

MANAGING INNOVATIONS IN SELECTED REGIONS AND THEIR INFLUENCE ON CREATION THE POLISH ECONOMY

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Abstract: Building an innovation-based economy is a widely applicable trend in the present global economic system. Developing countries are generally identified with technological and technical progress, which depends on cooperation of R&D units with economic operators. New introduced solutions are reflected in 'modern' products, which have ability to rapidly meet often exorbitant and changing customer needs. This article presents an analysis of the innovation and production issues on the example of four most dominant voivodeships in these areas, in the context of their impact on development of the national economy.

INTRODUCTION

Innovation issue is a very broad term due to its different types, divisions and criteria. An economic activity can be an example of such a division, including: breakthrough; distinctive; minor improvements innovation; product; process; marketing; economic; socio-cultural; in the field of science, technique and technology. [4] Possibilities for its usage are theoretically unlimited but in practice are limited regarding costs of its implementation. Considering financial resources of businesses from the SME sector they have hindered development possibilities, e.g. through technological innovation. But also they can benefit from certain solutions such as clusters [4], however, these practices are not commonly used in Poland. The innovativeness generally is connected with production which is generating benefits of increased quality possibilities of products. Thus allows to satisfy demanding customers with a flexible approach for manufacturing changes. The combination of innovative production in addition to the innovations applied in logistics lets the company to operate on the global market and make an attempt to compete with large companies [1]. The authors in their work are making an attempt to find the developed region in Poland, which under the innovative conditions is producing revenue and in a meaningful way will have an influence for building the national economy. Conducted examinations concern the data obtained from a website of Central Statistical Office of Poland. In the research work was used annual data concerning [6]:

- industry and construction: sold production of industry by enterprises size class (Poland and voivodeships, NACE 2007 [bln PLN]),
- science and technology: innovation activity: expenditures on innovation activity in enterprises by type of innovation activity (Poland and voivodeships industrial enterprises: capital expenditures on fixed assets - machines and technical equipment [bln PLN]),

- science and technology: innovation activity: share of net revenues from sales of innovative products in the industrial enterprises by size classes (voivodeships, share of net revenues from sales of innovative only for the enterprise products in total net revenues from sales [%])

The analysis will be conducted at using quantitative methods: analysis of dynamics and measures of correlation and the regression.

SOLD PRODUCTION OF INDUSTRY AND EXPENDITURES ON INNOVATION ACTIVITY

Analysis refers to research the relation between the two types of data - Sold production of industry and Expenditures for product and process innovations.

Sold production of industry as wording definition of the terms used in official statistics is „basic measure of economic activity (i.e. industrial activity, construction and assembly, transport and other activity) of enterprises and industrial companies, i.e. economic entities included, according to the NACE Rev.2, in the sections B, C, D, E. Sold production of industry is the value expressed in current basic prices i.e. excluding value added tax (VAT), excise tax and including the value of received subsidies on products (goods and services)”. Value of sold production refers to, first, value of products sold by an enterprise externally (whether the payments for them have been received or not) and secondly, the value of manufactured products not classified for sale, but treated as sales. The first value includes finished products, semi-finished products and parts of own production, performed services and works, including construction and assembly works realized by own forces, scientific and research as well as designing, geodetic and cartographic works. They result from multiplying the number of sold products and services by the selling price of the unit corrected by due extra charges, granted rebates, reductions, discounts or contractual due payments for the sale of products and services, excluding value added tax (VAT). Second value refers to own products supplied to own retail sales as well as to catering establishments and wholesalers, then into benefits transferred to the social benefits fund and own products and services manufactured and transferred for increasing the value of own fixed assets. Further includes also transferred goods and services free of charge for the purpose of representation and advertisement, transfer of goods and services provided for the taxpayer's and staff's personal needs and donations of goods and services rendered free of charge. [5]

Expenditures for product and process innovations are determined as "current and capital expenditures on product/process innovation activity". Refers to expenditures towards scientific R&D works related to development the production of new and significantly improved products (product innovations) and processes (process innovations), acquisition of software and knowledge from external sources (licenses, patent rights, disclosures of know-how, etc.) and acquisition and installation of machinery and devices, expansion, modernization of buildings used for the implementation of product and process innovations. In addition the expenditure included personnel training connected with innovation activity and marketing of new or significantly improved products. [2]

