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Sales range and innovative activity in the manufacturing system of Poland

JEL Classification: *L52; O25; P51; O31, O32, O33*

Keywords: *innovation; manufacturing; system; country; sale range*

Abstract
Research background: In the literature, there is a discussion on the importance of the spatial distance from the user in the context innovation activity. However, most of this kind of studies concentrate on exporting enterprises and compare them to domestic ones. Exporting activity is very important for catching-up countries, because of technology transfer in its background.
Purpose of the article: The aim of this paper is to determine whether the innovative activity in Poland's manufacturing system is a consequence of close interactions (local and regional), or perhaps conditioned by the imperative of functioning on the national and international market. The main hypothesis was that on the current development level of Poland, the relationship between the range of sales and innovation activities are different from those in the more developed countries.
Methods: Empirical studies was created in 2006–2012 as a result of the systematic collection of questionnaires filled by manufacturing enterprises in Poland from all regions (5209 correct fulfilled questionnaires). Methodical analysis was based on the theory of probability — probit modeling, because dependent variables were binary (0 or 1).
Findings & Value added: Local and regional space is not stimulating innovation activity in opposite to national one. High intensity observed only when the company has been working on the international market. It means that the industry maturity level in Poland is good

enough for creating a domestic innovation environment. This kind of an aggregation level should be stimulated by the government innovation policy.

Introduction

Currently, it is believed that one of the determinants of high competitiveness of companies are their activities on the international market. The possibility and ability to sell products and services abroad accelerates the creation of innovative projects, creates opportunities for the promotion of technologically advanced enterprises through the implementation of new products, processes, or organisational techniques on other markets (OECD, 2003).

The model of the endogenous growth suggests that internationalization is an opportunity for businesses, mobilising them to innovation activity, particularly to the research and development intensity, and as a result to the growth of export (Romer, 1990, p. 75). At the same time, heterogeneity of companies concentrated in a limited geographical space (locally, regionally) has a negative impact on their opportunities for the investment expansion, improvement of productivity or development of export (Bernard *et al.*, 2003, p. 1269) — the advantage of specialisation over diversification. Specialisation according to the concept of endogenous development should contribute to an increased number of interactions (new specialised products and processes) only at the regional level, or even local, thus leading to the growing volume of internal transactions. This fact raises the question whether internationalisation proves to be a stronger phenomenon.

The first concepts discussing the process of internationalisation of enterprises were formed in the 70's of the last century, but since then they have evolved from the level of an incremental process (stage) towards the holistic, specified and integrated approach (Daszkiewicz, 2014, p. 9). Currently, the Upssala-I model is at the front of considerations (Johanson & Vahlne, 1977, p. 28; Johanson & Wiedersheim-Paul, 1975, p. 309) (U-model) as well as the updated U-model (Johanson & Vahlne, 2009, p. 1411; Schweizer *et al.*, 2010, p. 350), which draw attention to the important role which is played by knowledge and education of companies as a result of the internationalisation process.

In the traditional sequential model of the internalisation process, the entrance onto the international markets takes place when the company reaches a critical mass, which is composed of, among others, the accumulated and available capital, the ability to learn along with the acquired experiences, technical knowledge and the abilities to absorb it (Gorynia & Jankowska, 2007, pp. 21–44). At the same time, the ongoing technological revolution

has reduced the information distance to the foreign markets and has thus limited the capital requirements related to this and has simplified the management processes. Although currently it is easier to appear on the international market, there are still limitations to this process, like the competency gap, higher qualitative and quantitative requirements compared to the local or national market, a very narrow specialisation often resulting from the dominant role of the foreign consignee.

The causes for implementing new solutions as a result of the exploration of foreign markets should be sought in:

- facilitated access to new technologies (including products and their manufacturing methods) on these markets (Greenaway & Kneller, 2007, p. 152),
- possibilities for obtaining technical assistance in the supply chain – from the buyers or professional service providers located abroad (Blalock & Gertler, 2004, p. 403),
- contact with the competing companies and imitation of marketing or management techniques used by them (Blalock & Gertler, 2004, p. 405).

