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SIZE AND EQUITY OWN OF ENTERPRISES FOR INNOVATION ACTIVITY IN REGIONAL INDUSTRIAL SYSTEMS – EVOLUTIONARY APPROACH (PROBITING MODELING)

A. Świadek[1]*, B. Czerniachowicz[2], M. Tomaszewski[1]*****

[1]Department of Economics and Management, University of Zielona Góra, Poland
[2]Institute of Enterprises Economics and Organizations, Faculty of Economics and Management, University of Szczecin, Poland

ABSTRACT
The main objective of the study was an attempt to search for changing conditions affect the size classes of enterprises on regional innovative activity of industrial systems and, consequently, determine the boundary conditions for the model structure of regional innovation networks taking into account the specificity of Poland and its regions. The study was based on a questionnaire on a group of 1920 companies from four polish regions: Mazovian, Lower Silesia, West Pomeranian, Lubusz. The study used probity modeling (probability). This method is an effective research tool for large enterprises, but the static tests in which the dependent variable has a qualitative character. The results of the study indicated that the size of the companies determines their innovative activity in the Polish regions. This relationship has, however, heterogeneous implications. According to the evolutionary school, situation varies depending on the level of economic development of the surveyed regions. The article pointed out that innovative activity in Poland moves from a group of large industrial enterprises in poor regions, through the medium entities in intermediate provinces, to small in the most developed. The use of the probit modeling proved to be a useful tool for assessing the impact of class size on the behavior of industrial firms in regional innovation systems in Poland. This allowed to observe the evolution of innovation systems from peripheral through the intermediate to leading in the country and outline the critical framework to take account of their intrinsic characteristics. Finally, the methodology used let systemic innovation processes evaluate in a distributed and heterogeneous regional-industrial systems.

Key words: innovation, innovation activity, regional industry systems. JEL Code: O31,O32, R58.

INTRODUCTION

Dynamism and system of innovation have been so far described in theoretical trends determined as the evolutionary and neo-schumpeter school. Innovation process on the enterprise level is recognized in these concepts as the system of activities which are interconnected by mutual feedbacks. Innovation is the result of interactive process of learning which often engages several actors from inside and beyond the enterprise (1).

Innovation and its diffusion has become the result of the interactive and collective web process of personal and institutional connections evolving in time. In the region they are responsible for challenges made by "the new economy": globalization and acceleration of technological changes, creating thus the chance of economic development in poorly developed regions.

Innovation systems on a national and sector level became the subject of theoretical-empirical

Correspondence to: **Associate Professor Arkadiusz Świadek, PhD, Department of Economics and Management, University of Zielona Góra, Poland; E-mail: aswiadek@uz.zgora.pl; **Assistant Professor Barbara Czerniachowicz, PhD, University of Szczecin, Faculty of Economics and Management, Institute of Enterprises Economics and Organizations, Mickiewicza Street 69, 71-307 Szczecin, E-mail: b.czerniachowicz@wneiz.pl
***Assistant Professor Marek Tomaszewski, PhD, Department of Economics and Management, University of Zielona Góra, Poland; E-mail: m.tomaszewski@wez.uz.zgora.pl

research in the world in the last 15-20 years, although in Poland not until the end of the nineties (2). This approach has focused on determinants of development and diffusion of process and product innovation (3). There exist the differentiated approach to defining the term of national innovation system. From the perspective of the carried out research in the papers we can recognize it as the entirety of interconnected institutional and structural factors in national economics and society manifested by its three basic elements (industry, research-developmental sphere and around business institutions) and the connections between them. Industrial system will constitute the collection of subjects performing the production activity but not necessarily the innovation one on an isolated area, thanks to which there occur inner interactions between subjects and in the relation of the system and its surrounding. However, it is worth paying attention to the relation occurring between the internal and external market participants, and less often the intrinsic existences. Conclusions from carried out research in the world prove that production subjects reach higher economic benefits when they are the elements of intensive web integration (4). National system of innovation consists of regional equivalents, altogether creating the functional web, joining all subjects working in the sphere of innovation and transfer of technology in the given country (5).