Analysis of correlation and regression refers to verify the *correlation coefficient* and the *regression function*. First one constitutes the criteria of strength and linear relation, which may take place between two variables, however, the second one enables the quantitative links, which may take place between an independent variable and a dependent variable. To examine the dependencies and its significance, the following hypothesis should be verified: [3 p. 44-52]

1. Test for significance of correlation coefficient
 - $H_0: r_{XY} = 0$ correlation between the Y and X variables is insignificant $t_{r_{XY}} \leq T^*$
 - $H_1: r_{XY} = 1$ correlation between the Y and X variables is significant $t_{r_{XY}} > T^*$
2. Test for significance of parameter
 - $H_0: t_{a_0 \rightarrow a_n} = 0$ parameter $a_0 \rightarrow a_n$ is insignificant $t_{a_0 \rightarrow a_n} \leq T^*$
 - $H_1: t_{a_0 \rightarrow a_n} = 1$ parameter $a_0 \rightarrow a_n$ is significant $t_{a_0 \rightarrow a_n} > T^*$
3. Test for significance of determination coefficient
 - $H_0: F = 0$ multiple correlation coefficient is insignificant $t_F \leq T^*$
 - $H_1: F = 1$ multiple correlation coefficient is significant $t_F > T^*$

The description of the calculations presented in the tables (1-4) was carried out for sold production value and expenditures on innovation activity in division for Poland and the voivodeships with the highest values - Masovian (1), Silesian (2) Greater Poland (3) and Lower Silesian (4), in period 2006-2014.

Table 1

The list of correlation and regression analysis measures for sold production of industry (Y-Poland, X_1 to X_4 – voivodeships)

Correlation coefficient	$r_{X_1Y} =$ 0,995	$r_{X_2Y} =$ 0,963	$r_{X_3Y} =$ 0,986	$r_{X_4Y} =$ 0,996	
Significant correlation coefficient	$t_{r_{X_1Y}} =$ 26,42	$t_{r_{X_2Y}} =$ 9,483	$t_{r_{X_3Y}} =$ 15,59	$t_{r_{X_4Y}} =$ 30,00	
Critical value	$T_{0,05;7}^* = 2,365$				
HYPOTHESIS	H_1	H_1	H_1	H_1	
Linear regression function	$y_1 = -10,46 + 0,55x_1 + 1,5x_2 + 3,42x_3 + 2,97x_4$				
Significant structural parameters	$t_{a_0} =$ 0,212	$t_{a_1} =$ 0,404	$t_{a_2} =$ 2,876	$t_{a_3} =$ 1,592	$t_{a_4} =$ 1,813
Critical value	$T_{0,05;4}^* = 2,776$				
HYPOTHESIS	H_0	H_0	H_1	H_0	H_0
Determination coefficient	$R^2 = 0,998$				
Test Fisher – Snedecor	$F = 823,03$				
Critical value	$T_{0,05;4;4}^* = 6,39$				
HYPOTHESIS	H_1				

Analysing the correlation for Polish sold production of industry, showed that the highest share in its creation has sold production of industry in each voivodeships. Read out critical value and its comparison with the calculated value of the significance for correlation coefficient, finds that all voivodeships shows statistical significance dependencies. In case of researching the structural parameters it can be observed that only the second parameter and therefore variable

next to it, give a significant effect on the dependent variable. Therefore, it can be said that the sold production of industry in Silesian voivodeship creates significantly Polish sold production of industry. Very high fitting level of model to empirical data confirms the statistical significance of the relationship between the sold production of industry in Poland and the voivodeships.