The main research purpose appears to be determination whether the innovative activity in the national system is the local or regional consequence, or whether it requires the over-regional or even over-national scope. On this basis a question appears: do companies located in Poland behave differently than those functioning in much more developed countries — high technological gap?

The article consists of four parts. The first one describes the theoretical backgrounds for the studied phenomena. The second is the description of the research methodology that is being applied. The third one is a specification of the obtained research results. The last one is a discussion of findings, implications and recommendations for practice, research limitations, suggestions for future research.

The theoretical background and research hypothesis

In the light of previous studies on the effects of diffusion of knowledge, undertaking and intensifying export contribute to the launch of mechanisms of the so-called technological learning through export (learning-by-exporting) (Mińska-Struzik, 2013, p. 50; Rodil *et al*, 2016, p. 248). This process occurs in the course of export and is a necessary step to achieve a higher level of the company's development (Garcıa & Avella, 2008, p. 91). It is also believed that the international expansion is a gradual process, where companies increase their technological level due to learning how to

operate on foreign markets (Delgado *et al*, 2002, p. 60). In addition, exporters are exposed to a more intensive competition and are forced to a more frequent implementation of innovations than entities operating only on the local market — this also affects their productivity (Impullitti & Licandro, 2018, p. 189; Wagner, 2007, p. 78).

Although in the literature there is a discussion whether it is export that stimulates innovations, or the other way round, these phenomena are probably linked with a number of mutual interactions. Moreover, it is a phenomenon of a more heterogeneous nature, as there are innovative companies, which do not export and entities functioning on the international market, which do not introduce new technologies, as it depends on many circumstances. Research in this area was carried out in Spain in 1994–2005 and 2001–2008 obtaining different results. In the first one, it has been argued that the interactions are turning, while only R&D has a positive impact on export, and the other way round. At the same time, only the innovation processes have a significant impact on the export activity, while this one, in turn, only determines the product innovations (Filipescu *et al.*, 2013, pp. 30–31). The second study has demonstrated that innovations lead to the formation of export opportunities, and not the other way round (Monreal-Perez *et al.*, 2012, p. 862). What is more, the effect referred to in the literature as learning through export has not been observed in the analysed entities.

In the studies conducted in Poland by Mińska-Struzik (2012, pp. 8–10) the positive impact of export on the innovation activity has been proven, with the fact that in the case of product innovations it was almost three times greater than the process innovations. In the analyses carried out in Germany and in the European Union countries of the "old 15", consistent results have been only partially achieved. It was shown that in the more developed countries, the intensity of export depends only on the innovative products, while it does not depend on innovative processes at all (Becker & Egger, 2013, p. 340). However, the attention at the same time is paid to the obtained conclusions, which are different than those achieved for research quoted previously, conducted in Spain.

The results obtained in other studies conducted Poland (Podlasie region) indicate that there is a strong correlation between the implementation of innovations and conducting the R&D activity and export (Czemiel-Grzybowska & Walicka, 2013, p. 623). These analyses should be considered important, although approaching the recognised problem narrowly, as they did not consider different types of innovation activity in detail, apart from the aforementioned research and development. At the same time the low linear correlation between the innovation activity and volume of export

expressed in value is interesting. Perhaps the low level of technological advancement of the studied region, which at the stage of evolution, in a manner different than in developed regions, stimulates the innovation activity. In other words, low technological advancement of the exported products and the location of the region in the east of the country (geographical specificity) may result in low dependencies. Based on the abovementioned reasons, research previously conducted in Poland, although interesting and having a lot of unique values, also seem to partially recognise the formulated problem.

Summing up these short theoretical considerations, we conclude that these phenomena, even in the world research, did not gain full stability for the achieved results, and the research concepts are still evolving.

Therefore, on one hand, we are still dealing with theses that appeal for stimulating the export activities of enterprises, because it is significantly related to innovative activity, while on the other hand, new economic geography and the process of spatial approximation suggest that the companies, entering close geographical (local or regional) interactions, create innovative solutions, which ultimately lead to their export, at least outside the region. This does not change the fact that the end result of such a product system is obtained through the production, and mutual and multiple resale of intermediates in close spatial boundaries. As a result, a regional product is formed, which is subject to export.

