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Do eco-innovations need specific regional characteristics?

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Abstract

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Jelcodes:Q55,R11

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An econometric analysis for Germany

Jens Horbach

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JEL: Q55, R11, C25

Keywords: Regional and location factors, environmental innovation, mixed effects model

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1 Introduction

Eco-Innovations lead to less environmental impacts or to a reduction of energy use and are therefore crucial for climate protection. Recently, the determinants of these innovation activities have been widely explored (Demirel and Kesidou 2012, de Marchi 2012, Horbach 2008, Horbach et al. 2012). Compared to other, non-environmentally related innovations, regulations and cost-savings are more important for eco-innovations. But, mainly because of the lack of adequate data the literature neglected regional characteristics as determinants of eco-innovations (see Cainelli et al. 2011 as an exception). At the latest since the seminal works of Krugman (1991) the relevance of spatial characteristics for innovation activities has been recognized. Innovation activities are not equally distributed in space because agglomeration effects caused by many firms of the same sector in a region, labor market pooling, other location factors and regional clusters (Blien and Maier 2008) play a crucial role. This paper tries to explore the specificities of eco-innovation concerning location and regional factors for Germany using the establishment panel of the Institute for Employment Research (IAB) in Nuremberg. Do eco-innovations need another regional background, factor endowment and location conditions compared to other innovations?

The paper is organized as follows: Section 2 summarizes the existing literature on the role of location and regional factors for the innovation behavior of firms from a theoretical background and shows some empirical, stylized facts from the literature. Hypotheses are developed to which extent eco-innovations need specific regional and location characteristics. Section 3 analyzes the role of regional characteristics for general and eco-innovations from an empirical perspective. Section 4 summarizes and concludes.

2 Innovation effects of location and regional characteristics

2.1 General innovation

Regional characteristics and location factors seem to be very important for innovation activities of firms. In Germany, the R&D intensity measured by the R&D personnel as a share of total labor force varies from 1.57% (Baden-Wuerttemberg) to only 0.14 in Mecklenburg-Vorpommern (see Gehrke et al. 2010, data for 2007).

From a theoretical side of view, the so-called diamond model of Porter (Porter 2000, see also Eickelpasch et al. 2011) summarizes different strands of literature in a comprehensive way:

Firstly, the regional endowment with natural, human and capital resources, physical, administrative, informational, scientific and technological infrastructure and the quality and the specialization of production factors determine the technological capabilities of a region. Secondly, agglomeration effects play an important role. These effects occur because of the local proximity of (similar) firms, consumers and a fitting infrastructure (see also Eckey 2008). They may be divided in localization and urbanization advantages. Localization advantages denote the positive external effects that may result from the proximity of firms of the same branch. Urbanization advantages occur because of the existence of an agglomeration of firms of different branches and because of typical advantages of highly concentrated urban areas (e. g. more leisure and cultural opportunities and a higher product diversity) (Eckey 2008).

Why does geographic proximity may trigger innovation capacities? In a seminal paper, Audretsch states that "The spillover of knowledge from the firm or university creating that knowledge to a third-party firm is essential to innovative activity. Such knowledge spillovers tend to be spatially restricted" (Audretsch 1998:1). An illustration for this statement may be derived from common labor markets in a region. Because of social embeddedness in a region the mobility of many employees is low so that an employee looking for a new job prefers to find one in the same region. Therefore, these regionally pooled labor markets may easier lead to knowledge spill-overs between regional firms because the new employees enhance the human capital of their new firm by knowledge that they obtained in their old firm. Asheim and Gertler (2005: 291) even resume that "… the more knowledge-intensive the economic activity, the more geographically clustered it tends to be." Following these authors this tendency has been intensified despite the increasing possibilities to exchange information (e. g. by internet platforms) because of the high importance of the so-called "… embedded tacit knowledge" (Asheim, Gertler 2005: 292). This tacit knowledge needs short distances and normally face-to-face interaction. Especially organizational innovations such as the reorganization of production units where patenting or secrecy is difficult may easily overcome short regional distances. Other examples are failures in innovation activities that are rarely published but often diffused within a region.

All in all, the existence and the effects of knowledge spill-overs for innovation outcomes strongly depends on "... the nature of new knowledge in different industrial sectors" (Iammarino and McCann 2008:13). A high amount of necessary tacit knowledge increases the importance of regional knowledge spill-over possibilities.

Furthermore, Porter (2000) also stresses the importance of demand conditions especially the existence of local customers enhancing the productiveness of a firm in a region.

