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Location of a Competitor and the Regional Innovation Activity of Industrial Systems in Transition Country–Poland's Case Study

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

Aims: Spatial proximity with competitive enterprises is a factor influencing the acceleration of the technological progress in industrial systems in the most developed countries, but is it like that also in Poland? The main objective of the conducted studies was the identification of the effect of distance from the nearest competitor on the innovation activity of the selected regional industrial systems in Poland.
Study Design: Surveys were conducted in the years of 2007-12 on a group of 2 434 industrial companies in four diverse provinces located in different parts of the Poland-Masovian, Greater Poland, Silesian and Swietokrzyskie.
Place and Duration of Study: Faculty of Economics and Management (university in Zielona Gora), between October 2007 and June 2012.
Methodology: The methodical side of analyses was based on the theory of probability – the probit modelling.
Results: The obtained results of the analyses indicate, that both the location and the current level of the economic development of the analysed provinces do not influence the diversity of the innovation activity of the regional industrial systems. Therefore, the discussed regularities in Poland have the

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system nature (against isolated nature). The challenge to creating cluster structures and facilitate their development in Poland in the horizontal approach, taking into account the obtained results of studies, will be extremely difficult to achieve. The knowledge deficit and low own abilities create areas of local system technological gaps – impossible to take innovation action between competitor in the local spatial proximity. The regional level in any case did not show significant statistical co-dependencies, what proves that this level of aggregation currently remains neutral for the implementation of the innovation activity. Just the beyond regional distance from nearest competitor (especially international) allow the acceleration of innovation processes. So, industrial enterprises in Poland are much more connected to the international innovation networks, than are depending on local or regional technological trajectories.

Conclusion: The obtained research results indicated a different effect of the spatial proximity of competitors in Polish regions on the innovation activity of the industrial systems compared to the most developed countries. A new showing up technologies should improve that image of our future. Strong international connection will be more important for innovation activity and knowledge flow in Poland, than close physical distance to the potential collaboration firms.

Keywords: Innovation; competitor; system; region; industry; transition country; Poland.

1. INTRODUCTION

Territorial system (milieu approach) is understood as a space in which are developing interactions between the participants and the process of acquiring knowledge, that lead to the generation of innovative goods and through the learning process, leading to the convergence of the effectiveness of forms of cooperation [1]. Studies on the objectives, structure and meaning of the space was a field of research in such countries as Germany and the United Kingdom and less in the United States, Canada, Austria, Israel and Sweden [2,3,4,5,6]. The growing importance of geographical proximity often resulted from a desire to replicate typical solutions for Silicon Valley, currently treated as a pattern approach [7]. It was concluded that spatial factors, market and competitive position, technological trends and collaboration, as well as technology policy, are important factors in the business environment [1].

Establishment and functioning of clusters intuitively suggests the existence of agglomeration economics in relation to innovation processes. M. Prevenzer and L. Zucker demonstrated, on the example of biotechnology cluster, tendency to form clusters of innovation, which also confirms the importance of location in the area of high technology [8].

Sources of the companies' advantage within the cluster and the degree of their concentration are dependent on balance between the competition and cooperation. There is no contradiction between cooperation and competition. Cooperation between companies may help increase their innovation level, in order to achieve or maintain their comparative advantage. For this reason, the benefits from cooperation may outweigh the negative effects associated with the "curvature" of competition and diseconomy of the scale [9].

Research works of M. Dodgson and S. Hinze on the increase of importance of the horizontal cooperation and developed by them set of indicators suggest that the understanding of the nature and importance of competition and the spatial proximity for the labour division in innovations, and the quality and effectiveness of the regional innovation systems are still unclear [10].

The innovation and cluster policies are connected in parallel with different components of the regional network of innovation, they favour the horizontal linkages, to stabilise the system habits, what is reasonable in highly developed countries. Interactions shaping the innovation habits occur in the "catching up" type of countries, however more in the vertical than horizontal systems. The latter are naturally an incidental phenomenon. Unlike in countries characterised by a large, calculated for a few decades, technological gap. Thus, it is not a system anomaly, but a typical backwardness in the development of institutional mechanisms, which require time [11].