The basic research hypothesis is formed as a statement that at the current level of development in Poland, the relations between the range of sale and the innovation activity are different than the ones observed in more developed countries. Only the structural changes in the economy and the acceleration of technological progress (reduction of the technological gap) will bring these trajectories closer together.

Research methodology

The empirical layer of the research was created in 2006–2012, as a result of the systematic collection of questionnaires filled by industrial enterprises (manufacturing — NACE 1.1) from various regions, completed by conducting appropriate econometric analyses on the developed database of primary data (5209 correctly completed questionnaires). Extension over time was due to the necessity to collect very large research sample (systemic approach), and it obviously takes more time.

The methodological part was based on probability, and more precisely on statistical modelling of the probit type. Its usefulness arises when the

dependent variable takes two values (0 or 1), meaning that the studied phenomenon takes place or not. Classical regression proves to be defective in this place, because it takes into account the occurrence of phenomena which mathematically go beyond the scope between zero and one, which is not consistent with the logic of the analyses. Its use has already been repeatedly and successfully tested by various researchers in the country and abroad (Dzikowski, 2012, pp. 475–488; Tomaszewski, 2013, pp. 101–113). Different levels of aggregation of the sale range have been adopted for independent variables: local, regional, national, international. The selection of variables in the study was based on methodological standards applicable in all OECD countries. According to them, the innovation activity is understood as the entrance (expenditures and their structures), exit (implementations in relation to the structure) and interactions with the environment (in a division into different institutions from the area of science and industry).

The mere interpretation of the obtained models was limited to the character standing next to the main parameter of the equation and the achieved probability values. Moreover, several basic statistics have been indicated, related to the model and its parameter: standard error, Wald statistics, chi-square, p-model value (the limit value p was assumed for the analyses at the level of 0,05).

All values from the research part contained in the tables should be interpreted similarly. In each case 5 209 companies take part in estimation process. The probability value (p_1) in each table means that the chances for an event in an aimed group, is the estimated value. The last column (p_2) presents the chances for the same event, but in the remaining group of enterprises. For example, (Table 1), the chance for R&D in local operating companies is 17.0%, but for non-local — 39.0%. It means that R&D happens higher more than twice for non-local enterprises.

Results

Local (close) environment and innovation activity

Innovation activity of the manufacturing system in Poland strongly depends on the scale of operations of enterprises within the meaning the sale range. From seventy-two potential models, only eight cases did not achieve the statistical significance. What is more, every time the directions of interaction are consistent within the considered independent variables, without raising any interpretative problems (Table 1).

In the event when a company only operates on the local market, the chances to perform the innovation activity are statistically significantly lower than for entities operating on a larger scale. It was impossible to estimate only one model for the dependent variable "new technologies directly related to production". In the remaining seventeen cases, the interactions proved to be important when assuming a negative sign by the main parameter.

In terms of funding the innovation activity, the limitations at the local level can be observed for the R&D expenses — a decrease of chances by 56,4%, which is more than a half. For investments in buildings, related to the start of production of new products or the application of new technologies, the probability of their implementation drops by 40,7%. The local sale range is also not conducive to the purchases of new computer software or machines and devices — declines by 35,9% and 18,6%, respectively.

The chances to implement new products and technological processes decline to a similar degree — by 22,8% and 26,3%, while the detailed structural analysis of the latter shows significant declines of two categories: by-production systems by 45,7% and support systems by 55,6%.

The local sales range also has a negative impact on innovative cooperation within sector relations. In the case of a supply chain, the probability drops by 35,7% for suppliers and by 39,1% for recipients, with the highest absolute values for the first group. Opportunities for innovative cooperation with competitors decrease by 60,0%, but with the base value close to zero. On this basis, we can conclude that the innovative interactions with the sector environment occurs more often within the supply chain (vertical relations) than at the level with competitors.

The probability values achieved for the innovative cooperation with research centres for companies selling their products only on the local market are not only significantly lower than for entities operating on a larger scale, they also oscillate around zero. On this basis, it can be argued that the companies are not interested, at this stage of development, in the research of relations with the institutional sphere of R&D in Poland.