Local chains of innovation lead to the creation of chances (opportunities) for poorly developed regions. However, they are not the ready solution for all their economic problems. They provide access for small and average enterprises to global resources, while on the other hand they enable the production of goods for the international market (6).

Regional industrial systems, thanks to the process of cooperation, play a crucial role in the division of work among manufacturers, sellers, buyers or the research-development sphere. Subjects, which do not cooperate and do not exchange knowledge, reduce their competitiveness in a long period of time and lose the ability to enter into relations of exchange (7). Structure of industry in countries of the "catching up" type usually has a not very modern (meaning competitive) character, marked by a low participation of high technology products in international trade. Current observations in connection with the conducted research by the author suggest that the improvement of structure of exchange will have the character of evolutionary changes in the area of classes of enterprises' sizes and the technology of production used in them (8). New solutions are usually obtained by the passive transfer of technology, even more intensively if the enterprise is the element of international industrial chain (9).

Observation conducted in the most developed countries indicate that despite the growing meaning of internationalization of economy, the region is perceived as the alternative possibility of existence and development of the sector of small and average enterprises in the new constellation of the global market. For this reason, one of the main goals of regional politics in the European Union is providing the fluent adaptation of regional industrial structures facing the world changes of social, economic and technological parameters (10).

Problem of influence of the size and properties of enterprises on shaping the innovation activity is not the new phenomenon. What is more, the approach towards it has evolved in time, changing quite radically. At the origin of the innovation theories it was thought that activity in creating new technologies is the domain of large enterprises (11). In the 1980s, this approach was fundamentally reformulated by P. Drucker, who proved the greater meaning of common innovation behaviours in the group of small and average enterprises (12). This discussion is not finished, and the problem of influence of enterprises' size on the development of technology seems currently to be the phenomenon with more heterogenic nature than previously. Condition of classes of size has differentiated meaning depending on other factors occurring in innovation systems (13). There still exist circumstances which suggest the improvement of technological advancement in economy by stimulating innovation in large subjects. This often takes place in countries, which are poorly developed in economic manners, where enterprise is not properly developed and it is far from the phenomenon of the common character.

The situation in the area of enterprises' area does not look different. On the one hand we more often get to know about the necessity of endogenous growth in context of innovation activity in countries which are most economically developed. On the other hand, such countries like Poland, not having the right system dynamism and internal imperative for creating new solutions, will not be able to create internal mechanisms responsible for generating new knowledge and the possibility of its implementation for a long time. So it is difficult to expect in the next years, considering the slow evolution of systems, that in Polish provinces the national subjects will be responsible for acceleration of the progress.

The analysis conducted in this paper tries to enrich the current achievements from this scope, introducing the previously described evolution of economic systems.

Sketched concept frames contributed to undertaking the issues of the influence of size and property of enterprises on innovation of regional industrial systems. The basic hypothesis of the conducted research was the statement that innovation activity in territorial industrial systems and in their contexts with the surrounding is crucially determined by the influence of the structure of size and enterprises' property. The proper (skillful) identification of innovation processes and their limitations in the national system of management creates foundations for building diversified paths of development of innovation chains, which take into consideration the national and inter-regional specificity, enabling the acceleration of processes of shaping, absorbing and diffusion of technology.

The main goal of the research was the attempt to search for changeable conditions of the influence of the classes of size and structure of enterprises' property on their innovation activity in the area of regional industrial systems and in consequence the determination of edge conditions for the model structure of the regional chain of innovation taking into consideration the specificity of Poland and its regions. Presented effects of the research constitute only the selected part of conclusions obtained as the result of conducted analysis.

Exemplificative aspect of the paper was based on four selected cases of different provinces of Mazovia, Lower Silesia, West Pomerania and Lubusz. Research was conducted based on the questionnaire in the group of 1919 industrial enterprises from selected regions, including: microenterprises – 643, small – 690, medium – 452, large – 134. The basic path of accumulating data was the procedure joining the initial phone conversation with sending the questionnaire form by mail. Supplementary forms of conducting the survey were the interview conducted telephonically or obtaining the filled-in questionnaire electronically or by fax. Improperly filled-in questionnaire, depending on a mistake made, _ disqualified it from the possibility of participating in the next stages of the examination. Part of the lacking data was supplemented by another contact with the enterprise or by materials available in the electronic form. Technological structure of enterprises participating in the examination corresponded approximately the data presented by the Central Statistical Office.