An empirical analysis of the impact of regional factors on innovation requires the development of a set of fitting indicators. Table 1 shows such indicators that are empirically testable.

Table 1: Indicators for location factors and agglomeration effects

Factors following Porters diamond model	Indicators
Hard factors	Proximity to suppliers Availability of high-qualified labor supply Availability of space for business activities Proximity to universities or other research institutions Price or rent levels of business space, offices, energy and water Regional wage level Traffic connections Regional taxes Relationship to public administration
Soft factors	Quality of living conditions (leisure possibilities, residential amenity) Availability of cultural activities (music, theatre etc.)
Related and supporting industries	Presence of competitive related industries
Demand conditions	Proximity to customers

Source: Porter (2000), IAB (2009).

At least for Germany, there is a considerable number of empirical analyses analyzing the importance of location factors and regional characteristics for innovation and performance at the firm level.[1] Eickelpasch et al. (2011) analyze the importance of hard and soft location factors for innovativeness and firm performance for 2,100 East German firms. They find that local cooperation intensity triggers the innovativeness of the questioned firms whereas a strong local competition seems to act as a barrier. Furthermore, the proximity to research institutions and universities and the supply of skilled workers were important trigger factors. This result is also confirmed by Lejpras and Stephan (2011). Broekel and Brenner (2011) detect inter-industry differences in the importance of regional factors for firms´ innovativeness based on an analysis of German patent applications in 2000. Gauselmann and Marek (2012) show that agglomeration advantages are some of the most important pull factors for foreign direct investment in transition countries. Fritsch and Slavtchev (2005) analyze the influence of differ-

[1] Please note that this short literature overview only cites some recent examples and is by far not complete. For a more comprehensive overview see Broekel and Brenner (2011) or Stephan (2011).

ent knowledge sources on regional patenting output. They confirm the important role of quality of university research for regional innovation success.

2.2 Specificities of eco-innovation

Following a widespread definition of Kemp and Pearson (2008) "Eco-innovation is the production, application or exploitation of a good, service, production process, organizational structure, or management or business method that is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and the negative impacts of resource use (including energy use) compared to relevant alternatives".

Following this definition, it is not important if positive environmental impacts have been the primary goal of the innovation activities or came about by chance or as by-product. Consequently, eco-innovations can also be the result of other economic motivations such as increasing market shares or reducing costs (see also Horbach et al. 2012).

As already mentioned, there is a large and recent literature on the determinants of eco-innovation based on this definition but empirical studies analyzing the importance of regional factors of eco-innovations are still rare. One example is Cainelli et al. (2011) especially analyzing the role of local cooperation for eco-innovation. The authors find that networking with other firms and institutions is especially important for eco-innovation.

Some other contributions try to detect specificities of eco-innovation compared to other innovations (e. g. de Marchi 2012, Horbach 2008, Belin et al. 2011) but - because of the lack of adequate data - their empirical analyses neglect the influence of regional factors. Two main results of this literature are that, on the one hand, eco-innovations are more dependent on regulation compared to other innovations. Secondly, cost-savings as motivation caused by material or energy savings are very important for eco-innovations while they have less relevance for other innovations.

But there are also possible regional and location conditions favoring eco-innovations. Many eco-innovations fields are very new (renewable energies, electro mobility) so that they are more dependent on external sources of information and on basic research activities compared to other traditional and more established innovation fields. Therefore, the existence of universities and other research institutions seems to be especially relevant for eco-innovation. These institutions also contribute to the regional availability of high-skilled employees having a "fresh" education in new research fields such as new energy technologies. As information flows seem to be especially important for young technologies, local cooperation networks

may also especially promote eco-innovation. On the other side, sunk costs and path dependencies are not so important for new eco-innovation fields so that the production of eco-innovative products may also offer chances for regions with an under-developed or old industry structure taking the solar valley in Bitterfeld as an example. Therefore, regions looking for new business activities may be more likely to attract eco-innovating firms.

Furthermore, energy intensive industries are more likely to realize eco-innovations because of regulation measures and/or environmental impacts that induce energy intensive firms to innovate. Therefore, regions characterized by an energy-intensive industry structure may be more eco-innovative.

As already mentioned, eco-innovation is highly dependent on regulation. In fact, the environmental policy in Germany is highly centralized, there are only few regional differences but control measures and the cooperation with local authorities may differ between regions. Therefore, the cooperation with local enforcement authorities seem to be more important for eco-innovation compared to other innovations.