Summing up this part of the argument, we observe a system reluctance of companies limiting their activity to the local level, to show any innovation activity. Close geographical relations with customers in Poland do not create conditions conducive to entering into interactions of the technological nature. This is due to the current level of technological advancement of the country, weakness of local markets (no potentials), undemanding internal competition, or the lack of pressure from the demand. Innovation activity at this level is primarily maintained through the relations with suppliers located outside the region and the passive transfer of knowledge. Given the

current level of development of the local markets in Poland, it can be concluded that their development possibilities based on endogenous principles are unsatisfactory, taking into account the social mentality reluctant to change.

Space of the region and innovation activity

Since the local scope of impact proved to be unfavorable, perhaps the regional environment will be more conducive to innovation activity in Poland? Unfortunately, the boundaries of regions are also an inhibiting factor for the technological progress. In this situation, it has been possible to estimate fourteen out of eighteen models with statistically significant coefficients. It changes the importance of the regional environment from the unfavorable impact towards to a neutral one. However, in opposite cases, this level of aggregation is a de-stimulating factor for the innovation activity in the national manufacturing system. So far the boundaries of provinces have not created a friendly endogenous atmosphere for technological changes (Table 2).

In the area of financing innovations, the most noticeable is the decline in opportunities for the R&D business by 38,5%, while investments in modern fixed assets were reduced symbolically, but statistically significantly, by three percent points (change by 3,9%). In the remaining cases, chances also drop, but not more than by 22,2%.

The implementation of new products in companies operating only on the regional market takes place 12,0% less often than in other entities, and new technological processes by 6,7%, including directly manufacturing by 12,2% and by-production systems by 26,5%.

The innovative cooperation takes place less often by 13,6%, while at the same time the absolute probability of its occurrence is quite high — 0,38. Innovative cooperation with customers has chances at the level of 17%, and these are strictly intraregional relations. In the case of other institutional forms of cooperation, the highest probability was noted for national research units — 0,05 and it is almost a half lower than for other companies.

The boundaries of regions are the natural destimulant for innovation activity in the national manufacturing system, although the power of the negative impact is smaller than for the local sales range. Thus, endogenous intraregional relations cannot create circumstances conducive to technological changes in the provinces, and these are system-wide conditions, as they concern all regions in Poland. So far they have not achieved the internal potential able to spontaneously and systemically create innovations and accelerate processes related with them.

National environment and innovation activity

When analysing the patterns which were observed for the companies with the national sales range, we can argue that the boundaries of the regions define the boundary between the low and high systemic innovation activity in Poland. Companies operating nationally are much more interested in implementing new technologies. Thus, the territory of the region is a measure of the technological inefficiency, as opening to a wider environment is conducive to accelerating the innovation activity, as evidenced by fifteen statistically significant models in which the parameter has achieved a positive sign (Table 3.)

The chances for carrying out the R&D works increased by half, and reaches the value of 42%, as long as the companies operate in the supra-regional scale. On the other hand, the probability of investments in new buildings increases by 21,7%, in machines and devices by 12,7% and in new computer software by 9,6%.

Positive trends can also be observed on the implementation of new products and technological processes — an increased interest by 18,0% and 16,4%, respectively, but in the case of directly production processes the chances are higher by 25,6%. As in the case of funding, it was possible to estimate the significant models for all considered areas of innovation activity. This means that the observed impact of the national environment is common (system) and positive every time.

In terms of the sector innovative cooperation, the chances increase for the positive interactions with customers by 21,1% and with suppliers by 16,7%. At the same time, in the case of the latter, still the absolute probability value is higher, which reflects the supply model of innovative processes in the country, stimulated by the suppliers, while less by the customers (users).

The national environment turns out to be a condition sufficient for raising the system chances for the innovation activity of industrial companies. In other words, the export activity is not a prerequisite for the acceleration of innovative processes in Poland. The supra-regional level is related to a higher level of competition, quality requirements, risk and necessity of the different organisation of the activity (increased distance). In total, they induce the break of the current thinking about the market, in order to be able to expand the sales and cross the demarcation line between the low and high productivity.