The relatively high degree of concentration of cooperative compounds for the vertically unrelated companies in the same region, means the relatively high role, which is for the innovation activity played by the geography economy. This

is consistent with the results of many analyses showing that the innovation activity in a given technological field aims at the high concentration in space [12].

M.E. Porter in the part of his studies on the competitive advantage noted that many states in the USA and regions in Europe have oriented their policies towards the promotion of cooperation between enterprises [13]. The approach of local authorities involving the preference of the support for horizontal cooperation networks at the expense of the vertical ones is not clear in the foreign literature, not to say incorrect, and inclining towards the advantage of the specific solutions should have strong fixation in the studies conducted in particular countries, taking into account their specificity.

Trust strengthens mutual benefits resulting from the relations between companies. This confirms the thesis that it can be stronger in geographically concentrated networks than in case of the distributed relationships [14]. The consequence is that the increasing importance of tacit knowledge to achieve and maintain competitiveness proximity is more important, because it is realized through interpersonal, face-to-face contacts and the development of personal relations based on trust that tacit knowledge can be more readily shared [15]. Then the transactions are carried out on a small scale, are unpredictable

The horizontal local networks (spatial proximity) should at the same time have essential links with the “outside world” in order to absorb knowledge generated outside the region to boost its innovation activity. Concentration to a greater or lesser extent on local connections may influence the worsening of the competitive position of companies [16].

Empirical analyses of the relations between the habit of cooperation and the quality of the innovation system in the regional perspective do not lead to the clear conclusion that the focus on cooperation in the region determines the innovation activity [17]. Research conducted by M. Fritsch in the regions of Vienna and Slovenia showed that “cooperation is positive for innovation”, but this hypothesis is too harsh to confront it with reality.

There is a further need for studies, which will test the empirical ideas and will complement and develop the theoretical constructions of such concepts like “the learning region”, “innovation environment” and “industrial districts”. Especially interesting in these cases seem the countries undergoing the transformation of the economy, where there was brought the destruction of many of the previously help cooperative compounds (networks of connections) and indicated the inadequacy of popular assumptions, concepts and boundary conditions of the economic development in the developed countries, what puts into question the meaning of the direct transfer and application of new solutions to the ground of a country like Poland [18].

So far, only few work was devoted to innovation in peripheral regions in less developed countries [19]. In these areas, the infrastructure of innovation is generally less developed, than in the regional centers [20]. Therefore, in order to accelerate technological progress it should begin to overcome barriers to the periphery [21], to which we can include: resistance to change, lack of financial resources, the higher (less predictable) risk factor, lack of skilled workers, the distance from competitor, R&D units and business support organizations, low level of entrepreneurial culture, the low penetration by government programs [22].

Based on the presented theoretical solutions there was formed a hypothesis that the phenomenon of competition in the regional dimension contributes to the acceleration of innovation processes in Polish provinces.

The main objective of the conducted studies was the identification of the effect of the distance from the nearest competitor on the innovation activity of the selected regional industrial system in Poland.

Surveys were conducted in the years of 2007-11 on a group of 2 434 (the number of filled in questionnaires) industrial companies in four selected, diverse provinces located in different parts of the country – Masovian, Greater Poland, Silesian and Swietokrzyskie. There was chosen four provinces located in Poland with different economic development level, different location and different connection to international markets, to show, that despite of the differences determinants for innovation activity in Poland, are similar. Masovian and Silesian are most well-development regions (central and south Poland) , Greater Poland is large and medium development (western Poland) and

Swietokrzyskie is less-development (eastern Poland).

