

Interactions between investments in innovation and SME competitiveness in the peripheral regions

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Abstract. Since 2000 (The Lisbon Strategy), the discussion about the possible interactions between investments in innovation and competitiveness has become increasingly essential. Enterprises differ substantially with regard to their innovation activities, competitiveness and performance: size, sector, type of investment together determine their innovation activities. The main aim of this study is to analyze the roles of investments in innovation and how investments influence SME competitiveness in a peripheral region in Poland. The author investigates the effects of innovation activities among small and medium but also micro firms. The research was based on the data drawn from CATIs carried out among 808 firms (410 innovative and 398 non-innovative ones). To determine statistically significant differences between the variables of innovative and non-innovative companies, the logistic regression method was implemented. The research results show that among SMEs in the peripheral regions, not every type of investment affects competitiveness. The greatest dependence is demonstrated by the expenditures on machinery and equipment, on marketing activities, on intellectual property protection, and on training. The study also shows the existence of negative factors, the increase in which leads to a reduction in competitiveness level. Moreover, an innovative company which invests in innovation increases the chance of improving competitiveness more than a non-innovative company which invests in innovation.

Keywords: investments in innovation, competitiveness, SMEs, peripheral region, logistic regression.

JEL Classification: L11, L25, O31, R11

Received:
May, 2020
1st Revision:
December, 2020
Accepted:
February, 2021

DOI:
10.14254/2071-
8330.2021/14-1/20

1. INTRODUCTION

The issues of innovativeness and competitiveness in relation to enterprises, economies and territorial units are interrelated (Kot, 2006). Both innovativeness and competitiveness have become the concepts often referred to in economic theories as well as in practical activities in the recent years. In the modern global economy, competitiveness is the basic mechanism of development, and innovativeness is one of the ways to achieve it (Reichel, 2006). Competitiveness preconditioned by innovativeness and continuous technological progress is a challenge for countries and regions that want to develop. Under this approach, the issue of innovativeness, as a specific social process, is becoming more and more important for the development of every enterprise and economy. The relationship between investments in innovation and SMEs' competitiveness is crucial for a better understanding of the latter. Does more of implemented innovations result in a higher firm-level competitiveness?

Studies on the efficiency of innovation activity among SMEs exist but they tend to have ambiguous findings: in some cases we can find a positive relationship (more innovation, more competitiveness) or a negative relationship (more innovation, less competitiveness) (e.g., Lewandowska & Stopa, 2019; Moen, 2018; Lejpras, 2015; Fitjar & Rodríguez-Pose, 2011; Petrov, 2011). We think that the positive or negative relationship depends on the type of an investment in innovation. According to (Crescenzi, 2005), innovation activity can lead to different outcomes depending on a region. This may be due to the fact that peripheral regions might be able to provide an innovative environment for SMEs, while large firms rely on the wealthier environment in core regions (Karlsson & Olsson, 1998). Innovations can create new markets where a firm has a monopolist status, therefore, innovation can directly affect competition (Kim & Mauborgne, 2004). Most studies try to explain how companies in the peripheral regions can be more innovative despite the weaker potential (Eder, 2019). There is a need to study what differences occur in their innovation activity. This study is aimed to see which investment activities of enterprises will be effectively directed at improving competitiveness (or inaction). Similar studies have been carried out by (Negassi *et al.*, 2019; Grillitsch *et al.*, 2015; Eiriz *et al.*, 2013), but there are no significant results for small companies. SMEs are important sources of innovation as they contribute to strengthening of the regional economy and competitiveness (Taymaz, 2005; Klietnik *et al.*, 2020). We expect different results since the research has been conducted in a peripheral region. Practice shows that innovation is the key to business development, competitiveness and business growth. Companies must introduce new products and processes into production, create new organizational structures and new forms of marketing to achieve market success. Without thoroughly thought-out and planned investments in innovations and their implementation, bankruptcy of the company seems to be only a matter of time. However, on the other hand, it is relatively difficult to manage innovation, and the innovation process itself is difficult to maintain at an appropriate level. Investments in innovation and implementing innovations are both expensive and uncertain, and even innovations that are a technological success may not bring profit to organizations.