From the demand side, the "green" orientation of a region may play an encouraging role for eco-innovating activities. It may lead to a higher local demand for environmentally benign products and to a higher environmental awareness of firms.

3 Econometric analysis of the role of regional variables for innovation activities

3.1 Description of the databases

The analysis of the role of location and regional factors for (eco-) innovation is based on two waves (2005 and 2009) of the establishment panel of the Institute for Employment Research in Nuremberg. The establishment panel was founded in 1993 to get a representative picture of German establishments which have at least one employee subject to social security. The survey is characterized by very high response rates of more than 70%. The 2005 wave contains a filter question that allows for determining whether the firm belongs to the environmental sector or not. The environmental sector comprises goods and services which prevent environmental damage in different fields such as air or water pollution. A share of 6.9% (1117 firms) of all the firms in the sample of the wave 2005 declared to belonging to the environmental sector. In 2009, the firms were asked about the importance of different location factors for their firm. Furthermore, the questionnaire contains information about the innovative behaviour of the firm. The combination of the two panel waves allows an identification of innova-

tive firms within the environmental sector and an analysis of the importance of location factors for these firms. Because of panel mortality, the combination led to a reduction of the number of cases of environmental firms (570 firms) in our sample.
Furthermore, the survey data was combined with regional data on the level of the German "Kreise and kreisfreie Städte" (BBSR 2011, see also the description of the relevant variables in the Appendix).

Our estimation strategy is as follows: In a first step, the (regional and location) determinants of all innovations are explored using an adequate econometric model (see below). The dependent variable inno is binary taking the value 1 if the firm realized an innovation in 2008 and 0 if not. In a second step, the specificities of eco-innovations versus other innovations are analyzed. The sample is now restricted to innovators, the dependent binary variable ecoinno gets the value 1 if the firm realized an eco-innovation and the value 0 in the case of a non-environmentally related innovation.
We apply a two-level mixed-effects logistic regression because variables at the firm and the regional level are considered. This model accounts for the problem that the innovation activities of firms within a region may be correlated (see also Bellmann et al. (2010)and Bellmann et al. (2013) for an application of this approach). The model contains both random and fixed effects.
The model reads as follows (STATA manual 2011): We have to consider a two-level model for a series of 411 clusters (411 regional German units, Kreise and kreisfreie Städte)

$$\Pr(y_{ij} = 1|\mathbf{u}_j) = H\,(\mathbf{x}_{ij}\boldsymbol{\beta} + \mathbf{u}_j)$$

for j = 1; …; 411 clusters, with cluster j consisting of i = 1; …; n_j observations. The responses are the binary-valued $inno_{ij}$ or the $ecoinno_{ij}$. The vector $\mathbf{x}_{ij}$ are the covariates for the fixed effects, whereas the vector $\mathbf{u}_j$ analogously represents the random effects. Because of small numbers of cases in many regions, a random intercept model has been estimated assuming fixed slopes.

Description of the correlated variables

Variables at the regional level: Dynamic is an indicator for the dynamics of a region´s economy defined by the difference between registrations minus de-registrations of trade per capita.

The variable specdum is an indicator for possible spill-over effects, it gets the value 1 if the branch the firms firm belongs to is over-represented in the region. Unemprate2009 denoting the unemployment rate of 2009 and GDP denoting the GDP per capita measure the economic success of a region. Poverty measured by the share of social aid recipients on population indicates the extent to which a region is disadvantaged. Popdens describes the population density of a region and accounts for agglomeration effects. Education as an indicator for the qualification potential of a region denotes the share of German secondary school qualifying for university admission. The variable sharegreen denotes the voting results for the green party.

Variables at the firm level: The variables loc1 to loc12 show the perception of the questioned firms concerning the importance of the different location factors for their firm. The following factors are considered: Proximity to customers (loc1), proximity to suppliers (loc2), quality of the available skilled personnel (loc3), attractiveness of the location for skilled personnel (in terms of leisure and residential amenity, loc4), proximity to research and technology centers and universities (loc5), availability of land for commercial purposes (loc6), price level of land for industrial or commercial purposes and rents (loc7), over regional traffic infrastructure (loc8), regional wage level (loc9), cooperation with local authorities (loc10), local taxes (loc11) and price level for energy and water (loc12).

The technological capabilities are captured by the following variables: R&D gets the value 1 if the firm realizes R&D expenditures, capstocknew describes the modernity of the capital stock, highqual denotes the share of employees with a university degree, furthereducation gets the value 1 if the firm realized further education measures.