2. METHODOLOGY

The methodical side of analyses was based on the theory of probability – probit modelling. When a dependent variable takes dichotomous values, the possibilities of using the popular multiple regression, widely used for quantitative phenomena, are limited. The problem can be solved by an alternative solution – the logistic regression [23]. Its advantage is that an analysis and interpretation of results are similar to the classical regression method, hence the methods of selecting variables and testing the hypotheses have a similar pattern. There are, however, also differences, which include: more complex and time-consuming calculations and production of the residual plots usually do not contribute significantly to the model [24]. In a model where the dependent variable can equal either 0 or 1, the expected value of the dependent variable may be interpreted as a conditional probability of an event at given independent values.

The forerunners in using the logistic curve were P.F. Verhulst and R.F. Pearl. A full model was not used, however, until 1994 and 1953 by J. Berkson [25].

Generally, the logistic regression is a mathematical model which can be employed to explain the impact of several variables X1, X2,..., Xk on a dichotomous variable Y. If all the independent variables are qualitative, the logistic regression model is equivalent to a log-linear model. To describe such a phenomenon one could also employ the logit regression [26].

The assumptions common for all those models are as follows [27]:

- The data comes from a random sample,
- *Y* can take only two values: 0 or 1,
- Subsequent *Y* values are statistically independent,
- The probability that Y=1 is defined by a normal distribution (NCD) for a probit model or a logistic distribution (LCD) for a logit model,
- There is no perfect linear relationship between X_i variables (no co-linearity of independent variables).

In the methods with a dichotomous variable, the parameters are estimated according to the maximum likelihood (ML) method. According to its rules, a vector of parameters is searched for which gives the highest probability of arriving at the values observed in the sample [28]. Generally, the application of the ML method requires formulation of a likelihood function and finding its extreme value, which can be done in two ways: analytical and numerical. Despite its complex procedure, the ML method has gained popularity since it can be applied to a wide array of models, including models with variable parameters, complex delay structure models, heteroscedastic models, and nonlinear models. The features of the ML method, even for small samples, are in many cases much better than other alternative estimators.

Non-linear estimation comprises six algorithms to find the minimum of the loss function. It allows arriving at best estimators for a given loss function. Each of those methods uses a different strategy to find the minimum of the function. The following algorithms can be used [27]:

- quasi-Newton algorithm,
- simplex,
- simplex and quasi-Newton algorithm,
- Hooke-Jeeves pattern search method,
- Hooke-Jeeves pattern search method and quasi-Newton algorithm,
- Rosenbrock pattern search.

The study used the group of four independent variables: the location of nearest competitor (locally, regionally, country and abroad). Dependent variables in this case are mainly:

a) The size of expenditures on the innovative activity in connection with their structure (research and development, investment in new machinery and equipment, investments in buildings and structures, land or new software),
b) The implementation of new processes and products taking into account the specific solutions (new technological processes and new products),
c) The subjective approach to the innovative cooperation (suppliers, customers, competitors, universities, R&D units and foreign research institutes).

Independent variables adopted to the studies determine the set of reference planes, which characterise the innovative activity of economic entities, consistent with the methodology used for the OECD countries [29], what allows for the utilitarian interregional and international comparison. A decision was made to build one

factor models, mainly due to large difficulties in the interpretation of the probit modelling there was additionally omitted the possibility for auto-correlation on the side of independent variables, due to their excluding nature. Given the set target and research hypothesis, 288 probit models were constructed, from which only a part reached the statistical significance. The different develop regions level of regions allows to carry out analyses on the evolution of the studied industrial systems.

Each questionnaire was entered to the Excel spreadsheet for initial processing based on formal logic. The actual calculations were made with the Statistica software.