Export and innovation activity

The export activity of the companies is also closely linked with the innovation activity. Both the strength and universality of impacts are greater than in the case of the national sales range. As we can see, for the trends the obtained results are consistent with analyses conducted in other countries, while being different in several interesting areas. From eighteen potential dependent variables, seventeen models were estimated (apart from the innovative cooperation with competitors). In all of them, the main parameters had a positive sign, Therefore, there is a positive and universal correlation between innovations and export. The achieved probabilities are naturally higher than for the national environment, that is the innovative intensity is higher in the group of experts (Table 4).

The chances for the R&D activity exceeded the threshold value of 50% and are higher by 82,7% compared to non-exporters. The passive transfer of new technologies is also carried out more often when the companies function on the international market, including the chances for purchasing machines increasing by 20,3% and computer software by 36,4%. The companies are also interested in more costly investments in new buildings — an increase of 71,4%.

In terms of implementation, the chances for new products and technological processes increase by 7,4% and 20,3%, respectively. However, it is worth noting that the absolute probability value for the entities exporting new products is lower only by 1 percentage point than for the companies operating in Poland. In other words, the foreign market does not stimulate more than the national environment of activities in terms of new products, as suggested by some studies carried out in the world, while technological processes do. Within new technological processes, the chances for new production technologies increase by 34,1%, for by-production systems by 57,1% and for support systems by 70,0%.

The innovative cooperation has also enjoyed an increased interest — an increase of 73,3%, with particularly high chances observed for the supply chain — 31% for the customers and suppliers. At the same time, this is the first case where the probability equalized between these groups, which means a balance between the supply and demand mechanism of innovative processes, but only in the group of exporters. The chances for innovative cooperation with the R&D sphere are still low, although statistically significant. Therefore, we can see that even the export activity cannot encourage the common relations between the sphere of business and science in Poland.

The export activity favours the innovation activity. The international market is very demanding and forces more dynamic adjustment of the offer in the national companies, including in terms of the used technologies. The positive impact of export on the system nature, more common and stronger than of the companies restricting their sales market to the borders of the country.

Discussion

As part of the conducted study on the national manufacturing system and dependencies between different levels of aggregation of the range of sales and innovation activity, a set of useful information has been obtained at the level of its development and directions of evolution. There is a close relation between the sales range and technological changes in the entities.

The Polish industry is divided into two parts. The first of them is a group of companies operating in the province boundaries, offering the manufactured products locally or regionally (34,9% of the population). It is characterised by a much lower tendency to innovations in the areas of funding and implementing new technologies, as well as innovative cooperation with the sector and scientific community. These phenomena are common and strong, especially for the entities limited to the local market. On this basis, it can be stated that the national provinces have not reached the endogenous ability (potential) so far for generating new technologies. Therefore, the Bernard *et al.* (2003) thesis is confirmed about the weakness of spatial approximation in stimulating innovative processes and the limited role of intraregional specialisation, that is small system chances for creation of cluster structures in these areas.

The second group of companies are those which go with their products beyond the region. At the same time, for the increased innovation activity the sales on the national market is sufficient, as the export additionally makes these processes more dynamic (intensifies them) in all planes under consideration. This undermines Becker's and Egger's (2013) thesis, which makes the export intensity dependent only on product innovations. Enterprises in Poland activate technological changes with the increase of the distance to the target market, which in turn increases the importance of the spatial approximation in the catching-up countries and the appropriateness or usefulness of the theory of the new Krugman's economic geography.

From an evolutionary perspective, the achieved results of the studies suggest that it is export that accelerates technological processes, as their chances increase along with the increase of the sales range — non-

compliance with the Monreal-Perez *et al.* (2012) research. At the same time, a stronger relation has been discovered between the export and new processes, when the national market remains a strong and necessary stimulant for the products, which is partly consistent with the conclusions drawn by Filipescu *et al.* (2013).

Taking into account other studies carried out in our country in this field, it can be stated that the strong relation of export with innovation activity has been confirmed, but with different characteristics. As the chances for process innovations are higher than for product innovations, and in the case of the former, export additionally intensifies them, when it does not do this to the latter, which can be considered the opposite to the thesis resulting from the Mińska-Struzik (2013) research.