The variable export captures the export orientation of the firm, competition captures the self-perceived competition pressure of the firm and demand describes the self-perceived demand situation of the firm. Energintens gets the value 1 if the questioned firm belongs to a energy-intensive branch, such as the chemical industry. Size denotes the size of the firm measured by the number of employees in 2009. The variable age gets the value 1 if the firm was founded after 1990. Subsidies equals 1 if the firm got any financial aid from regional, federal or EU sources.

3.2 Regional and location determinants of general innovations

In a first step, we analyze the determinants of the innovation activities of the whole sample including the firms of the environmental sector (inno as dependent variable, see Section 3.1). The results of our two-level model (see Table 2) show that firms in regions characterized by a high unemployment rate (unemprate2009) seem to be less likely to innovate. The existence of a high unemployment rate may point to two different effects. On the one hand, it may be a region where it is easier to recruit qualified employees (see also Bellmann 2010) but, in many cases, this argument is not so relevant because high regional unemployment rates are often due to the unemployment of low qualified workers who are less important for innovation success. On the other hand, regions characterized by a high unemployment are often economically less successful and offer less agglomeration advantages because of a low developed or old industrial basis. This effect seems to dominate in our analysis.

The analysis of the perceived importance of location factors show that a good quality of the available pool of skilled labor (loc3) and a high value in terms of leisure and residential amenity (loc4) triggers innovation success of the questioned firms. Furthermore, a low price level of land for industrial or commercial purposes and rents (loc7), low energy prices (loc12) and a good over regional traffic infrastructure (loc8) are also important for the realization of innovations.

Firms characterized by a high percentage of qualified (highqual) personnel, a new capital stock and those realizing R&D activities as inputs are more likely to innovate, further education measures also improve the technological capabilities of a firm. Furthermore, export oriented firms are more innovative. A high competition pressure also significantly triggers innovation supporting the view of Arrow (1962). The product demand also increases significantly innovation activities confirming Porter´s diamond model (Porter 2000). The size (sizedum) of the firm is also significantly positively correlated to innovation success due to the fact that bigger firms have more resources to realize innovations. Our econometric analysis also shows a positive effect of subsidies on innovation.

Table 2: Determinants of innovation activities

Dependent variable: inno: 1 Firms with product and process innovations in 2008, 0 Firms without innovations in 2008			
Correlates			
Regional level variables		Location factors	
		Loc1	1.01 (0.18)
Dynamic	1.00 (0.08)	Loc2	0.97 (-0.53)
Popdens	1.00 (0.61)	Loc3	1.18 (3.66)**
Sharegreen	1.03 (1.97)*	Loc4	1.17 (2.87)**
Specdum	0.84 (-4.09)**	Loc5	1.18 (1.59)
Unemprate2009	0.97 (-2.46)**	Loc6	1.00 (0.02)
		Loc7	1.18 (3.02)**
		Loc8	1.15 (3.00)*
		Loc9	1.02 (0.43)
Control variables		Loc10	0.94 (-1.35)
		Loc11	0.92 (-1.54)
Age	1.05 (1.02)	Loc12	1.16 (3.18)**
Competition	1.31 (6.72)**		
Demand	1.24 (5.18)**	Technological capabilities	
Energintens	1.00 (0.04)		
Export	1.01 (6.42)**		
Sizedum[1]	2.22 (3.37)**	Capstocknew	1.32 (5.23)**
Subsidies	1.82 (7.07)**	Furthereducation	2.25 (19.24)**
		Highqual	1.01 (5.16)**
		R&D	6.28 (19.71)**
Two-Level mixed-effects logistic regression reporting odds ratios. Number of observations: 13138, number of groups: 411. Z-statistics are given in parentheses. Wald Chi^2 (28) = 1614.97. LR test versus logistic regression $\|Chi^2\|$ = 222.19. Prob. = 0.00. +, *, ** denote significance at the 10%, 5% and 1% level, respectively. [1] Because of convergence problems, instead of size, the dummy variable sizedum was used (see also the Appendix for a definition).			

3.3 Specificities of eco-innovation compared to other innovations

In the next step, the specificities of the determinants of eco-innovations compared to other, non-environmentally related innovations are explored (see Table 3 for an overview of our main hypotheses and the related indicators).