The presentation and interpretation of the models was limited to their structural form. The tables included only the models, including the parameters, satisfying the condition of the statistical significance. All models were verified by some statistical test: t-students (independent variable), chi-square (model) and significant probability (model). Problem of system survey is to collect many questionnaires. So, questions should be easy to answer. That's why all variables (input and output) have a binary compositions – only four possibilities: (0;0), (1;0), (0;1), (1;1). Models with many independent variables was unable to achieved from this point of view – problem of interpreting possibility values and autocorrelation independent variables (possibility only 0 or 1 achived). The positive sign occurring by the main parameter indicates that the probability of the occurrence of the given phenomena is statistically significantly higher in the given group of companies than in the rest group of all subjects. The negative sign can be interpreted as the opposite phenomenon. Probit modelling is an increasingly popular tool to examine economic phenomena, and the results obtained this way constitute only a selected fragment of the effects of studies conducted by the author in this area in all provinces in the country.

3. RESULTS AND DISCUSSION

3.1 The Swietokrzyskie Province

Given the frequency of the occurrence of models with statistically significant parameters in the Świętokrzyskie province, it can be stated that the distance from the nearest competitor quite often determines different areas of the technological activity in the region (Table 1).

If the competing subject is in the immediate vicinity (locally) then industrial companies less often show the tendency to implement innovation processes. This results from the problem of the system isolation of companies and the low level of their original innovation abilities – resulting in total from the low maturity of the market mechanisms. The observed phenomena concern several planes of the innovation activity (four models with statistically significant parameters). The discussed problems do not occur in a group of subjects, for which the competitor is located outside the region, but not outside the borders of the country. Unfortunately, there are not many units like that in the region (28,5%), nonetheless, they prove the necessity to maintain close contacts with subjects operating on the market, at least domestic, which actuates the flow of knowledge and gives access to its latest aspects, despite the need to overcome the distance barrier.

Table 1. The form of probit with the independent variable "distance from the competitor", in models describing the innovation of the industry in the Swietokrzyskie province

Innovation attribute	Location of the nearest competitor	
	Locally	In the country
Expenditures for the B+R activity	-,39x-0,33	-
Investments in the previously not used fixed assets	-	+,65x+0,69
Computer software	-,43x+0,65	+,51x+0,33
Implementation of new technological processes (including):	-,43x+0,65	-
a) by-production systems	-.42x-0.32	+.37x-0.58
Cooperation with competitors	-	+,68x-2,01
Cooperation with universities	-	+1,31x-2,44
Innovation cooperation in total	-	+,42x-0,53

** P = .05*

Table 2. The form of probit with the independent variable "distance from the competitor", in models describing the innovation of the industry in the masovianprovince

Innovation attribute	Location of the nearest competitor	
	Locally	In the country
Expenditures for the B+R activity	-.54x-0.15	+.50x-0.50
Computer software	-.37x+0.46	+.30x+0.23
Implementation of new products	-.30x+0.52	+.31x+0.31
Implementation of new technological processes (including):	-.42x+0.65	+.32x+0.39
a) manufacturing methods	-.24x-0.05	-
b) by-production systems	-.42x-0.32	+.37x-0.58
c) support systems	-.31x-0.73	-
Cooperation with PAN units	-.71x-1.76	-
Cooperation with national JBR	-.37x-1.24	-
Cooperation with foreign JBR	-.85x-1.86	+.70x-2.34
Cooperation with recipients	-.33x-0.67	+.34x-0.89
Innovation cooperation in total	-.30x-0.05	+.32x-0.26

** P = .05*

3.2 The Masovian Province

Analysing the influence of spatial aspects on the innovation of companies it is worth to mention at the beginning that also in this case the geography plays a significant importance for the shape of innovation processes in the region. Given the frequency of the model occurrence with statistically important parameters it can be stated that the distance from the nearest competitor determines different areas of the technological activity (Table 2).

If the competing entity is in the immediate vicinity, also locally, then industrial companies are less often characterized by the tendency to implement innovation processes. Although the presented case belongs to the group of the most developed provinces in Poland, we observe analogous dependencies regarding the Świętokrzyskie province connected with the system insulation of companies and the low level of their original innovation capacities. The observed mechanisms apply to all planes of the innovation activity (twelve models with statistically significant parameters), what proves that in the developed province the identified geographical dependencies occur even stronger. The reason for this is the strong link between the region with the domestic industry. Therefore, the distance from a competitor is limited to this level. The discussed problems do not occur, as before, in the group of companies, for which the competitor is located outside the region, but not outside the borders of the country. Such entities are also a few in the region (23,4%), nonetheless, they prove the sufficient national aggregation to maintain the high dynamics of the knowledge flow, giving access to the latest technology, despite the imperative of the geographical barrier.

