

ENDOGENOUS OR EXOGENOUS INNOVATION DEVELOPMENT IN INDUSTRY ON REGIONAL LEVEL?

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Abstract At the moment endogenous growth theory has become increasingly popular in the world of science, particularly in developed countries. This article aims to show, for two regions case, the needs and sense of applying this theory in the Polish regions. Due to the low level of economic development of many Polish regions, they are unable to grow in a comparable rate as regions in developed countries. This explains the economic divergence between Polish regions and the highly developed regions of Europe and the World. Stimulating economic growth is insufficient in such cases, because of the weakness of its internal factors. Therefore it is important to strengthen an external impact to keep internal development. It means that the endogenous growth theory is no reason to exist, in conditions of poor Polish regions. Without external inputs there can't be convergence processes. Therefore, the economic development of the Polish regions should be based on the exogenous growth theory.

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INTRODUCTION

While studying the literature concerning theories of modern economic growth, we frequently find two groups of theories: exogenous and endogenous. The criterion assigning the theory to the specific group depends on the location of forces. Endogenous growth is the result of endogenous (internal) forces whereas the Model of Exogenous Growth is based on exogenous (external) forces.

The first attempts to create theories of endogenous growth go back to the beginning of the 1960s, when there were published the works of N. Kaldor, J. K. Arrow and N. Kaldor with J. A. Miralessa (Malaga, 2009).

In his 1961 work N. Kaldor wrote that economic growth occurs based on the cyclic process, stimulated by growth factors, and its effects concentrate on a small geographic area. Thanks to the agglomeration benefits, business activities are likely to concentrate on creating the centres of business activities,

which are called clusters. The N. Kaldor's model also indicates the different endogenous growth factors, such as: speciality, scale benefit effect or state interventionism. It is worth noting that as far as 1980s the interventionism has been considered the exogenous factor, shaping the conditions of regional growth. At present its role in the shaping of endogenous growth is highlighted. Interventionism should inspire rapid growth conditions, within the intraregional economic policy (Amin, 1999).

Rapid growth of the interest with theories of endogenous growth fell, however, on the 1980s and 1990s, when there appeared the main growth models by P. Romer (1986) and R. E. Lucas (1988). Those theories are based on the Assumption that production volume is a function, which depends on the level and technological capital. What is interesting is the fact that they do not treat technological level as an exogenous variable, like in classic models, but as an endogenous variable. This results from the fact that the level depends on the expenses size made

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by companies and authorities in the specific region. Apart from that, P. Romer points to the fact that there is a stronger barrier for the development of a region or country, meaning the gap in technological knowledge and not the capital barrier and investment opportunities (Romer, 1990). Romer's Model also indicates that regions may vary in terms of wealth and level of economic growth. Rich regions can be characterized by better access to science and research facilities equally in terms of quantity and quality. In such regions there may be more people working in the industries of science and research. However, weaker regions won't reach welfare growth, until the improvement of their technological level. Such situation supplies to the progressive divergence of regions with regard to the economic growth.

L.A. Rivera-Batiz and D. Xie articulate in a similar style. According to their thesis the free trade in a model of endogenous growth considering high-end technology, associated with the development of research-development segment, leads to the union of the regional income. People have to keep in mind that convergence depends on the mobility of the capital and the process of diffusion innovation, which is not always probable in case on weaker regions (Rivera-Batiz & Xie, 1993).

As it has been mentioned before, endogenous theories are based on the postulation that the technological level was treated as a endogenous variable that depends on the factor located inside the studied object. It is an apparent thesis in case of well-developed regions. However, it does not concern most of Polish provinces. Therefore, a question arises if the development in Polish reality is based on the impact of the internal or external conditions, and therefore should it be treated as an endogenous or exogenous? Theoretical currents have described dynamism and consistency of technological development, known as the evolutionary and neo-schumpeterian school. The innovation process in those concepts on the company level is thought to be a set of activities that are interconnected with each other and bound by mutual feedback. Therefore, innovation is the consequence of an interactive process of studying, which frequently uses a few actors from the interior and exterior of a company (Lundvall, 1992).

Innovation and its diffusion therefore result from the interactive and collective network process, personal and institutional connections that develop as time goes by. They have the responsibility for answering

in the area to the challenges of the "new economy": globalisation and acceleration of the technological change, as a result creating an opportunity of the economic growth in the underdeveloped regions.