From the perspective of selection of the examination attempt they decided on the analysis of four cases of provinces representing the diversified level of industrial development (strong, medium-strong, medium-weak, weak). Thanks to such treatment the specificity of regional industrial systems in the country and their evolution was introduced, decidedly limiting the costs connected with so extensive examination. However, it was remembered that each of the accepted cases has, apart from mutual features, own and unique specificity.

The conducted analysis had the statistical character and was conducted in the three-year system, according to methodological standards of examination over innovations conducted in OECD countries.

METHODOLOGICAL DETERMINANTS OF THE CONDUCTED EXAMINATION

The methodological part of analysis was based on the theory of probability. In case when the dependent variable reaches dichotomous values, we cannot make use of the commonly used multiple regression in quantitative phenomena. An alternative for this problem is the application of logistic regression. Its advantage is that the analysis and interpretation of results is similar to

the classic method of regression. And so, the ways of selection of variables and testing hypotheses have similar scheme. However, there are also differences, which include more complicated and time-consuming calculation or calculating values and creating graphs of remainders which often does not bring anything significant for the model (14).

Pioneers in applying the logistic curve were P.F. Verhulst and R.F. Pearl. The full model was used, however, for the first time only by J. Berkson in 1944 and 1953 (15,16).

In case of model, where the dependable variable reaches the value of 0 or 1, the expected value of the variable may be interpreted as conditional probability of realization of the given event with fixed independent variables' values.

Generally speaking, logistic regression is the mathematical model, which we can use in order to describe the influence of several variables X_1, X_2,..., X_k on dichotomous variable Y. When all independent variables are qualitative, the model of logistic regression is equivalent to the log-line model. For description of such phenomenon we can also use the probit regression (17).

Mutual assumptions for these models are as follows (18):

- data come from the random test,
- *Y* may take on only two values: 0 or 1,
- next values of *Y* are statistically independent from one another,
- probability that Y=1 is defined by NCD (normal composition) for the probit model or LCD (logistic composition) for the logit model,
- there is no perfect line dependency between variables X_i (assumption about the lack of co-linearity of independent variables).

The applied probit modelling allowed to evaluate the chance of the occurrence of diverse innovation behaviours depending on accepted edge conditions.

Probit and logit models differ in the specification of decomposition of the random component in equation. If F is the distribution of the logistic decomposition, we are dealing with the logit model, and if the random components have normal decomposition, we get the probit model (19).

Dependency between Logit and Probit values:

$$\frac{Logit}{Probit} = 1.6$$

Estimating parameters in methods with dichotomous variable is carried out with a method of the greatest reliability. In accordance with its rules, we look for the vector of parameters, which guarantees the greatest probability of obtaining values observed in the trial. In short, applying the MNW requires the formulation of reliability functions and finding its extreme which can be done analytically or numerically. Despite quite a complicated procedure MNW gained popularity as it can be applied in case of the wide range of models, among others with changeable parameters, with the complex structure of delays, hetero-scedastic, and also non-linear. MNW properties also in small trials are in many cases better than other, competitive estimators (20).

Procedure of non-linear estimation includes six algorithms in order to find the minimum of the loss function. This allows obtaining the best estimators with the given loss function. Each of these methods uses various strategies of search for finding the minimum of function. At disposal we have the following algorithms (14):

- quasi-Newton's[1],
- simplex,
- simplex and quasi-Newton's,
- Hooke-Jeeves's relocation of the system,
- Hooke-Jeeves's relocation of the system and quasi-Newton's,
- Rosenbrock's search of the system.

Maximization of reliability functions for logit or probit models takes place with techniques used during non-linear estimation. For probit and logit analysis there are available simple computer programmes (19).

[1] In the paper we used the quasi-Newton's method in order to search for maximum reliability of the estimated parameters of models. Taking into consideration the fact that differences between particular methods concern mainly precisions of calculations, and in the paper the general form of the model for interpreting the examined phenomena seemed sufficient, usage of the first of them was, according to the author, sufficiently justified.