Podkarpackie is one of the least developed regions in Poland in terms of GDP per capita, labor productivity, and infrastructure. The challenge to SMEs in Podkarpackie is “*increase in the competitiveness of an innovative enterprise in relation to other enterprises*”. Podkarpackie is classified as an EU peripheral where the effects of economic disadvantage have led to an EU modernization policy to “counteract the effects of peripherality”. Innovation expenditures play a significant role in the development of innovation potential and overcoming the peripheral barriers. The RIS 2019 emphasizes that design applications are one of a few relative strengths in the regional innovation system of Podkarpackie. Others are: sales new-to-market/firm innovations, R&D expenditures in the business sector, non-R&D innovation expenditures, and tertiary education. Relative weaknesses observed in the local SME sector include: public-private co-publications, lifelong learning, and marketing or organizational innovations.. There are two very well developed fields in

Podkarpackie: new IT technologies, and aeronautics & space technology. Both of them are also smart specializations of Podkarpackie together with quality of life and the automotive industry. The Aviation Valley cluster has its headquarters in Rzeszów and the Informatyka Podkarpacka cluster operates also here. The Aviation Valley now has 160 enterprises and 30 thousand employees, while its sales volume reaches 3 bln USD. Over the past 15 years, these sales have increased elevenfold. The ICT determine the way economies are positioned within the globalization process, and the factual evidence suggests that ICTs have a strong regional dimension. In the European Commission study analyzing the place of the ICT industry in each of the approximately 1,300 regions within the EU, Podkarpackie is doing quite well. The Rzeszów subregion is the only region in Poland outside Warsaw that is present in the top 30. Namely, it was second in terms of employment growth across the EU. The Rzeszów subregion has also a very high rank in the category of increasing revenues from the IT industry since it was in the top 30 in the field of investments in the IT industry.

The aim of this paper is to explore SME investments in innovation and their impact on competitiveness in a peripheral region. Related to this aim are two crucial questions. Firstly, does being an innovative company increase the chance of being more competitive? Secondly, does every single type of investment in innovation affect growth and improve SME competitiveness? The author investigates the effects of innovation activities not only among small and medium entities, but also micro firms which are not covered in the official innovation surveys by the national statistical offices.

The research is based on the data drawn from CATIs carried out among 808 enterprises (410 innovative firms and 398 non-innovative ones). Differences between the variables of innovative and non-innovative companies were checked by the *logistic regression method*. These variables have an ordinal character in this study. Due to the small control group and large differences in the means for variables, it was decided not to use the *propensity score matching* (PSM) method.

The article is organized as follows. The first section of the paper presents the literature review on innovations and investments in innovation related to competitiveness, highlighting their connections and the impact of some investments on competitiveness along with the possibility of their joint examination. In the second section the author presents the description of methods and the data used. The third section consists of the presentation and discussion of the results. The paper ends with the concluding remarks.

2. LITERATURE REVIEW

A new concept of territorially oriented regional policy, i.e. a place-based policy, was the basis for creating the principles of cohesion policy in the programming period 2014-2020. The idea of developing territorial "smart specializations" occupies an important place in the concept of a new regional policy (Uyarra *et al.*, 2018; Ranga, 2018; McCann & Ortega-Argilés, 2016). It is assumed that in the current programming period, regional research and innovation strategies for smart specializations (RIS3) form the basis for the development and building of innovativeness and competitiveness of European Union regions (European Commission, 2014). According to the basic premise of the concept of smart specialization, regional development should be based on its endogenous potential (Berlińska, 2019; Burciu, 2017; Lopes *et al.*, 2019). It is assumed that each territory should identify and designate its individual, specific and unique potentials resulting from its economic traditions, characterized by the highest development potential and creating opportunities for creating innovation. Smart specializations of the Podkarpackie region result from a choice, mainly based on the region's assets and endogenous resources. The main smart specializations of the Podkarpackie are aeronautics and space technology, quality of life, and the automotive industry. Ancillary smart specializations are found in Information and Telecommunications (Marshal's Office of the Podkarpackie Region, 2015). These are the economic sectors with the greatest development potential. The

development of smart specializations in the regions is conducive to increasing their innovativeness and building a competitive advantage throughout the country and the world. The purpose of RIS3 is to ensure knowledge-based development by supporting national and regional investments, exploiting the potential of the country and regions, their strengths and competitive advantages, and supporting innovative potential, including stimulating innovative investments in the private sector (European Commission, 2014, 2-3).

In the times of a global economy, innovations are perceived as a way of overcoming difficulties, ensuring and preserving economic growth. Innovation can play a significant role in seeking new sustainable sources of growth and competitiveness (Galbraith *et al.*, 2017). A permanent competitive advantage can be achieved primarily due to the growing innovative potential. Introducing new, significantly improved products, processes, and methods is becoming a key to productivity as well as job creation. During economic expansions companies increase innovation, while during economic contractions they decrease innovation (Lewandowska *et al.*, 2019). Weakly developed regions lack the resources to be able to increase innovation during recessions in a Schumpeterian way. Similar conclusions have been reached in other research (Gorączkowska & Tomaszewski, 2019). They indicate that business support organizations (BSOs) increase the chances of innovation activity, but their influence is different. Kokot-Stepień and Krawczyk (2020) confirmed the not significant impact of public support of innovative activity of enterprises. In another study Lewandowska and Stopa (2018) found that institutional support systems mitigate negative consequences of peripheral localization of the enterprises, where specific innovation strategy has no influence on SME assessment of innovation effectiveness. Innovation is too costly, and SMEs are too weak in peripheral regions, therefore there is a great need for reasonable and flexible institutional support systems. According to Florio *et al.* (2017) the most effective strategies to support SME innovation are represented by those more ambitious instruments that have a well specified logical intervention, focused objectives and selective targeting strategies.