Observations which were made in the most developed countries illustrate that in spite of the growing significance of the economic internationalization, the area still seems to be the alternative chance of existence and development of small and medium businesses sector in the constellation of the new global market. Due to that fact one of the main objectives of the regional policy in the UE is to guarantee the smooth adaptation of industrial structures in terms of global changes in the social, economic and technological factors (Reid, 2000).

In the past 20-25 years innovation systems became the subject of theoretical-empirical studies. This attitude concentrates on the determinants of expansion and diffusion of the innovations of the product and process. It's being are the relations happening between the interior and exterior region participants (Sternberg, 2000). Conclusions derived from the performed research demonstrate that the production subjects attain better success when they are the essentials of the intense network integration.

The outlined conceptual framework has set off the taking up of the dilemma of confronting endogenous and exogenous factors on the innovativeness of the regional industrial systems. Nowadays, the hypothesis of endogenous expansion is becoming increasingly popular in the world of science, especially in well-developed countries. In this framework the fundamental theory of the conducted study was the report that the progress of the researched regions in Western Poland as well as other underdeveloped regions of Poland mainly depends on the measure of endogenous factors.

A skillful recognition of factors deciding about the line of innovation processes as well as their restrictions in the national economic system, forms the foundation for creating diversified paths of the expansion of the network of innovation that comprise the national and interregional specification to accelerate the creation, absorption and diffusion of technology.

The main aim of the study was an effort to demonstrate, on the basis of two provinces from Western Poland, the opportunities and legitimacy of the application of the hypothesis of endogenous growth in underdeveloped regions.

The presented conclusions have only got the representative nature and they have been confirmed in half of the country's regions.

Current analyses have been conducted on the basis of the questionnaire obtained from a group of 951 industrial enterprises (457 – West Pomerania, 492 – Lower Silesian) in the years 2009-11. The essential way of collecting data was a process that combined a primary phone conversation with sending the questionnaire by mail – traditional or e-mail.

METHODICAL CONDITIONS OF CONDUCTED RESEARCH - PROBIT MODELLING

Methodical part of analyses was based on the Theory of Probability. The eighteen variables included (OECD, 2005):

- a) the occurrence of the expenditure on innovation activity with reference to their construction (research and development, investing in new machinery and technical equipment, investing in buildings and grounds, new software),

$$Y_{1i} = \begin{cases} 1, & \text{if the expenditure was present} \\ 0, & \text{if the expenditure was not present} \end{cases}$$

- b) introduction of new products and processes, also including detailed explanations in this respect (new products, new technological processes),

$$Y_{2i} = \begin{cases} 1, & \text{if a new solution was introduced} \\ 0, & \text{if a new solution was not introduced} \end{cases}$$

- c) innovation collaboration in subject approach (with suppliers, competitors, customers, universities, R&D centres, foreign research institutes),

$$Y_{3i} = \begin{cases} 1, & \text{if there was a cooperation} \\ 0, & \text{if there was no cooperation} \end{cases}$$

Autonomous variables used in the study included: the nature of the company's possession (state, foreign, mixed), variety of sales (local, regional, national, international), remoteness to the nearest competitor (local, regional, country, foreign), the nature of the relations maintained with the competitor (only essential, close cooperation), the distance to the key provider (local, regional, country, foreign), nature of

the relations maintained with the provider (crucial, close cooperation), distance from the main client (local, regional, national, foreign), nature of the relations maintained with the client (crucial, close cooperation), which were recognized by the owners of the company on the basis of the performed investigation.

All independent variables were adopted as a set of reference planes that illustrate the companies' innovation activity adopted based on methodologies that were used for OECD countries (OECD, 2005)

If the dependent variable reaches dichotomous values which are normally adopted in case of quantitative phenomena, we cannot adopt the multiple regression. For this problem the alternative solution is to adopt the probit regression. Its plus is that the analysis and interpretation of results is alike to the typical method of regression. Hence, the ways of variables selection and hypothesis testing have a similar scheme. Even though there are also visible some differences, as for instance the more complex and time consuming calculations or the value calculation and preparation of charts presenting the reminder often do not contribute anything significant to the model (Stanisz, 2007).