Independent variables, which were used in the research are the size of enterprises in division into micro, small, medium and large subjects, and their property in division into national enterprises, foreign ones and with the mixed structure of property. On the side of dependent variables there are: a) expenditures on the innovation activity in connection with their structure (research and development, investments in new machines and technical devices, investments into buildings, structures and lands, new computer software, b) implementation of new products and processes, taking into consideration also the detailed solutions in this scope (new products, new technological processes), c) innovation cooperation in the subject grasp (with suppliers, competitors, recipients, universities, JBR, foreign research institutions). The accepted independent variables constitute a set of reference depicting the innovative activity of enterprises accepted on the basis of methodology applied for OECD countries (21).

Considering logical relations occurring between the examined variables there was accepted an assumption that random components have normal distribution, and in consequence there were made calculations based on probit modeling. Statistical verification of models and their parameters was carried out based on the statistics Chi-square of Wald and connected with it test probability *p*, and statistics of *t*-student. All calculations were made _ using the *Statistica* software and taking into consideration analogical output conditions about the evaluation of models' gravity and their parameters, offered by the used programme. Because of the aesthetics of presentation of research results, the author has decided to present only models fulfilling criteria of estimation of parameters' gravity, resigning at the same time from the extended form of presentation also taking into consideration the calculated standard mistakes, statistics of evaluation of parameters' gravity and probability of the occurrence of phenomena. This was also justified by the fact that the structural form of the model is sufficient for the analysis of the examined phenomena.

Due to interpretation difficulties connected with modeling of the probit type we decided to build one-factor models. We also eliminated the possibility of autocorrelation of independent variables due to their excluding character.

Taking into consideration the fact that all accepted variables for examination have the binary character (achieved values 0 or 1), presentation of results will be finished on the level of structural presentation of the model's form. Positive sign appearing with the parameter means that the probability of innovation event occurrence is higher in the isolated group of enterprises in relation to the other community. Probit modeling is an effective research tool in case of large, but static tests in which the dependent variable has the quality form.

Each of the collected questionnaires was listed into the spreadsheet of *Excel* where data were subject to the initial preparation by using methods of formal logic.

Altogether, from the perspective of accepted goal and research hypothesis, there were created more than five hundred probit models, from which only a part reached the statistical gravity. The obtained formulas were grouped and interpreted in international, inter- and intraregional systems.

LUBUSZ PROVINCE

On the basis of obtained results it is hard to form a thesis that industrial innovation in the Lubusz province is owed to macro and small companies **(Table 1).** The higher the number of them in relation to average and large subjects, the lower the probability of occurring of the innovation company. These negative dependencies are especially clear for the group of the smallest units. Statistically essential regularities can be perceived in financial expenditures of R&D (research and development) implementations of new technological processes, but mainly in case of implementations not connected directly with production activity. On the side of cooperation in the area of innovations unprofitable interactions take place in case of national and foreign groups of units R&D or universities. It is in accordance with the world tendencies identified in this area.

Table 1. *The form of probit with independent variable of "enterprise's size", in models describing industrial innovation in the Lubusz province*[2].

Innovative feature	Size of enterprise			
	micro	**small**	**medium**	**large**
R&D expenditure	-0,42x - 0,26	-0,34x -025		0,61x-0,44
Software solution	-0,75x+0,87	-0,39x+0,80	0,65x+0,49	1,15x+0,56
Launching new products				
Implementation of new technology process (including):	-0,45x+1,13			1,10x+0,91
- none production systems		-0,40x-0,02		0,76x-0,25
- support systems	-0,82x-0,22	-0,63x-0,21	0,50x-0,56	0,98x-0,54
Cooperation with domestic science units			0,46x-1,65	
Cooperation with foreign science units		-0,80x-1,48		0,64x-1,77

Source: own study based on research.

Average companies increase the chance for innovation in the region, but this mainly concerns the area of financing and implementing new software. Beneficial relations are also visible at the junction of two average subjects with national units R&D.

Large enterprises are mainly responsible for diffusion of technology in the region, what is also visible in the R&D activity, implementation of new solutions (without products) or innovation cooperation (without national JBRs). Statistically crucial models in this group of companies not only appear relatively often, but the achieved values of probability are higher than for models describing behaviours of average enterprises. So the emphasis in regional innovation politics should be placed on the improvement of dynamics of technological changes in average and large subjects, and parallel there should be conducted the detailed studies on causes of the weak innovation of micro and small companies.