Table 3: Regional specificities of eco-innovations: Hypotheses and indicators

Hypotheses	Indicators
New green research fields require more external knowledge sources and technological capabilities	Proximity to universities, local cooperation networks (loc5), availability of high-skilled employees (highqual), R&D inputs, further education measures
Green orientation of the region leads to a higher local demand and to a higher environmental awareness of local firms	Votes for the green party (sharegreen)
"Disadvantaged" regions looking for new business activities are likely to attract eco-innovative firms	Regions characterized by a low relevance of urbanization effects (loc4) and a high poverty rate
Cooperation with local enforcement authorities seem to be more important for eco-innovation compared to other innovations	Importance of cooperation with local authorities (loc10)
Because of environmental impacts energy intensive industries are more likely to realize eco-innovations	Firms belonging to branches such as the chemical or the metal industry (energintens)

The results of our two-level mixed-effects logistic regression (see Table 4) significantly support the hypothesis that eco-innovation is highly dependent on external sources. The proximity to research centers and universities (loc5) seems to be highly more important compared to other innovations documented by the odds ratio of 1.7 confirming similar results of de Marchi (2012) for Spain and Belin et al. (2011) for France and Germany.

Table 4: Specificities of eco-innovations compared to other innovations

Dependent variable: ecoinno: 1 Suppliers of environmental goods and services with product and process innovations in 2008, 0 Other innovators			
Correlates			
Regional level variables		Location factors	
		Loc1	1.10 (0.68)
Education	1.00 (-0.29)	Loc2	0.89 (-0.72)
GDP	1.01 (0.85)	Loc3	0.98 (-0.13)
Popdens	1.00 (-1.27)	Loc4	0.72 (-2.13)*
Poverty	1.07 (1.7)+	Loc5	1.67 (2.82)**
Sharegreen	1.01 (0.45)	Loc6	1.01 (0.07)
		Loc7	0.95 (-0.28)
		Loc8	1.37 (2.45)**
		Loc9	0.88 (-0.93)
		Loc10	1.35 (2.20)*
		Loc11	1.34 (1.91)+
		Loc12	0.69 (-2.53)**
Control variables		Technological capabilities	
Age	1.01 (0.10)		
Competition	1.37 (2.56)**	Capstocknew	1.03 (0.20)
Demand	1.37 (2.50)**	Furthereducation	1.72 (3.32)**
Energintens	1.81 (3.93)**	Highqual	1.02 (5.12)**
Size	1.00 (0.92)	R&D	1.23 (1.45)
Two-Level mixed-effects logistic regression reporting odds ratios. Number of observations: 3297, number of groups: 382. Z-statistics are given in parentheses. Wald Chi^2 (26) = 138.99. LR test versus logistic regression $\|Chi^2\|$ = 1.35. Prob. = 0.12. +, *, ** denote significance at the 10%, 5% and 1% level, respectively.			

The hypothesis that eco-innovation may be a chance for "disadvantaged" regions is confirmed by several variables. The attractiveness of the region (value in terms of leisure and residential amenity, variable loc4) seems to be more relevant for other innovations, therefore the typical urbanization advantages do not seem to play an important role for eco-innovations. Furthermore, eco-innovation is more likely in regions characterized by high poverty rates. Eco-innovations are more dependent on a good over-regional traffic infrastructure (loc8) to compensate for the lack of urbanization advantages.

Our results also confirm the hypothesis that energy intensive sectors are more likely to introduce eco-innovations (energintens) whereas the green orientation of the region does not play the expected positive role for eco-innovations. The variable sharegreen remains insignificant.

As eco-innovation is more regulation oriented, especially eco-process innovations have often to be realized in close cooperation with local authorities what is confirmed by the significance of the respective variable loc10 (cooperation with local authorities) and loc11 (local taxes).
The hypothesis that eco-innovation needs more research input compared to other innovations is also confirmed by our results. Eco-innovations are more human capital intensive compared to other innovations confirming the results in the existing literature (see e. g. Belin et al. 2011). This result is shown by the significant relevance of a high-qualified staff for eco-innovation (highqual) and by the significant need of further education measures (furthereducation). All in all, these results point to the fact that eco-innovation is still a very dynamic field where rapidly changing knowledge is required.