3.3 The Greater Poland Province

In case of relations of the studies entities with competitive companies in the Greater Poland province there can be noticed two general conclusions. Distances from the competitor often influence the shaping of the innovation activity in the region. When the competitor is located further away – not locally, then the innovation activity of the industry in the Greater Poland province is higher (Table 3). In this case the national level is critical – twelve models with positive signs by the statistically significant parameters. At the same time the foreign location of the competitor also has a positive influence in this region the shaping of the innovation activity of the analyzed companies. Differently than it was previously considered in two cases.

The short distance from the competitor (local) does not contribute to the acceleration of progress, quite the opposite. The opposite situation takes place for contacts in the country and abroad. This probably results from the fact of weakness of the inner industrial system characterised by high deficit of knowledge and resistance in its flow. This does not change the fact that even the regional level does not favour the implementation of the innovation activity. This dismisses the chances for the possibility to create clusters in the horizontal dimension. The presence of models for the international distance to competitors result due to the localization of

this region in the Western Poland and its closeness to the countries of Western Europe.

3.4 The Silesian Province

In the last considered province the distance from the nearest competitor also significantly determines the innovation activity within its borders (Table 4). Just as before, also this time, the further the competitor is located from the studied company, the formation or implementation of new solutions takes place more often. The critical point is the boundary between the local territory and the others (including the region).

Table 3. The form of probit with the independent variable "distance from the competitor", in models describing the innovation of the industry in the Greater Poland province

Innovation attribute	Location of the nearest competitor		
	Locally	In the country	Abroad
Expenditures for the B+R activity	-.44x-0.23	+.53x-0.50	+.46x-0.38
Investments in the previously not used (including):	-	+.24x+0.59	-
a) in buildings, premises and lands	-	-	+.57x-0.73
b) in machines and technical devices	-	+.21x+0.34	-
Computer software	-.20x+0.22	+.21x+0.11	-
Implementation of new products	-.24x+0.46	+.33x+0.30	+.65x+0.36
Implementation of new technological processes (including):	-.40x+0.80	+.32x+0.58	-
a) manufacturing methods	-	+.21x-0.15	-
b) by-production systems	-.45x-0.29	-	-
c) support systems	-.36x-0.62	+.37x-0.83	-
Cooperation with suppliers	-	-	+.50x-0.74
Cooperation with PAN units	-	+.89x-2.98	-
Cooperation with universities	-.48x-1.65	+.80x-2.08	-
Cooperation with national JBR	-.84x-1.22	+.66x-1.62	-
Cooperation with foreign JBR	-	-	+1.11x-2.12
Cooperation with recipients	-.21x-0.84	-	+.61x-0.93
Innovation cooperation in total	-.29x-0.17	+.29x-0.34	+.69x-0.29

** P = .05*

Table 4. The form of probit with the independent variable "distance from the competitor", in models describing the innovation of the industry in the Silesian province

Innovation attribute	Location of the nearest competitor		
	Locally	In the country	Abroad
Expenditures for the B+R activity	-.56x+0.06	+.57x-0.28	+.51x-0.16
Investments in the previously not used (including):	-.26x+0.99	+.32x+0.81	-
a) in machines and technical devices	-.25x+0.77	-	-
Computer software	-	-	+.92x+0.63
Implementation of new technological processes (including):	-.29x+0.90	+.36x+0.71	-
a) manufacturing methods	-.28x+0.23	+.38x-0.04	-
b) by-production systems	-	+.36x-0.49	-
c) support systems	-.41x-0.34	-	+.47x-0.50
Cooperation with PAN units	-.76x-1.87	-	+.97x-2.14
Cooperation with universities	-.56x-1.38	-	1.02x-1.63
Cooperation with national JBR	-.31x-1.02	+.31x-1.21	-
Cooperation with recipients	-.25x-0.58	-	+.74x-0.71
Innovation cooperation in total	-.21x+0.10	+.30x-0.05	+.60x-0.00