In the Lubusz province character of properties also constitutes one of the main determinants explaining the current state of industrial innovation **(Table 2).** National companies are in a small degree interested in modernizing production and offering new products. This is a serious systemic problem, which results probably from isolation of these enterprises in the region, what in result is the consequence of the lack of contacts with companies responsible for the transfer of technology to the province. In opposition to national units there are mainly foreign companies, but also those with the mixed structure of property. This means that the current condition necessary to conduct the innovation activity is having in one's structure the foreign capital (external). In other words, transfer of technology to the region takes place mainly thanks to companies having their main offices abroad in situation when it weakens within national subjects.

Table 2. *The form of probit with the independent variable of "character of enterprise's property", in models describing the innovation of industry in the Lubusz province.*

Innovative feature	Character of company's ownership		
	domestic	**foreign**	**mixed**
R&D expenditure	-0,53x+0,01	0,38x-0,43	0,59x-0,39
Investment in new fixed assets	-0,56x+1,31	0,57x+0,79	
- building and grounds			
- technical equipment and machinery	-0,46x+1,00	0,48x+0,57	
Software solution	-0,92x+1,38	0,83x+0,53	0,80x+0,62

Source: own study based on research.

[2]In tables there are only models with parameters statistically essential

Differences in cooperation between innovation units limit to more intense cooperation of the mixed companies with universities, in situation when foreign subjects more often use the experiences of foreign research-developmental units.

WEST POMERANIAN PROVINCE

Innovation of industry in the West Pomeranian province does not depend on micro and small companies **(Table 3).** The higher the number of them in relation to average and large subjects, the lower probability of occurrence of the innovation company. The lowest probability of occurrence of the innovation subject can be observed in the collectiveness of the smallest companies and at the same time it concerns all respondents of the examined surfaces with especially strong influence on the financial area. In comparison with other groups of enterprises, the collectiveness of small subjects also characterizes weak activity in generating new solutions but the number of estimated models is smaller.

Table 3. *The form of probit with independent variable of "enterprise's size", in models describing innovation of industry in West Pomeranian region.*

Innovative feature	Size of enterprise			
	micro	**small**	**medium**	**large**
R&D expenditure	-0,36x-0,27	-0,62x-15	0,79x-0,62	
Investment in new fixed assets	-0,39x+0,97		0,45x+0,74	
- building and grounds	-0,64x-0,27		0,38x-0,53	
- technical equipment and machinery	-0,31x+0,80		0,31x+0,63	
Software solution	-0,75x+0,89		0,84x+0,46	0,94x+0,62
Launching new products	-0,42x-0,33		0,40x-0,56	
Implementation of new technology process (including):			0,36x+0,72	
- new production methods		-0,26x+0,19		
- none production systems	-0,85x-0,13		0,41x-0,45	0,75x-0,37
- support systems	-0,59x-0,16			0,73x-0,35
Cooperation with suppliers		-0,28x-0,25	0,41x-0,58	
Cooperation with PAN units	-0,69x-1,40		0,42x-1,68	
Cooperation with universities	-0,65x-1,28	-0,45x-1,26	0,75x-1,72	
Cooperation with domestic science units				0,87x-0,80
Cooperation with foreign science units		-0,41x-0,07	0,55x-0,39	

Source: own study based on original research.

Average enterprises are currently the core of innovation in the region– their activity in this scope concerns almost all examined areas. Although not every time the probability exceeds the 0,5 value, it still remains crucially different in regard to other groups of enterprises (including also big ones). It is worth emphasizing that average companies dominate in regard to innovation activity both in the financial area and in the implementation and cooperative one. The observed phenomenon of change of the center of gravity from large companies towards average ones proves the evolution of regional industrial system, where the core of technological transformations is no longer the domain of elite group of subjects, but has become the common phenomenon. This phenomenon has not reached the goal level in the form of high creativity among small and micro subjects, nonetheless it constitutes support for building the internal system of innovation.