Conclusions

In the Polish national manufacturing system, there is a connection between sales range and innovation activity. The boundary for low and high innovation activity is geographical region border. With sales range increase, innovation activity grows. The conclusion was repeatable in every part of the analyzed activity. Polish regions didn't achieve a self-sustaining and endogenous technology development potential.

The achieved conclusions show the new possibilities for directions to efficiently support the growth of innovation activity in Poland. The support should go to both exporting companies and those with a national range, which are active over the region's borders. In the second case, a reasonable option for better innovation performance is to use extensive and systemic solutions for passive technology change i.e. to buy a new equipment.

The research sample, although large, is not representative in statistical terms. The conclusions can't be transferred to the whole industry in Poland. Another problem is the data specification (the data quality). To achieve a large sample of the fulfill questionnaires, there was a need to use simple, but logical answers for the questions. In this case, it was not possible to collect continuous data, but dichotomous (binary) only. The third important limitation was lack of the possibility to directly compare the achieved results with other researches carried out in Poland.

The first suggestion, after completing this research, is to extend the next one by service industry companies research, especially to include intensive knowledge-based ones. The conclusions from this research can be useful as a good background in preparation of other bodies of research. The next solution for the future is to do a fully representative piece of research in

statistical terms. It will be tough, but is achievable, in the Author's opinion. This could have interesting implications for the innovation policy in Poland. A more specific suggestion is the necessity to provide more pieces of research to understand the innovation processes and their restrictions. It should rely on just active companies over the region, but not exporting. This is the novelty in comparison to current pieces of research in Poland.

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Annex

Table 1. Coefficient value by independent variable „local range", in probit models describing innovation activity in the polish manufacturing system (statistical significant coefficient only)

Innovation activity	Coefficient	Standard error	Wald-statistic	Chi-square	p_1	p_2
Expenditures on R&D	-,684	0,055	-12,45	167,69	0,17	0,39
New investments (including):	-,380	0,049	-7,69	58,23	0,65	0,78
a) building and structures	-,381	0,056	-6,81	48,57	0,16	0,27
b) machinery and technical equipment	-,348	0,048	-7,26	52,35	0,57	0,70
Software solutions	-,589	0,048	-12,28	152,60	0,41	0,64
New products	-,320	0,048	-6,73	45,48	0,44	0,57
New technology (included):	-,565	0,048	-11,69	135,58	0,56	0,76
a) by-production systems	-,474	0,054	-8,86	82,40	0,19	0,35
b) support systems	-,534	0,060	-8,96	87,12	0,12	0,27
Cooperation with suppliers	-,303	0,054	-5,56	31,98	0,18	0,28
Cooperation with competitors	-,412	0,109	-3,77	16,71	0,02	0,05
Cooperation with customers	-,354	0,058	-6,07	38,74	0,14	0,23
Cooperation with PAN-units	-,400	0,164	-2,44	7,33	0,01	0,02
Cooperation with universities	-,380	0,105	-3,63	15,15	0,02	0,05
Cooperation with domestic R&D units	-,677	0,100	-6,82	59,86	0,02	0,09
Cooperation with foreign R&D units	-,821	0,230	-3,562	22,71	0,00	0,02
Total innovation cooperation	-,424	0,050	-8,555	74,84	0,30	0,46

P_1 – probability value of phenomenon in the purposeful group of enterprises
P_2 – probability value of phenomenon in the alternative group of enterprises

Table 2. Coefficient value by independent variable „regional range", in probit models describing innovation activity in the polish manufacturing system (statistical significant coefficient only)

Innovation activity	Coefficient	Standard error	Wald-statistic	Chi-square	p_1	p_2
Expenditures on R&D	-,427	0,048	-8,90	81,80	0,24	0,39
New investments (including):	-,117	0,048	-2,46	5,99	0,73	0,76
a) building and structures	-,192	0,050	-3,88	15,35	0,21	0,27
b) machinery and technical equipment	-,129	0,046	-2,84	8,08	0,64	0,68
Software solutions	-,282	0,044	-6,34	40,14	0,52	0,63
New products	-,144	0,044	-3,25	10,53	0,50	0,56
New technology (included):	-,148	0,046	-3,18	10,04	0,69	0,74
a) production technology	-,152	0,045	-3,38	11,67	0,43	0,49
b) by-production systems	-,275	0,048	-5,75	33,75	0,25	0,34
Cooperation with customers	-,210	0,052	-4,04	16,68	0,17	0,22
Cooperation with universities	-,495	0,105	-4,73	27,19	0,02	0,05
Cooperation with domestic R&D units	-,284	0,072	-3,94	16,63	0,05	0,09
Cooperation with foreign R&D units	-,304	0,126	-2,42	6,65	0,01	0,02
Total innovation cooperation	-,175	0,045	-3,89	15,16	0,38	0,44