In case of a model in which the dependent variable achieves the value of 0 or 1, the value of the expected variable may be interpreted as the conditioned probability of the realization of the given incidence at fixed values of independent variables. The application of probit modelling allowed the assessment of the occurring possibility of diverse innovative behaviors depending on the adopted boundary conditions.

Estimation of parameters in methods containing the dichotomous variable is performed by a method of the greatest credibility. In accordance with its principles, one needs to locate a vector of parameters that can guarantee the greatest probability of obtaining values observed in the sample (Welfe, 1998). In a few words, the application of method of the largest credibility requires formulation of a credibility function and finding its extreme, what may be performed in an analytical or numerical way. In spite of a fairly complicated form the method of the largest credibility has become popular, as it may be applied in case of the broad array of models together with those with variable parameters and those with a complex construction of delays as well as non-linear. The properties of MWN even in small samples are

in many instances better than the other, competitive estimators (Welfe, 1998).

In order to locate the smallest amount of the loss function the process of non-linear assessment is typically done with the use of one of six algorithms. It allows the acquisition of the best estimators for the given loss function. Each of these methods uses diverse strategies to find minimum of the function. We can use one of the following algorithms (Stanisz, 2007):

- 1) quasi-Newton,
- 2) simplex,
- 3) simplex and quasi-Newton,
- 4) Hooke-Jeeves Pattern Moves,
- 5) Hooke'a-Jeevesa Pattern Moves and quasi-Newton,
- 6) Rosenbrocka function.

The maximization of the function of credibility for one probit model is done by using techniques used for non-linear estimation. There are available simple computer applications for the probit analysis (Maddala, 2006).

Statistical verification of the models was performed on the basis of Wald's Chi-quadrant statistic, while the parameter significance verification by the t-student test using asymptotic standard evaluation mistakes. All calculations have been performed by using the Statistica software. Due to the aesthetics of the presentation of study results, the authors decided to illustrate only those models which fulfill the criteria concerning the importance of models and parameters, thus resigning from a complex form of presentation as the statistics of assessment

of parameter's importance and the model as a whole, nevertheless taking into consideration the calculated standard errors and probabilities of incidence of particular phenomena. It has also been justified by the fact that the model's structural form suffices for the analysis of the analyzed phenomena.

Because of the difficulties with the interpretation of probit models, there was made a decision to create models with single independent variable.

Take into account that all variables adopted to the study, have a binary character (they reach values 0 or 1) interpretation of results will be performed on the basis of the model's structural form. A plus sign next to a parameter means that the incidence probability an innovative action is superior in a separated category of companies in relation to the rest of the community. Probit modelling is an advanced research tool used in case of huge, static sets of samples where the dependent variable possesses the qualitative form. Over one thousand probit models were estimated to reach the research goals. Most of them were statistically significant. The resulting formulas have been grouped and interpreted in inter-regional and regional systems.

CHARACTERISTIC OF RESEARCH SAMPLES

As it was mentioned in the introduction, the study has been carried out based on a sample of 951 industrial companies from two voivodeships of Western Poland. The structure of the studied companies between regions is similar, therefore I take into account the size of the company as it is presented in the table below.

Table 1: Structure of industrial companies in the studied sample of voivodeships from the perspective of the size of the company in 2009-11 (in percent)

No	Size of enterprise	West Pomerania	Lower Silesia
1	Micro	24,6	39,2
2	Small	35,6	34,6
3	Medium	32,2	19,9
4	Large	7,6	6,3

Source: Own studies based on performed research

Similar to the case of structure size, the technological size of the analyzed companies is shaped in a similar way, which is confirmed in the next table.

Table 2: Structure of industrial companies in the studied sample of voivodeships from the perspective of used technology in 2009-11 (in percent)

No	Technology advance	West Pomerania	Lower Silesia
1	High	3,1	5,1
2	Medium-high	10,3	17,9
3	Medium-low	28,6	30,3
4	Low	57,9	46,7

Source: Own studies based on performed research

Furthermore from the perspective of the quantitative sample the results are similar or exceed those carried out by the Central Office of Statistics on the discussed issue.

Taking into account the ownership of the companies and tendency to take risk in development based on new technologies we are witnessing typical for underdeveloped regions, anti-innovative behaviours of state companies (3 model statistically significant on 18 possible).