Large enterprises constitute rather a supplement of, often a crucial one, processes realized by smaller subjects, for example in the area of corporation with foreign research-developmental units, in situation when average ones are in strong relations with suppliers, universities or national JBRs **(Table 4).** Such shaping of models induces a conclusion about the necessity of creating different instruments of support within politics of innovation in the region for micro and small subjects (problem of stimulating the awareness) in opposition to the others.

Table 4. *Form of probit with independent variable of "character of enterprise's property", in equations describing innovation of industry in the West Pomeranian region.*

Innovative feature	Character of company's ownership		
	Domestic	**Foreign**	**Mixed**
R&D expenditure		0,51x-0,41	
Investment in new fixed assets			
- building and grounds			
- technical equipment and machinery			
Software solution	-0,72x+1,29	0,52x+0,63	0,92x+0,63
Launching new products		0,42x-0,47	-0,52x-0,39
Implementation of new technology process (including):			
- support systems	-0,38x+0,02	0,51x-0,35	
Cooperation with PAN units		0,65x-1,62	
Cooperation with domestic science units	-0,92x-1,04	0,88x-1,84	
Cooperation with foreign science units		0,41x-0,26	

Source: own study based on research.

Character of properties of examined enterprises also matters for the innovation activity in the West Pomeranian region, although the number of crucial models yields to the one achieved in the Lubusz province. National companies are marked with low tendency for creating or transferring knowledge. An opposition for these units are the foreign enterprises, which innovation activity is clearly higher in areas of R&D activity, implementation of new choices and cooperation as the entirety. Despite the fact that discussed activity crucially differs from foreign companies' advantage, then in enterprises with mixed structure of property, it is currently difficult to explicitly evaluate the problem of assimilation by knowledge.

LOWER SILESIAN PROVINCE

In the Lower Silesian region the size of enterprises also has a meaning for the innovation activity realized in this area **(Table 5).** The main innovation dynamo are medium enterprises in connection with large companies. The latter ones play a crucial role especially in the area of implementation of new technologies and innovation cooperation. On the opposite pole, there are micro subjects in which the innovation activity is weaker than in other groups altogether. Extremely interesting is a fact of occurring only of one model statistically crucial in the group of small enterprises, additionally in which the parameter has reached the positive sign. Taking into consideration previous analogical research in other regions, in connection with dynamic changes in technological potential of the Lower Silesian province in Poland, we can make a thesis that small subjects are not the de-stimulating factor for innovation activity, as it happens in economically weak and average regions constituting their immanent developmental limitation (pejorative). In other words, the main focus of innovation, although remains the domain of medium and large subjects, moves towards small companies. This is undoubtedly one of the most important determinants of innovation activities in Lower Silesia, emphasizing its specificity.

Observed shaping of models leads us to a conclusion about the imperative of construction of different instruments of support (innovation politics) in the region for micro subjects (problem of stimulating awareness), small (improvement of dynamism), medium and large (maintaining high engagement in innovation activity).

Taking into consideration enterprises' property **(Table 6)** and their tendency to undertaking technological development we can observe typical, although disappearing in developed areas, anti-innovation behaviours of national companies (9 statistically important models out of 18 possible). Average behaviour, but clearly differentiated in the group, can be observed in foreign enterprises and the ones with mixed structure of property what gives a relatively broad base of innovation subjects in the region. This does not change a fact that from a

perspective of property the industrial system of the Lower Silesia resembles the case between weak and strong regions in Poland. It seems that the factor in favour of drawing foreign capitals is also the localisation of the province by the western boundary of the country.

Table 5. *The form of probit with independent variable of "enterprise's size", in models describing industry's innovation in the Lower Silesian region.*

Innovative feature	Size of enterprise			
	micro	small	medium	large
R&D expenditure	-0,71x-0,17		0,43x-0,48	0,82x-0,45
Investment in new fixed assets	-0,41x+1,15		0,48x+0,91	
- building and grounds	-0,30x-0,37		0,33x-0,53	
- technical equipment and machinery	-0,33x+0,86			
Software solution	-0,60x+0,76	0,26x+0,44	0,45x+0,45	
Launching new products				
Implementation of new technology process (including):	-0,27+0,91		0,42x+0,74	0,74x+0,78
- new production methods				0,58x+0,07
- none production systems	-0,35x-0,21		0,44x-0,44	0,94x-0,39
- support systems	-0,37x-0,28		0,44x-0,49	0,47x-0,43
Cooperation with competitors				0,72x-2,02
Cooperation with universities	-0,51x-1,38		0,55x-1,66	
Cooperation with domestic science units	-0,55x-1,34		0,43x-1,59	
Cooperation with customers	-0,45x-0,53			0,77x-0,72
Overall innovation cooperation	-0,27x+0,02			0,67x-0,12

Source: own study based on original research.