An *investment in innovation* is an investment that creates the basis for being innovative, and then is implemented or contributes to the implementation of new products, processes or organizational solutions (Oslo Manual, 2005:29; PARP, 2007:23-24). Until the implementation, the investment is a potential investment in innovation and can represent the following types of activities: (1) Investments in machinery and equipment; (2) Investments in intellectual property; (3) Investments in knowledge. *Competitiveness* is a very differently defined concept. In general terms, competitiveness is about continuous existence (some call it "surviving") in the marketplace. In order to be able to do so, there is the need for a special ability to maintain and enhance market share (Leal Filho & Weresa, 2007). Competitiveness should also reflect the changing needs and preferences of user groups and may involve providing the highest quality products and services at the lowest possible price. According to the Oslo Manual (2005:35), competitive advantage is achieved by improving the company's ability to be innovative (by increasing the ability to develop new products or processes or increasing and creating new knowledge).

On the basis of the theory, it has been proven that achieving a competitive advantage is possible only through innovative activities, and the ability of enterprises to innovate and to raise the technological level determines the competitiveness of the whole economy (Porter, 1990). Despite this, scientific research on the relationship between innovation and economic performance of enterprises does not give unequivocal solutions. It is both about the direction and strength of this relationship. In the 1990s, a professor at Harvard University, A. Bhide (2000), conducted in-depth interviews with hundreds of founders of young companies (not older than 8 years) that were on the Inc. list of 500 in the prestigious rankings in the US. The image of the entrepreneur of above-average success emerging from this research is surprising. Only 6 percent of respondents said they started their business with a unique product or service (Bhide, 2000: 32). In 58 percent of cases, identical or nearly identical substitutes were available on the market, and in 36 percent the

substitutes differed only in functionality or price. So, the idea for a super-fast business was to imitate or only slightly adapt products or services already available on the market.

In the following years, intense attempts were made to examine the relationship between innovation and dynamic company development. They confirmed that high innovativeness is a factor, but not the only factor of business success. Such a conclusion was formulated, among others, in the OECD document on the basis of a review of many years of research on dynamic companies, where the final conclusion is: "*The dynamics of growth is correlated with innovation, however the direction of this relationship is not clear*" (OECD, 2013: 27). A similar conclusion results from a meta-review of the results of 42 empirical studies conducted in several dozen countries in the years 1990-2007, covering a total of over 2,000 companies, conducted by Rosenbusch *et al.* (2010). They find that, in general, innovations have a positive impact on the economic performance of enterprises. However, this relationship is conditioned by other factors, such as the company's age, type of innovation, as well as the company's organizational culture. A similar conclusion has been reached in other research (Audretsch *et al.*, 2014). Szczygielski *et al.* (2017) Bilan *et al.* (2019) indicate that the impact of innovativeness on growth strongly depends on type of activity as well as type of innovation. Gkikas *et al.* (2014) assessed the level of importance of different types of innovation affecting and effecting high-growth in SMEs in an uncompetitive regional economy. They found that relationships with customers were most effective and important for business growth and leadership skills were found to be an important factor for implementing innovation. So how can one study the connection between investments in innovations and enterprise competitiveness? According to Porter (1998), these relations illustrate changes in labor productivity and capital. Sustained increase in efficiency requires continuous progress in the economy, and thus implementing innovations. Increasing the efficiency of enterprises and entire sectors is possible by improving the quality of products, modifying them, and improving technologies. This means that innovations lead to changes in competitive advantages, which ultimately is reflected in changes in the efficiency of production factors. Enterprises are developing thanks to investments in innovation and implementing of innovations, which allows companies to achieve competitive advantage over domestic and foreign rivals.

This research was conducted on firm-level data. To the author's knowledge, there are a few studies (see, for example, Moen *et al.*, 2018; González-Pernía *et al.*, 2012; Luchko *et al.*, 2019; Mishchuk *et al.*, 2016; Markowski, 2004; Report "Badanie wpływu...", 2009) on the relation between innovation and competitiveness, that are similar to this. Research by Markowski (2004) and Report "Badanie wpływu ..." (2009) has been very useful and provided a notion of innovations and competitiveness in Poland. Authors of the Report "Badanie wpływu ..." (2009) find effects of innovations and the impact these had on competitiveness of SMEs. But they used the method of the *propensity score matching* (PSM) and the analysis did not focus on peripheral regions. Berghäll (2016), for example, investigated how rigorous measures of innovation and the technology gap fare with respect to competitiveness in the Finnish ICT industry measured by the Lerner index. González-Pernía *et al.* (2012) tested the extent to which the capability of generating new knowledge and creating new firms are associated with regional competitiveness. In the study, however, the analysis did not include company perspective.