DETERMINANTS OF INNOVATION ACTIVITY IN THE WEST POMERANIAN REGION

Table 3: Probit form for the independent variable „character of company’s ownership”, in models describing the innovation of industry in West Pomeranian voivodeship

Innovative feature	Character of company’s ownership		
	domestic	foreign	mixed
R&D expenditure		+ ,51x-0,41	
Software solution	- ,72x+1,29	+ ,52x+0,63	+ ,92x+0,63
Launching new products		+ ,42x-0,47	- ,52x-0,39
Implementation of new technology process (including):			
- support systems	- ,38x+0,02	+ ,51x-0,35	
Cooperation with universities		+ ,65x-1,62	
Cooperation with foreign science units	- ,92x-1,04	+ ,88x-1,84	
Overall innovation cooperation		+ ,41x-0,26	

Source: Own studies based on performed research

An opposite behaviour can be observed in companies with foreign ownership. In turn, companies with a mixed ownership structure only two models have been extracted, which are opposed, this is an evidence of an ambiguous character of this group.

Table 4: Probit form for the independent variable „range of sales”,
 in models describing the innovation of industry in West Pomeranian voivodeship

<i>Innovative feature</i>	<i>Range of sales</i>			
	<i>local</i>	<i>Regional</i>	<i>country</i>	<i>international</i>
R&D expenditure	-,94x-0,24		+,28x-0,48	+,31x-0,51
Investment in new fixed assets	-,40x+0,93			
- building and grounds	-,47x-0,34			+,33x-0,57
Software solution	-,75+0,80			+,54x+0,43
Implementation of new technology process (including):	-,36x+0,89			+,40x+0,65
- none production systems	-,52x-0,24			+,30x-0,46
- support systems	-,43x-0,23			+,40x-0,50
Cooperation with universities				+,79x-2,02
Cooperation with domestic science units		-,81x-1,32	+,41x-1,60	
Cooperation with foreign science units				+,46x-1,94
Overall innovation cooperation	-,42x-0,15			+,31x-0,37

Source: Own studies based on performed research

The range of sales of offered products strongly determines the innovation activity of studied companies. The closest environment (local) does not create favorable conditions for stimulating innovation activity. On the contrary, companies that are operating on such regions are rarely as innovative as companies that are operating on a larger scale. Especially international range induces units to implement new solutions. A noteworthy fact is that,

in West Pomeranian voivodeship, international range of sales definitely more often stimulates companies to innovation activity, than the national range, which can be the result of the closeness of international market.

Taking into account the number of models statistically significant received for this research area one can state that the factors accurately describe the discussed relationships.

Table 5: Probit form for the independent variable „distance to the closest competitor, in models describing the innovation of industry in West Pomeranian voivodeship

<i>Innovative feature</i>	<i>Distance from competitor</i>			
	<i>local</i>	<i>regional</i>	<i>country</i>	<i>foreign</i>
R&D expenditure	-,57x-0,15		+,51x-0,42	+,36x-0,45
Investment in new fixed assets				
- building and grounds				+,37x-0,51
Software solution				+,85x+0,51
Launching new products			+,37x-0,48	
Implementation of new technology process (including):				
- none production systems			+,36x-0,36	
- support systems				+,37x-0,39
Cooperation with suppliers			+,36x-0,49	
Cooperation with universities	-,63x-1,35			+,68x-1,76
Cooperation with domestic science units	-,40x-1,26	-,50x-1,29	+,47x-1,46	+,45x-1,53
Cooperation with foreign science units	-1,05x-1,47		+,77x-1,84	+,48x-1,84
Overall innovation cooperation	-,31x-0,10	-,31x-0,14	+,40x-0,26	+,44x-0,33

Source: Own studies based on performed research

While analyzing the frequency of occurrence of models with statistically significant parameters one can state, that the distance from the nearest competitor also determines different aspects of technological activity in the region. If the competing subject is in direct proximity (local or regional), industrial companies rarely tend to realize innovation processes. It is the result of systematic isolation of companies and low level of their basic innovation ability - the joint outcome of immaturity of market

mechanisms. The observed phenomena relate to all areas of innovation activity (7 models with statistically significant parameters). Problems discussed here do not occur in turn in a group of companies that have their competitor located in the same country or abroad. Maintaining strong contact with companies that are active on national or international market actuates the flow of knowledge and gives access to its newest aspects, despite the need of coping with the distance barrier.