4 Summary and conclusions

The existing theoretical and empirical innovation literature stresses the importance of regional factors and location conditions for location choice of firms and their innovation success. Innovation activities are not equally distributed in space because agglomeration effects and specific regional infrastructures may promote innovation success. Concerning environmentally oriented innovations, the so-called eco-innovations, there is a widespread empirical literature analyzing their determinants but - because of the lack of adequate data - the inclusion of regional and location factors has been neglected. This paper tries to close this gap by using the establishment panel of the German Institute for Employment Research in Nuremberg combined with data at the regional level.
The existing literature on eco-innovations shows that these innovations have different determinants compared to other innovations. Especially regulation measures and cost-savings as motivations are more important for eco-innovations. Due to the fact that many eco-innovation fields such as the development of technologies for renewable energy or for electro-mobility require more basic research and more external sources a fitting and specialized regional infrastructure may promote eco-innovation activities. To explore specific determinants of eco-innovations compared to other innovations including variables at the firm and the regional level, a two-level mixed effects logistic regression has been applied. This econometric model takes into consideration that the innovation outcomes of the firms in one regional unit may be correlated.

Our econometric results show that external knowledge sources such as the regional proximity to research centers and universities are more important for eco-innovations compared to other innovations. Eco-innovations seem to be a chance for under-developed, "disadvantaged" regions because regions characterized by high poverty rates are more eco-innovative. Furthermore, eco-innovations are less dependent on the typical urbanization advantages. The so-called solar valley in Bitterfeld may serve as an example. The econometric results also show that eco-innovations need a higher qualification of the personnel connected with further education measures within the firms compared to other innovations.

From a policy side of view, our analysis shows that investment in environmentally related research institutions and universities located in under-developed regions may help these regions to overcome economic problems. Because of the short tradition of many eco-innovation fields path dependencies are not so important but the availability of external knowledge from specialized universities and research institutions is a pre-condition for eco-innovation success.

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Appendix: Descriptive statistics and definitions of the variables

Variables	Description	Mean	St. Dev.
Endogenous var.			
Inno	1 Realization of a product or process innovation in 2008 0 No innovations in 2008	0.50	0.50
Ecoinno	1 Innovation in the environmental sector 0 Innovation in other sectors	0.04	0.20
Regional level			
Education	Share of German secondary school qualifying for university	27.25	5.73
GDP	Gross Domestic Product per capita 2009 (/1000)	28.1	10.1
Dynamic	Registrations of trade minus deregistrations per cap. (* 1000)	1.42	1.13
Popdens	Inhabitants per area (in km^2) of settled or traffic land	2173.5	1323.6
Poverty	(Number of recipients of social aid (2009)/population) * 100	3.89	1.75
Sharegreen	Share of the votes for the green party in 2009	9.83	4.58
Specdum	1 If the sector the firm belongs to is over-proportionally important in the region, 0 other	0.38	0.49
Unemprate2009	Unemployment rate in 2009	9.58	3.71
Control variables			
Age	Foundation of the firm after (1) or before 1990 (0)	0.53	0.50
Competition	High competition pressure (1), low or no competition p. (0)	0.42	0.49
Demand	Good or very good profit situation (1 yes, 0 other)	0.36	0.48
Energintens	1 Energy supply, chemical industry, metal/steel production 0 Other sectors	0.11	0.31
Export	Export share on turnover (in %)	6.97	18.0
Sizedum	1000 or more employees (1), less than 1000 employees (0)	0.02	0.15
Size	Number of employees in 2009	233	1650
Subsidies	Subsidies from regional, federal or EU sources (1 yes, 0 no)	0.09	0.29
Location factors	1 Extremely and very important 0 Important, less important, not important		
Loc1	Proximity to customers	0.64	0.48
Loc2	Proximity to suppliers	0.20	0.40
Loc3	Quality of labor supply	0.64	0.48
Loc4	High value in terms of leisure and residential amenity	0.21	0.41
Loc5	Proximity to research and technology centers and universities	0.07	0.26
Loc6	Availability of land for commercial purposes	0.13	0.33
Loc7	Price level of land for commercial purposes and rents	0.23	0.42
Loc8	Over regional traffic infrastructure	0.31	0.46
Loc9	Regional wage level	0.28	0.45
Loc10	Cooperation with local authorities	0.38	0.49
Loc11	Local taxes	0.27	0.45
Loc12	Price level for energy and water	0.44	0.50
Technological capabilities			
Capstocknew	State-of-the-art capital stock (1), older capital stock (0)	0.17	0.38
Furthereducation	Further education measures (1 yes, 0 no)	0.60	0.49
Highqual	Share of employees with university degree (in %)	9.64	19.0
R&D	Existence of R&D activities (1 yes, 0 no)	0.13	0.33