P_1 – probability value of phenomenon in the purposeful group of enterprises
P_2 – probability value of phenomenon in the alternative group of enterprises

Table 3. Coefficient value by independent variable „domestic range", in probit models describing innovation activity in the polish manufacturing system (statistical significant coefficient only)

Innovation activity	Coefficient	Standard error	Wald-statistic	Chi-square	p_1	p_2
Expenditures on R&D	+,379	0,036	10,41	109,37	0,42	0,28
New investments (including):	+,234	0,038	6,13	37,65	0,79	0,72
a) building and structures	+,165	0,038	4,30	18,76	0,28	0,23
b) machinery and technical equipment	+,226	0,036	6,21	38,69	0,71	0,63
Software solutions	+,391	0,036	11,00	120,78	0,67	0,52
New products	+,214	0,046	4,62	37,16	0,59	0,50
New technology (included):	+,337	0,037	8,99	80,97	0,78	0,67
a) production technology	+,205	0,035	5,84	34,08	0,52	0,43
a) by-production systems	+,283	0,037	7,71	59,72	0,37	0,27
b) support systems	+,247	0,039	6,34	40,64	0,28	0,20
Cooperation with suppliers	+,137	0,038	3,62	13,02	0,28	0,24
Cooperation with customers	+,129	0,040	3,26	10,70	0,23	0,19
Cooperation with universities	+,237	0,064	3,68	13,92	0,05	0,03
Cooperation with domestic R&D units	+,325	0,053	6,13	38,74	0,10	0,06
Total innovation cooperation	+,201	0,035	5,69	32,42	0,46	0,39

P_1 – probability value of phenomenon in the purposeful group of enterprises
P_2 – probability value of phenomenon in the alternative group of enterprises

Table 4. Coefficient value by independent variable „foreign range", in probit models describing innovation activity in the polish manufacturing system (statistical significant coefficient only)

Innovation activity	Coefficient	Standard error	Wald-statistic	Chi-square	p_1	p_2
Expenditures on R&D	+,617	0,039	15,66	246,46	0,53	0,29
New investments (including):	+,365	0,045	8,12	68,09	0,83	0,73
a) building and structures	+,448	0,041	10,98	119,79	0,36	0,21
b) machinery and technical equipment	+,365	0,042	8,69	77,24	0,77	0,64
Software solutions	+,540	0,041	13,07	176,16	0,75	0,55
New products	+,123	0,039	3,14	9,96	0,58	0,54
New technology (included):	+,451	0,044	10,14	106,85	0,83	0,69
a) production technology	+,381	0,039	9,74	95,65	0,59	0,44
b) by-production systems	+,428	0,040	10,82	116,7	0,44	0,28
b) support systems	+,418	0,041	10,15	102,27	0,34	0,20
Cooperation with suppliers	+,207	0,041	5,03	25,08	0,31	0,24
Cooperation with customers	+,431	0,042	10,26	104,17	0,31	0,18
Cooperation with PAN-units	+,215	0,092	2,34	5,33	0,02	0,01
Cooperation with universities	+,477	0,063	7,56	55,97	0,08	0,03
Cooperation with domestic R&D units	+,450	0,052	8,58	72,13	0,14	0,06
Cooperation with foreign R&D units	+,709	0,085	8,32	71,83	0,05	0,01
Total innovation cooperation	+,441	0,039	11,28	127,97	0,56	0,38

P_1 – probability value of phenomenon in the purposeful group of enterprises
P_2 – probability value of phenomenon in the alternative group of enterprises