Table 6. *Values of parameters with independent variable of "character of the enterprise's property", in probit models describing industry's innovation in the Lower Silesian region (statistically important models).*

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

Source: own study based on research.

MAZOVIAN PROVINCE

In Mazovian region the size of enterprises plays a different meaning for the innovation activity realized in this area than in previously observed cases of provinces **(Table 7).**

Table 7. *The form of probit with independent variable of "enterprise's size", in models describing industry's innovation in the Mazovian region.*

Innovative feature	Size of enterprise			
	micro	**small**	**medium**	**large**
R&D expenditure	-0,74x-0,08		0,82x-0,51	1,19x-0,41
Investment in new fixed assets	-0,63x+0,91	0,42x+0,46	0,47x+0,54	
- building and grounds	-0,77x-0,45	0,29x-0,84	0,61x-0,84	
- technical equipment and machinery	-0,44x+0,58	0,33x+0,26		
Software solution	-0,36x+0,46		0,48x+0,23	
Launching new products	-0,36x+0,55		0,38x+0,32	0,76x+0,36
Implementation of new technology process (including):	-0,57x+0,72	0,24x+0,37	0,59x+0,38	
- new production methods	-0,39x+0,02		0,32x-0,20	
- none production systems	-0,69x-0,22	0,22x-0,57	0,62x-0,60	0,56x-0,51
- support systems	-0,41x-0,69		0,45x-0,93	0,60x-0,88
Cooperation with universities	-0,48x-1,64			
Cooperation with domestic science units	-0,32x-1,25		0,41x-1,46	
Cooperation with foreign science units			0,51x-2,19	1,26x-2,20
Cooperation with customers	-0,22x-0,71			
Overall innovation cooperation	-0,32x-0,04			0,59x-0,20

Source: own study based on research.

Innovation dynamo are not only medium enterprises, but alternatively large ones. The most crucial from the system and evolution perspective is the support of innovation activity in the region by the class of small industrial enterprises, mainly in the area of passive transfer of technology. Previous examinations in economically strong regions suggested in a small number of cases that small subjects are not the de-stimulating factor for undertaking innovation activity, when in the analysed case we perceive wide interest of its conducting. This is undoubtedly a strong determinant of innovation activity in Mazovia, showing its specificity.

On the opposite pole there are once again micro subjects, in which innovation activity is crucially weaker than in other groups altogether. This concerns almost all examined areas. It is difficult to simultaneously expect that the observed situation would change in the near future.

Observed phenomena mean that relation between subjects, their current experiences, level of trust on the market and implementation of new solutions make the new industrial system in the region work efficiently. Taking into consideration its potential in the scale of the country we can issue a thesis that it has the right critical mass dynamizing technological changes. This way from the perspective of enterprises' size it has bases to increase the innovation distance towards other regions.

The observed shaping of models leads to a conclusion about the imperative of construction of different instruments of support (innovation politics) in the region for micro subjects (problem of stimulating awareness), small, medium and large (maintaining high engagement in innovation activity).

From the point of view of enterprises' properties and their tendency to undertaking innovation activity, we can also observe untypical behaviours for national conditions **(Table 8).** Although we can still perceive anti-innovation behaviours of national companies (12 models

with statistically important parameters out of 18 possible), the main factors accelerating changes in subjects are no longer the foreign enterprises but the ones characterised by mixed structure of property. At the same time we observe the transfer of accelerating power from units with exclusive foreign capital to those, in which there exists the native capital, and there is much more of them in the regional structure. Moreover, this group of units clearly predominates in the innovation activity over foreign subjects. A significant number of models proves that the discussed factor plays a significant meaning in shaping the innovation activity in the region.