Table 2

The list of correlation and regression analysis measures on innovation activity (Y-Poland, X₁ to X₄ – voivodeships)

Correlation coefficient	$r_{X_1Y} =$ 0,708	$r_{X_2Y} =$ -0,144	$r_{X_3Y} =$ 0,031	$r_{X_4Y} =$ 0,311	
Significant correlation coefficient	$t_{r_{X_1Y}} =$ 2,658	$t_{r_{X_2Y}} =$ -0,385	$t_{r_{X_3Y}} =$ 0,082	$t_{r_{X_4Y}} =$ 0,865	
Critical value	$T_{0,05;7}^* = 2,365$				
HYPOTHESIS	H_1	H_0	H_0	H_0	
Linear regression function	$y_1 = 0,06 + 3,39x_1 + 0,66x_2 + 1,94x_3 + 1,5x_4$				
Significant structural parameters	$t_{a_0} =$ 0,027	$t_{a_1} =$ 6,568	$t_{a_2} =$ 1,697	$t_{a_3} =$ 1,973	$t_{a_4} =$ 2,193
Critical value	$T_{0,05;4}^* = 2,776$				
HYPOTHESIS	H_0	H_1	H_0	H_0	H_0
Determination coefficient	$R^2 = 0,931$				
Test Fisher – Snedecor	$F = 13,441$				
Critical value	$T_{0,05;4;4}^* = 6,39$				
HYPOTHESIS	H_1				

The study of relationships for businesses bearing the expenditures on innovative activities has shown, that the highest correlation is taking place in relation to expenditure on innovation activities in Masovian voivodeship. The critical value read and its comparison with the calculated value of the significance of the correlation coefficient indicates that only for this variable should the alternative hypothesis be adopted, which constitutes the statistical significance of correlation. In case of researching the structural parameters it can be observed relational linking with correlation, because Silesian voivodeship which is equivalent to variable standing next to parameter α_1 , significantly creates expenditure on innovation activities in Poland. Very high fitting level of model to data, confirms acceptance of the hypothesis about the statistical significance.

Table 3

The list of correlation and regression analysis measures of dependences for sold production of industry and expenditures on innovation activity (Y – Polish production, X₁ to X₄ – voivodeships expenditures)

Correlation coefficient	$r_{X_1Y} =$ -0,201	$r_{X_2Y} =$ -0,710	$r_{X_3Y} =$ 0,694	$r_{X_4Y} =$ 0,782
Significant correlation coefficient	$t_{r_{X_1Y}} =$ -0,543	$t_{r_{X_2Y}} =$ -2,671	$t_{r_{X_3Y}} =$ 2,547	$t_{r_{X_4Y}} =$ 3,325

Critical value	$T_{0,05;7}^* = 2,365$				
HYPOTHESIS	H_0	H_1	H_1	H_1	H_1
Linear regression function	$y_1 = 752,36 + 56,01x_1 - 121,66x_2 + 207,05x_3 + 137,85x_4$				
Significant structural parameters	$t_{a_0} =$ 1,435	$t_{a_1} =$ 0,467	$t_{a_2} =$ 1,353	$t_{a_3} =$ 0,907	$t_{a_3} =$ 0,869
Critical value	$T_{0,05;4}^* = 2,776$				
HYPOTHESIS	H_0	H_0	H_0	H_0	H_0
Determination coefficient	$R^2 = 0,777$				
Test Fisher – Snedecor	$F = 3,499$				
Critical value	$T_{0,05;4;4}^* = 6,39$				
HYPOTHESIS	H_0				

Analysing the correlation of enterprises incurring outlays on the activity of innovations in provinces and their impact on Polish manufacturing industry indicated that the highest dependency occurs in the provinces of Silesian, Greater Poland and Lower Silesian. The critical value read and its comparison with the calculated value of the significance of the correlation coefficient reveals that in the case of these provinces, it is necessary to adopt an alternative hypothesis which constitutes the statistical significance of their relation. In the case of analysing the parameters, the situation is the reverse, as no parameter, or the variables (outlays) alongside them create the sales in industry. Adjusting the data to the model at a medium level did not facilitate the confirmation of the statistical significance of their dependency.