Table 6: Probit form for the independent variable „relations with the competitor”, in models describing the innovation of industry in West Pomeranian voivodeship

Innovative feature	Relations with competitor	
	none contacts	close
Cooperation with competitors		+ ,94x-2,19
Cooperation with universities	- ,51x-1,37	+ ,44x-1,63
Overall innovation cooperation	- ,31x-0,10	

Source: Own studies based on performed research

From the perspective of the character of connections with competitive companies, one should pay attention to the fact that it was possible to extract a few models statistically significant (only 4). Those models show that only close relations with competitors favor implementation of innovation activity. Even maintaining neighborhood relations is not enough to positively affect innovation activity. This kind of behavior is characteristic for countries that have a low technological level of development

and it is especially the most significant in peripheral regions. Therefore relational conditions require more advanced economic foundations, so that they could play an important role in innovation activity. It is indirectly proved by a geographical condition pointing out that direct proximity of a competing company does not stimulate innovative behavior. On the contrary, the discussed factors influence the discussed areas only in more technologically developed countries.

Table 7: Probit form for the independent variable „distance to the supplier”, in models describing the innovation of industry in West Pomeranian voivodeship

Innovative feature	Distance from supplier			
	local	regional	country	foreign
R&D expenditure	- ,34x-0,29			
Software solution		- ,44x+0,84		+ ,35x+0,58
Implementation of new technology process (including):				
- new production methods				+ ,32x0,19
- none production systems	- ,39x-0,24			
- support systems		- ,34x-0,18		+ ,55x-0,47
Cooperation with suppliers			+ ,38x-0,51	
Cooperation with universities				+ ,40x-1,66
Overall innovation cooperation		- ,28x-0,11		+ ,29x-0,30

Source: Own studies based on performed research

Models describing the impact of distance to the supplier on innovation activity are also clear. If a supplier is located at a considerable distance (outside the region or even abroad) innovation activity

increases. However if suppliers operate within the same town or region as their partners their impact is negative.

Table 8: Probit form for the independent variable „relations with supplier”, in models describing the innovation of industry in West Pomeranian voivodeship

<i>Innovative feature</i>	<i>Relations with supplier</i>	
	<i>unnecessary</i>	<i>close</i>
R&D expenditure	-,38x-0,31	+,35x-0,62
Investment in new fixed assets	-,79x+0,99	+,52x+0,49
- technical equipment and machinery	-,62x+0,81	+,53x+0,34
Software solution	-,39x+0,73	+,39x+0,39
Implementation of new technology process (including):	-,58x+0,92	+,51x+0,46
- new production methods	-,50x+0,16	+,30x-0,13
- none production systems		+,48x-0,68
Cooperation with suppliers	-,41x-0,40	+,31x-0,68
Overall innovation cooperation		-,28x-0,11

Source: Own studies based on performed research

In case of studying the relations held with suppliers, a strong, positive influence on the development of innovation activity has been observed only among

those companies, that close cooperated with each other. Similar to the case of relations with competitors.

Table 9: Probit form for the independent variable „distance from the main customer”, in models describing the innovation of industry in West Pomeranian voivodeship

<i>Innovative feature</i>	<i>Distance from customer</i>	
	<i>local</i>	<i>foreign</i>
Software solution		+ ,41x+0,55
Implementation of new technology process (including):		+ ,34x+0,72
- none production systems	- ,36x-0,19	+ ,42x-0,44
Cooperation with domestic science units		+ ,39x-1,54
Overall innovation cooperation	- ,26x-0,14	+ ,29x-0,31

Source: Own studies based on performed research

The above table also informs, that as in the case of suppliers as well as competitors, companies that have foreign customers are more often characterized by innovation activity rather than companies with local customers. Furthermore, we can say that having customers fitting into that group (local) has a definitely negative influence on the innovation activity of a company. In case of the “distance from the main customer” the amount of models with a statistically significant parameter is low (seven), but concerns three important areas: investments in software, implementation of new technological processes with special consideration of supporting systems and cooperation in innovation with national

research and development units. Also in this case one can state that local environment is unfavourable as a potential receiver of innovative goods, which is similar to other regions of the country.

The observed regularities once again reassure us that the activity of industry in West Pomeranian voivodeship in the area of new products and technologies requires from the companies to overcome the distance barrier (space) in order to be able to transfer knowledge. One does not see any symptoms of change in the situation as it takes place in case of industrially developed regions of Poland. Regional environment does not favour creation of new solutions.