Table 8. *The form of probit with independent variable of "character of enterprise's property", in models describing industry's innovation in the Mazovian region.*

Innovative feature	Character of company's ownership		
	Domestic	**Foreign**	**Mixed**
R&D expenditure	-0,79x+0,32	0,56x-0,41	1,02x-0,43
Investment in new fixed assets			
- building and grounds	-0,32x-0,45	0,50x-0,77	
- technical equipment and machinery	-0,38x+0,71		0,62x+0,34
Software solution	-0,47x+0,71	0,83x+0,25	
Launching new products	-0,33x+0,67		
Implementation of new technology process (including):	-0,53x+0,93		0,96x+0,42
- new production methods	-0,42x+0,22		0,53x-0,18
- none production systems	-0,38x-0,16		0,44x-0,51
- support systems	-0,38x-0,52		0,45x-0,88
Cooperation with domestic science units	-0,46x-0,98		0,55x-1,42
Cooperation with foreign science units	-1,42x-1,15	1,04x-2,24	1,15x-2,24
Overall innovation cooperation			0,71x-0,84
Cooperation with suppliers	-0,49x+0,25		0,73x-0,22

Source: own study based on research.

CONCLUSIONS

Diversification of innovation activity in Polish regions, taking into account the structure of size and enterprises' property in industrial systems, indicates their time evolution and in consequence different habits in the examined scope. In the economically weakest case not only the development of industry is limited due to its actual potential of economics but the additional negative tendencies are enhanced by unprofitable structural conditionings. Innovation dynamism is concentrated in large subjects supported in several areas with medium units. Anti-innovation behaviours concern micro and small enterprises.

In the West Pomeranian region we can observe a change of transferring innovation activity towards medium subjects in connection with large ones, when micro and small companies still show the unwillingness to develop new technologies. Taking into consideration natural diversification of the number of medium companies in relation to large ones, without the consideration for objective potential of economics, innovation activity concerns a much wider group of companies, what contributes to a more intensive transfer of knowledge in the system.

In the next region, according to the accepted evolutionary approach, small enterprises stop showing anti-innovation behaviours, in order to become a crucial group of innovation support in the best developed region. Observed phenomena prove the unusually wide base of enterprises

directed towards technological changes, what in connection with economic potential of these provinces, gives them disproportionate advantage supporting the creation of new solutions.

From the point of view of property of enterprises, national units can be characterised by ambivalent approach to innovation processes. On the opposite pole there are foreign subjects. However, in accordance with the previously set thesis on changes of evolutionary character, innovation activity in Polish regions moves towards subjects of mixed structure of property. Regardless of the considered case, the level of awareness and acceptance for innovation in the group of national subjects leaves a lot to wish for. Thus, thesis about the endogenous, regional, technological development, supported with, among others, the theory of clusters, in Polish conditions is very unreal. The main reason responsible for this is the lack of the internal ability to self-maintaining innovation development – system auto-dynamism.

The size and property of capital in Polish companies play an essential role in realization of processes of creating and implementing new technologies and for the initiation of relations of innovation cooperation. National and foreign literature indicates the section of small and medium enterprises financed by the internal capital as the one which due to its numerous advantage is responsible for their process of dynamic diffusion after market – especially the local and regional one. In this case the technological level of the introduced solutions does not matter. Meanwhile, the conclusions resulting from the conducted research suggest that the discussed interactions are more often dependable on the specificity of the industrial system and the current stage of its development. According to the evolutionary and systemic perspective, as the industrial potential grows and its competitiveness improves, the responsibility for acceleration of the progress moves from the point of seeing classes' size from large economic units, through medium ones, towards small ones, and from the point of view of property's character from foreign subjects towards the mixed ones. Owners of national micro-enterprises in Polish conditions are distinguished by far advanced restraint to undertake risk resulting from running the innovation activity.

National politics directed to the support of innovation in the section of small and medium enterprises, should consider not only the need of applying differentiated pro-innovation mechanisms for particular classes of subjects' sizes, but also the fact of different maturity of provinces in the area of absorptions' potential of generated solutions.

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