondent deploys its principal economic activity for deliveries from manufacturing industries, 1992
	Share of deliveries, that have both origin and destination in the regional environment (NUTS-II) of respondent's location and their destination in the sector in which the respondent deploys its principal economic activity, in the sum of deliveries that have their origin in the Netherlands and their destination in the sector in which the respondent deploys its principal economic activity for deliveries from sectors in which the respondent deploys its principal economic activity, 1992
Effect on competitive strength	Estimated effect of innovation on competitive strength, 1994 to 1996
Innovativeness	Share of revenues from technological new products in total turnover, 1994 to 1996
	Share of revenues from technologically improved products in total turnover, 1994 to 1996
	* Share of revenues from technologically new or improved products, which are introduced as new in the market, in total turnover, 1994 to 1996
Innovation in partnership	The development of technologically new or improved products or production processes in active cooperation with other innovating agents. Pure contracting in innovation trajectories is not regarded as innovation in partnership.

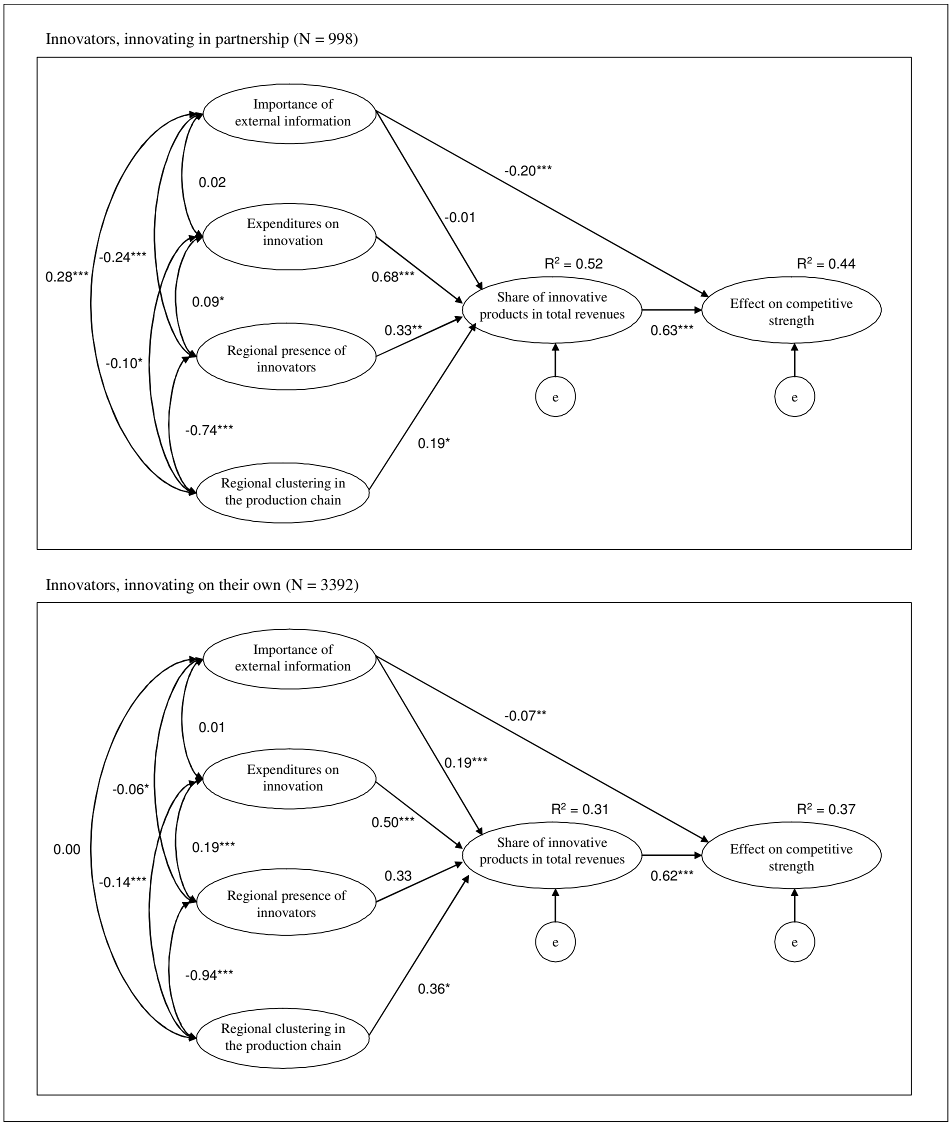
Figure 1 Initial causal structure



Expenditures on innovation, the importance attached to external information and regional clustering in terms of regional thickness in the production chain and in terms of regional presence of innovators, are all supposed to relate positively to innovation output in terms of innovativeness and effect on competitive strength. The direct effect of the importance of external information on competitive strength is supposed to be negative. The aim of innovation is to create, at least temporarily, a monopoly position. On the basis of information already developed outside the innovating company, such a position is not very likely to be established. The model estimations are calculated for both innovators which innovate in partnership and innovators which innovate by themselves. Unfortunately, due to limited sample size, we were not able to calculate the estimates for groups classified by the origin of their partners in their innovation trajectories.