Table 4

The list of correlation and regression analysis measures of expenditures on innovation activity dependences for sold production of industry and dependences for sold production of industry and (Y- Polish expenditures, X_1 to X_4 – voivodeships production)

Correlation coefficient	$r_{X_1Y} =$ 0,354	$r_{X_2Y} =$ 0,350	$r_{X_3Y} =$ 0,339	$r_{X_4Y} =$ 0,351	
Significant correlation coefficient	$t_{r_{X_1Y}} =$ 1,001	$t_{r_{X_2Y}} =$ 0,987	$t_{r_{X_3Y}} =$ 0,952	$t_{r_{X_4Y}} =$ 0,992	
Critical value	$T_{0,05;7}^* = 2,365$				
HYPOTHESIS	H_0	H_0	H_0	H_0	
Linear regression function	$y_1 = 11,78 + 0,09x_1 - 0,003x_2 - 0,13x_3 - 0,04x_4$				
Significant structural parameters	$t_{a_0} =$ 1,169	$t_{a_1} =$ 0,319	$t_{a_2} =$ 0,026	$t_{a_3} =$ 0,285	$t_{a_3} =$ 0,108
Critical value	$T_{0,05;4}^* = 2,776$				
HYPOTHESIS	H_0	H_0	H_0	H_0	
Determination coefficient	$R^2 = 0,146$				
Test Fisher – Snedecor	$F = 0,172$				
Critical value	$T_{0,05;4;4}^* = 6,39$				
HYPOTHESIS	H_0				

Analysing the correlation in reverse to the afore-mentioned, this illustrates the lack of dependency confirmed by the absence of its statistical significance. This analogical situation is in the case of analysing the structural parameters, as no parameter, or the variable alongside it (sales in industry in provinces) creates an enterprise that incurs outlays on the activity of innovation in Poland to a significant degree. Poor adjustments confirm the lack of statistical significance.

DYNAMICS OF CHANGE IN NET REVENUE FROM SALES OF INNOVATIVE PRODUCTS

Analysis of the dynamics relates to analysing the variability for net revenue from the sale of products in all the provinces in Poland (Łódź, Masovian, Lesser Poland, Silesian, Lublin, Subcarpathian, Podlaskie, Świętokrzyskie, Lubusz, Greater Poland, West-Pomeranian, Lower Silesian, Opole, Kuyavian-Pomeranian, Pomeranian, Masurian) in the period of 2006-2014 in percentage form.

“Net revenues from sale of products - value of sold goods and services, taking into account discounts, rebates and deductions, excluding VAT”. [2]

Research on the gauges of dynamics facilitates the definition of the direction and intensity of change that occur consecutively over a specified time depending on the chosen period adopted as the base. The *single-base gauges of dynamics* and *chain gauges of dynamics* are distinguished. The former serves to define the change in the level of the phenomenon in the consecutive periods (x_t), in juxtaposition with the adopted base period (they are divided up into relative, absolute and index growth). Nevertheless, the latter serves to define the change in the consecutive periods (x_{t-1}) (which are divided up into single base).

A *medium-tempo tempo of change* constitutes the summing up of the variability of the whole timescale of the phenomenon under analysis in terms of the averaged values [3 p.31-34].

$$\bar{w} = \bar{t} - 100 = \left(\sqrt[n-1]{\frac{x_n}{x_1}} \cdot 100 \right) - 100 \quad (1)$$

Analysis was carried out on the division in terms of the general values for the particular provinces and in accordance with the groups relating to the size of enterprises – small (10 – 49), medium (50 – 249) and large (250 and more) (its results are presented in Table 5).

In the case of small enterprises with regard to the lack of data for 2006, the analysis was run in the period of 2007-2014. The preliminary years were presented as the base years.

Table 5
Medium-term tempo of change in the years 2006-2014

VOIVODESHIP	TOTAL	ENTERPRISE		
		SMALL	MEDIUM	LARGE
Łódź	-0,3%	9,8%	-9,7%	0,8%
Masovian	-22,8%	0,5%	-1,2%	-26,1%

Lesser Poland	-6,7%	20,6%	-1,2%	-8,9%
Silesian	2,1%	-12,3%	-3,4%	3,6%
Lublin	-10,6%	5,6%	-8,6%	-13,7%
Subcarpathian	-12,1%	5,2%	-5,8%	-14,4%
Podlaskie	-8,3%	14,1%	-5,4%	-11,9%
Świętokrzyskie	-11,5%	-14,9%	0,4%	-16,7%
Lubusz	-9,8%	3,5%	-20,7%	-7,1%
Greater Poland	-4,6%	-11,1%	-15,5%	-1,5%
West-Pomeranian	-6,1%	8,3%	-6,3%	-7,8%
Lower Silesian	5,4%	-9,5%	-6,9%	10,0%
Opole	-2,7%	-13,5%	-17,6%	6,1%
Kuyavian-Pomeranian	-3,1%	13,9%	3,9%	-6,6%
Pomeranian	22,0%	-27,0%	-12,4%	26,6%
Masurian	-20,6%	-26,8%	-12,3%	-24,5%