Table 10: Probit form for the independent variable “character of the relations held with the customer”, in models describing the innovation of industry in West Pomeranian voivodeship

<i>Innovative feature</i>	<i>Relations with customer</i>	
	<i>unnecessary</i>	<i>close</i>
R&D expenditure		+ ,57x-0,81
Investment in new fixed assets	- ,51x+0,92	
Software solution	- ,49x+0,73	+ ,42x+0,36
Implementation of new technology process (including):	- ,67x+0,92	+ ,60x+0,39
- none production systems	- ,46x-0,27	+ ,54x-0,74
- support systems	- ,48x-0,25	+ ,33x-0,55
Cooperation with suppliers		+ ,33x-0,71
Cooperation with domestic science units		+ ,78x-2,05
Overall innovation cooperation		+ ,36x-0,50

Source: Own studies based on performed research

The last table confirms the above deliberations which depicts the influence of contacts with the supplier on the innovativeness of industry in West Pomeranian region. Also in case of customers, having close relations with this group of companies is a condition for noting a higher innovation activity of companies. Similar as before, having customers in local scale is a decisively limiting factor for innovation activity.

Factors influencing industrial system in Lower Silesia Taking into account the company’s ownership and its tendency to undertake technological development we witness typical, although fading in well-developed regions, anti-innovative behaviour of state companies (9 statistically significant models out of 18 possible).

Table 11: Probit form for the independent variable “character of company’s ownership”, in models describing the innovation of industry in Lower Silesia

Innovative feature	Character of company’s ownership		
	domestic	foreign	mixed
R&D expenditure	-,53x+0,05		
Investment in new fixed assets			
- building and grounds	-,34x-0,18		
Software solution	-,45x+0,96		+,55x+0,50
Implementation of new technology process (including):	-,68x+1,42	+,71x+0,77	
- new production methods	-,33x+0,38		
- none production systems	-,73x+0,28		+,59x0,37
- support systems	-,61x+0,11		+,59x0,44
Cooperation with competitors			+,67x-2,02
Cooperation with universities	-,65x-1,01		
Cooperation with customers	-,39x-0,35		

Source: Own studies based on performed research

A contrary behaviour, but clearly different inside the group can be observed in companies with a mixed ownership structure, which gives a relatively broad base of innovative companies in the region. This does not change the fact that, from the ownership’s

perspective the industrial system of Lower Silesia resembles a case placed between weak and strong regions in Poland. It seems that the factor favouring drawing foreign capital is also the location of this voivodship at the western border of the country.

Table 12: Probit form for the independent variable „range of sales”,
 in models describing the innovation of industry in Lower Silesia

Innovative feature	Range of sales			
	local	regional	country	foreign
R&D expenditure	-,96x-0,27	-,40x-0,33	+,31x-0,56	+,61x-0,64
Investment in new fixed assets				
- building and grounds	-,57x-0,38			
- technical equipment and machinery				
Software solution	-,69x+0,66		+,33x+0,37	+,43x+0,39
Implementation of new technology process (including):	-,59x+0,93			+,56x+0,64
- new production methods				+,35x-0,02
- none production systems	-,78x-0,22			+,64x-0,58
- support systems	-,54x-0,32			+,50x-0,60
Cooperation with suppliers	-,50x-0,50			
Cooperation with universities			+,50x-1,82	+,47x-1,73
Cooperation with domestic science units	-,85x-1,40			+,46x-1,69
Cooperation with customers	-,58x+0,59	-,68x-0,57	+,30x-0,84	+,50x-0,87
Overall innovation cooperation	-,73x+0,04		+,34x-0,26	+,35x-0,21

Source: Own studies based on performed research

Spatial range of products' sales strongly determines the innovation activity of the studied companies. The local environment does not provide sufficient reasons to stimulate innovation activity. On the contrary, companies operating on such market remain less innovative than enterprises operating on a larger scale. Especially international range or alternatively national induce companies to undertake processes of creating new solutions.

The space of a region, but not local, provides ambiguous but two interesting conclusions. On the one hand only two models with parameters statistically significant were evaluated with a negative sign – for two very important dependent variables: the expenses on R&D and cooperation

with customers. This proves that, both are crucial conditions of system support for innovation in the region. On the other hand, the lack of other models suggest too small diversity of companies to find significant differentiations between them. At this side it's important that, it does not positively determine the thesis that the endogenous region's environment limits innovativeness of industrial companies.