The initial model fits approximately to the dataset with SRMSR = 0.075 and can therefore be accepted (see also the appendix). It is not a surprising research outcome that expenditures on innovation form the most important asset in innovation processes for both innovators that innovate in partnership and innovators which innovate by themselves. As expected, the direct effects of external information on the estimated effect of innovation on competitive strength are, again for both subpopulations, negative. Regional clustering in the production chain shows, for both innovators innovating in partnership and innovators which do not innovate in partnership, a weak positive connection to innovative output as measured by the share of innovative products in total revenues. External information has a positive effect on innovative output, but only for firms, which innovate by own strength. Regional presence of innovators only has a positive effect on innovative output for innovators innovating in partnership.

Figure 2 Model estimates for innovators innovating in partnership and innovators innovating by own strength



Source: TNO Inro (2003) on the basis of Statistics Netherlands, Innovation Survey and University of Groningen/Statistics Netherlands (1999), regionally divided input-output tables of the 12 Dutch provinces

- * Statistically significant with $\alpha = 0.1$
- ** Statistically significant with $\alpha = 0.01$
- *** Statistically significant with $\alpha = 0.001$

7 Conclusions

Regions matter for innovation. Although the effects from regional thickness in the production chain on innovative output are not very convincing given the statistical significance with $0.01 < \alpha < 0.1$, the effect of regional presence of innovators in the production environment is relatively large and statistically significant with $\alpha < 0.01$. Regional presence of innovators, however, is only relevant for the innovative output of innovators innovating in partnership. In relation to Scott's and Storper's (1987) arguments on new industrial spaces the research outcome seems to point to relatively low transaction costs in seeking partners with complementary capabilities and competences in a regional environment that is characterized by high levels of presence of innovating firms. However, given the relatively weak relation with regional embeddedness in the production chain, these partners do not necessarily have to be embedded in regional production networks which manifest themselves in 'hard' supply and delivery coordinated through the market.

Networks matter for innovation. Innovators which innovate in cooperation with other innovating agents experience higher levels of innovative output than their innovating counterparts, innovating by themselves. The scalarity of network links provide some interesting insights. Although most innovators innovate with domestic partners, the relation between partnership and innovative output is relatively strong for innovators engaging in international cooperation, compared to innovators, innovating with domestic partners. However, innovators which engage in partnership with domestically based partners experience higher levels of innovative output than innovators, which do not innovate in partnership. In our descriptive analyses we found indications that differences in innovative output between small and large firms are for the most part explained by differences in international orientation.

Information matters for innovation. Use of external information and access to external competences through cooperation and partnership seem complementary assets. The positive relation between the importance attached to externally derived information and innovation only exists for companies that do not innovate in partnership. This result is surprising, given theoretical contributions which emphasize the importance of information exchange in regional networks of cooperating firms (Maskell en Malmberg, 1999).

Expenditures within the firm matter for innovation. Although external factors outside the firm certainly are of great importance for innovation, first, the internal expenditures of innovating firms on research and development, education and training and obtaining licences and patents, are of crucial importance in explaining innovation.

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Appendix 'Model estimates'

Structural equation models base themselves, unlike multiple regression which bases itself on individual observations, on the covariances between the variables distinguished in the model. In models which are characterized by a positive number of degrees of freedom, the number of equations describing the relation between covariances, exceeds the number of the parameters to be estimated. These models are, in other words, overidentified. Through maximum likelihood estimation, an optimal solution is identified out of all possible outcomes. In this iterative process, the assumptions on the distribution of individual observations are the same as the assumptions made in multiple regression estimations. Given the assumption that the model estimations also apply to the (unknown) parameters in the population, the probability can be derived that the calculated estimates fit to the parameter sin the population. Under the condition that these estimates do not significantly differ from the population parameters, the model can be accepted. In structural equation models, the researcher has a large number of indices at his disposal. G^2 (Kline, 1998) reflects the value of the maximum likelihood estimate and the sample size. In large samples, this test statistic is interpreted as a Pearson χ^2 statistic with degrees of freedom that are equal to the difference between the number of observations and the parameters to be estimated. The value of χ^2 is, however, not interpretable in a standardized way and its value is highly dependent on sample size. The Standardized Root Mean Squared Residual (SRMSR) (Browne en Cudeck, 1993) does not depart from requirements of perfect fit. Models are an abstraction of reality and need to fit approximately to population parameters. Values of SRMSR of 0.05 represent a close fit, values of about 0.08 would indicate a reasonable error of approximation. Models should not be accepted when SRMSR turns out to be more than 0.10.