Analysis of the absolute and relative growth, as well as index growth, both single base and chain-base, facilitates the estimation of the variability of the net revenue from the sale of products. The total value for Poland indicates the highest variability in the Pomeranian Voivodeship, while the lowest in the Masovian Voivodeship. These values were at the levels of 25.5% and -13.31%, which illustrated growth of 479.32% and -88.62% that were attained in comparison with the years 2012/2006 (max. and min.). The chain dependencies illustrated the highest growth and decrease in the Pomeranian Voivodeship in the years 2012/2011 with respective growth of 3704.94% and a drop of -92.28% in 2009/2010. The annual section indicates extreme values at the level of 22.03% (Pomeranian Voivodeship) and -22,78% (Masovian Voivodeship). The remaining provinces registered average annual decreases with the exception of the provinces of Silesian, Lower Silesian and Pomeranian, where average annual growth was noted.

A review of the dependencies in terms of net revenues from the sale of the products of small enterprises illustrates the Lesser Poland Voivodeship as the one with the highest growth rates (13.29%, which gives growth of 2827.66% in 2009 with relation to 2007 and -12.5% in the years 2009/2010), while the Pomeranian Voivodeship and Opole Voivodeship are those with the largest drops (-5.64%, which gives a drop of -98.43% in 2007/2012 in the case of Pomeranian and a decrease of -98.19% in 2009/2008 in the case of Opole). In average annual terms, it is possible to note that there is a relatively equal distribution of increases and decreases (7 provinces registered decreases, whereas 9 of them growth), in which the highest growth was noted in the Lesser Poland Voivodeship and the largest drop in the Pomeranian Voivodeship).

Enterprises noted the highest decreases in the Lubusz Voivodeship, whereby the average tempo of their changes was at the level of - 20.70%, which in turn, reflected the largest drops in the years 2006/2014 and 2006/2007, namely -80,92% and -77.76% respectively. The singularly highest growth was noted in the Subcarpathian Voivodeship at the level of 3.82% when compared with the years 2006/2010, while in average annual terms it was noted at 3.9% in the Kuyavian-

Pomeranian Voivodeship, which is one of the two provinces with growth (Świętokrzyskie Voivodeship).

Enterprises employing over 250 workers are represented by two provinces – Pomeranian Voivodeship and Masovian Voivodeship. The former relates to the highest growth in the average annual perspective (26.63%), as well as the highest growth and drops. In 2011/2012 growth was noted as 42.21% with further growth by as much as 6919.67%; while a drop of -23.2% in 2012/2013. The average tempo of negative change in the period was represented by the Masovian Voivodeship, which was at the level -26.11%.

SUMMARY

In summing up the significance of innovations in terms of creating the economy, it is possible to state that the analysed elements, thus the outlays on innovative activities, as well as the net sales of industry are in sound relations. In analysing both the factors separately, it is possible to say that the provinces create a domestic economy, which is a certain truism. Nevertheless, not all do so to a full extent, which already indicates the dominant region of Poland shall be the 'theoretically' more developed. The same situation holds true in the case of mixed dependencies, but only with regard to the dependencies of the outlays in the provinces and domestic production, in which a correlation exists between three provinces and Poland. Unfortunately, this has not been confirmed by statistical significance (this judgment leaves 5% chance of a mistaken interpretation), which also takes place with regard to the analysis of the impact of production in provinces on the size of outlays on innovative activities in Poland. By analysing the share of net revenue with the sale of innovative products, it is possible to note the prevalent downward trend as only two provinces in average annual terms noted growth on a national scale.

In formulating the final conclusions, it is possible to state that production and innovativeness are interconnected, whereas the economic growth of Poland does not translate to the innovativeness of the state. The share of the provinces indicates regionalization with regard to the utilization of the latest solutions, which in turn creates the possibility of their development thanks to the rational financial market of the whole country.

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