Similar to the previous research carried out by the author, also in this case, international connections are strong and often pointed stimulant of carrying out innovation activity. It places the medium voivodships on a middle stage of development in the direction of a supporting intra-regional environment.

Table 13: Probit form for the independent variable „distance to competitor and relations with competitor”, in models describing the innovation of industry in Lower Silesia

Innovative feature	Distance from competitor		Relations with competitor	
	local	beyond region	competi-tion	Close
R&D expenditure	-,65x-0,13	+,91x-0,45		
Investment in new fixed assets		-,34x+1,08		
- building and grounds	-,33x-0,33		+,71x-0,49	
- technical equipment and machinery				+,50x+0,62
Software solution	-,27x+0,65			
Implementation of new technology process (including):		+,86x+0,06		
- new production methods	-,38x-0,17		+,109x-0,36	
- none production systems	-,31x-0,31			
Cooperation with competitors				+,68x-2,16
Cooperation with universities	-,51x-1,34	+,93x+1,61		
Cooperation with domestic science units	-,64x-1,28	+,61x-1,53		
Cooperation with customers	-,38x-0,52	+,52x-0,70		
Overall innovation cooperation	-,31x+0,06			
Overall innovation cooperation	-,73x+0,04		+,34x-0,26	+,35x-0,21

Source: Own studies based on performed research

While analysing the influence of spatial-relational aspects on the innovativeness of companies, the interpretation of phenomena began from the competitors. Taking into account the frequency of occurrence of models with statistically significant parameters one can state that the distance to the closest competitor usually determines different areas of technological activity in the region. If the competing company is found in a direct neighbourhood (local), then industrial companies rarely tend to realize innovation processes. It is the result of the problem of isolation of companies and low level of their basic innovation capabilities – resultant from low maturity of market mechanisms. Discussed problems in turn, do not occur in a group of companies for which the main competitor is located abroad. Unfortunately there aren't many units like that in the region; still they prove the need of maintaining strict contacts with companies operating on international market because it improves the dynamism of knowledge-flow and gives access to its newest aspects.

From the point of view of connections with competitors, although only a few models proved to be statistically significant, they regarded interesting areas. Buying new machines and devices is the main channel of technology transfer to polish businesses, however with passive characteristic. Close relations with companies being potential competitors allow gaining information on technological options (novelties) and influencing the dynamism of changing production equipment.

A similar situation takes place in case of cooperation in innovation with competitors. Maintaining both close as well as hostile relations, regardless of the geographic distance helps in developing new solutions, which is a natural horizontal mechanism of knowledge-flow just as before. From the perspective of this phenomena affecting the system dynamism one can see that up to one fifth of companies maintain close relations with competitors. Observed relations should launch processes of horizontal knowledge transfer on a large scale, in the future, rarely seen in polish economic reality.

Table 14: Probit form for the independent variable “distance from supplier” and „relations with suppliers” in models describing the innovation of industry in Lower Silesia

Innovative feature	Distance from supplier		Relations with suppliers	
	local	internatio- nal	necessary	Close
R&D expenditure			-,52x-0,30	+,35x-0,64
Investment in new fixed assets			-,62x+1,14	+,38x+0,74
- building and grounds		+,34x-0,53	-,39x-0,39	+,28x+0,67
- technical equipment and machinery		+,42x+0,67	-,56x+0,86	+,37x+0,48
Software solution	-,31x+0,60		-,36x+0,61	+,50x+0,5 d
Implementation of new technology process (including):			-,33x+0,89	
- none production systems			-,40x-0,25	+,30x-0,54
- support systems			-,43x-0,32	+,29x-0,60
Cooperation with customers		+,37x-0,74		

Source: Own studies based on performed research

In case of relations held with suppliers the dominating role are played by financing areas and implementation of new solutions. If the studied company holds close relations with a supplier of materials needed for production, then more often does this company perform innovation activities, the opposite when relations with this group of companies are marginalized. High technological activity is connected, similar as in other regions, with functioning of industry in Lower Silesia as a part of international supply chains. However the

fact of existence of a limited number of models on the spatial variable's site proves the strong diversity of the flow of materials, resources and half-finished products to the regional industry system. Taking into account the universality of innovation processes among companies in this voivodeship one has to conclude that the meaning of mutual interactions and their complexity with suppliers in the region is growing, which is an important support for creating strong territorial industry system.