** P = .05*

In other words, the unfavourable location is narrowed down to the nearest one, what means that the represented technological level and competition in the local gap are weaker and do not favour the stimulation of the development of new products and technologies. Since the increase in the distance constitutes in the literature the limitation for the implementation of innovation processes, then the opposite results obtained in the study prove that the local dimension of competition is not sufficient to stimulate the innovation in the region. This, in turn, suggests the need to overcome the geographical barrier for the improvement of technological parameters of the offered products. While what is positive is the argument that the discussed difficulties have only the local nature. The presence of models for the international distance to competitors result due to the strong connections of this region with FDI's and export-oriented production.

Geography actively and strongly influences the involvement of the industry in the region into the innovation activity. The present economic potential of the province, similarly as in other considered cases, over the years from the perspective of horizontal section relations did not create the strong industrial system being able to compete on the external market (the lack of the element supporting the self-development), although in this case there can be observed symptoms of the improving situation.

4. CONCLUSION

The aim of the conducted studies was the identification of the influence of the location of the nearest competitor on the innovation behaviours of companies in the selected regional industrial systems in Poland. For the analysis there were adopted four diverse in terms of location and economic level regions in the country – Masovian, Greater Poland, Silesian and Swietokrzyskie provinces.

Research conducted in the most developed countries show that the geographical proximity influences the acceleration of the technological progress and transfer of technologies between the companies. The spatial close-up in high-tech industries constitutes a significant support point for innovation systems located in such countries. However, in Poland we are dealing with the permanent and inherent lack of knowledge on the regional level, hence it is difficult to create innovation clusters self-sustaining development. On this basis there was created the scientific doubt whether we are dealing with similar mechanisms in the country classified as the group of "catching up" type of countries?

The obtained results of the analyses, based on the theory of probability, indicate that both the location and the current level of the economic development of the analysed provinces do not influence the diversity of the innovation activity of the regional industrial systems. Therefore, the discussed regularities in Poland have the system nature and are common for all provinces in the country, It's worth to mention, that similar researches were provided by author for others regions, too [30].

Creating clusters in the horizontal (system) approach in Poland, taking into account the obtained results of studies, will be extremely difficult to achieve. The knowledge deficit and low own abilities create areas of local system technological gaps. The regional level in any case did not show significant statistical co-dependencies, what proves that this level of aggregation currently remains neutral for the implementation of the innovation activity. The geographical proximity in this grasp remains the factor stimulating innovation attitudes, but in highly developed countries, which do not include Poland. Perhaps at this stage of development more significant for the national companies is the technological proximity independent of the distance or the opposite proportional to it, i.e., the greater the distance from the nearest competitor, the greater the occurrence of the technological closeness, resulting in the acceleration of innovation processes in the domestic companies. Because only the national location or the international one of the nearest competitor determines the transfer of technology. Although, international literature favors spatial proximity in well-development countries, it seems that new channels of modern economy (internet and improved communication) favor such possibilities in catching-up countries – technological gap. The distance to main competitor does not work in the same way, but evolution's direct into well-development economy, should change this trajectory, but we don't know what new solutions brings us a technology development. New products and processes in this area can restrict significance the spatial proximity concept for all economies in a long term.

Companies in Poland are still at the stage of absorption of technology originally developed outside the region's borders – in the country or abroad. Particularly unfavorable conditions for the innovation activity occur in the regional industrial systems at the local level. On this basis it can be concluded that as long as Poland is not in the group of the highly developed countries (strong high-tech region), the theory of the "new economic geography" in terms of studies conducted on the pages of this article will have a limited use.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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