Table 15: Probit form for the independent variable „distance from customer” and „relations with customers”, in models describing the innovation of industry in Lower Silesia

Innovative feature	Distance from customer		Relations with customers	
	local	beyond region	necessary	Close
R&D expenditure	-,47x-0,29		-,60x-0,30	+,37x-0,66
Investment in new fixed assets			-,59x+1,12	
- building and grounds		+,31x-0,52		
- technical equipment and machinery			-,61x+0,86	+,28x+0,54
Software solution	-,41x+0,64	+,28x+0,44	-,32x+0,59	+,30x+0,32
Implementation of new technology process (including):	-,50x+0,96	+,65x+0,73		+,28x+,62
- new production methods		+,51x+0,02		
- none production systems	-,42x-0,23	+,47x-0,41	-,54x-0,24	+,37x-0,60
- support systems	-,33x-0,32	+,60x-0,51	-,32x-0,34	+,37x-0,66
Cooperation with suppliers			-,34x-0,51	
Cooperation with universities	-,54x-1,42	+,43x-1,61		
Cooperation with customers	-,34x-0,59	+,49x-0,76	-,85x-0,56	+,58x-1,11
Overall innovation cooperation	-,32x+0,00		-,66x+0,03	+,42x-0,38

Source: Own studies based on performed research

From the studied special-relational relations with suppliers, competitors and customers the last one is the most explicit. On one hand innovation activity will occur more often if closer relations will be held with customers of the companies, however on the other hand the recipient should be located outside the region (country or abroad). The visible dichotomy means that on the contracting party side there is a distinct polarization of behaviour which is not visible in case of relations with competitors and suppliers. As far as having suppliers in close proximity does not affect the taking up of innovation processes, similarly in case of the character of relations held with competitors, but in case of the recipients those phenomena cumulate. In other words, local environment as a potential recipient of innovative goods remains unfavourable, just like in other parts of the country.

The shape of financial system and its tendency to innovate depends on the existence in industry chains, with a mixed structure among suppliers and based on international or national connections in case of competitors and recipients. The region has reached internal ability to generate new technological

solutions based on absorption of knowledge from outside the region (recipients and competitors) and other companies from inside of the region (suppliers), which are offered on national and international market. There is still the action imperative as an indirect link in the supply chain, mainly with industrial character.

The observed regularities confirm that the activity of industry in Lower Silesia in the area of new products and technologies requires from companies to overcome the distance barrier (spatial) in order to transfer knowledge. However symptoms of changing situation can be observed, for the regional environment is becoming more often favorable in the creation of new solutions.

CONCLUSIONS

In accordance with the hypothesis of endogenous economic growth, factors favoring expansion should be located in the researched object, in our case province. Still, while analysing the analytical part of data of this article it becomes apparent that many factors favoring the innovation growth of industrial

companies from the discussed provinces are located beyond them.

Taking into account the remoteness of competitors for innovation activity of manufacturing companies in the researched provinces, the dependency becomes noticeable showing that companies become more inventive if their competitors are situated in the nationwide or global scale. It is worth mentioning that the industrial companies' innovative action in the areas positively affected by the collaboration with the competitors.

Analogically, when you have suppliers and customers localized outside the country it can have positive influence on the innovation activity of manufacturing companies in the studied provinces. Positive impact on the inventive action of companies is also reinforced by the close relationship with them. Remaining in neutral or even good-neighborhood relations is inadequate for the enhancement of innovation activity of companies.

Because of the small level of economic growth many areas in Poland, counting the studied examples, cannot develop in economical manners at a similar speed as the regions in developed countries. It causes economic discrepancy between the weaker areas in Poland and the well-developed regions of Europe and the world. Due to the economic weakness of the areas, the interior factors which stimulate the economic growth are not sufficient. Thus, so significant for the growth, among others, of the researched provinces, are the continuous exterior impulses, that mean that the endogenous growth theory in weak areas of Poland have no right to survive. There can be no convergence without external impulses. Hence, the

economic growth of most of Polish areas ought to be based on the exogenous theory of the economic growth.

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