Some authors have investigated the opposite issue, which is what impact do competition and competitive conditions have on innovation? For example, Nguyen *et al.* (2016) investigated the comparative levels of efficiency, innovation and competition and then examined the effect of competition on innovation of banks. The research presented in this paper covers many aspects of the potential impact of investments of innovation on the competitiveness of SMEs. Anderson *et al.* (2001) indicate that peripheral regions can be "hostile environments for new and small firms" due to additional costs to manufacture or to service, and also to a limited pool of high qualified employees.

3. METHODOLOGY

3.1. Sample

The analysis is based on a questionnaire from the project titled “The Study of the Impact of Investments in Innovation on the Competitiveness of the SME sector in Podkarpackie Voivodeship”. The sample selection in the survey was carried out by a stratified sampling method according to the size of the enterprise (number of employees) and its sector (NACE rev. 2 section, please see: Eurostat 2008). The sampling criteria were rendered according to GDP contribution. Research was based on data drawn from CATIs carried out among 808 enterprises (410 innovative firms /research sample and 398 non-innovative firms/control sample). An innovative company is one that has implemented new or significantly improved solutions in relation to the process and / or product (or service) and / or marketing and / or organization in the last six years. A non-innovative company is one that hasn't implemented new or significantly improved solutions in relation to the process and / or product (or service) and / or marketing and / or organization in the last six years. Both samples were controlled in terms of company size. Both groups (innovative and non-innovative firms) answered questions about investment in innovation activities. *The logistic regression method* was used. Due to the small control group and large differences in means for variables, it was decided not to use the *propensity score matching* (PSM) method.

3.2. Measures

Dependent variable

The dependent variable in this study is a measure of competitiveness occurring in the enterprise under the influence of investment in innovation. A measure of competitiveness was measured by the effects of investment in innovation i.e.: rank of an improved product or service among other products, revenues from the market due to support of existing enterprise products, prices of products and services as a result of the depreciation costs of new equipment, quality of improved product or service in the eyes of customers, company market share, new markets, production flexibility, production efficiency, downtime and breakdowns, labor costs, amount of materials and energy, operating costs, sources of supply, new market structures, harmful activity enterprises, work safety, labor standards, and employees.

Independent variables

The first independent variable in this study is the firm's size. We used the number of micro, small and medium enterprises to measure this variable. The second explanatory variable is the enterprise sector. This was measured as the number of enterprises from agriculture, industry, construction, trade, transport, social affairs, and services. The third independent variable is the type of investment in innovations. We used in this regard: the expenditures on R&D, the expenditures on machinery and equipment, expenditures on ICT, expenditures on intellectual property protection, expenditures on training, expenditures on marketing activities, and expenditures on the implementation of new solutions. Moreover, we used two type of innovation status of the firm: the innovative company and non-innovative company. We wanted to determine whether being an innovative firm increases the chance of being a more competitive firm.

The full set of variables that were tested as potentially significant is shown in Table 5 in the Appendix.

3.3. Estimation

The aim of the analysis was to examine the impact on the company's competitiveness factor, such as size (variable X_1), sector (variable X_2), type of investment in innovation (variable Z) and whether the

company is innovative or non-innovative (variable P_i). The models examined various variables, where the dependent variable (Y_i) is a measure of competitiveness (the effects of investment in innovation), which arises as a result of investments in innovation. The aim of the study is not to develop an optimal mechanism for determining the model. The aim is to determine statistically significant differences between the variables, such as size, sector, type of investment in innovation and whether the company is innovative or non-innovative.

$$Y_i \sim B(p_i, n_i), \quad \text{for } i = 1, \dots, m. \quad (1)$$

where the number of Bernoulli trials n_i is known and the probability of success p_i is unknown.

The model assumes that for each Bernoulli trial (value i), there is a set of k independent variables that give some information about the probability of success. These independent variables can be considered as the k -element random vector X_i . Then the model takes the form:

$$p_i = E(X_i). \quad (2)$$

The logit of the unknown probability of success p_i is modeled as a linear function of X_i :

$$\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 z_i + \varepsilon_i. \quad (3)$$

The model has an equivalent wording in the form:

$$p_i = \frac{1}{1 + e^{-(\beta_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 z_i + \varepsilon_i)}}. \quad (4)$$

When analyzing the impact of investments in innovations on competitiveness, a model was developed that took the form:

$$Y_i = \beta_1 x_{1,i} + \beta_2 x_{2,i} + \beta_3 z_i + \varepsilon_i \quad (5)$$

where:

Y_i – dependent variable (a measure of competitiveness (the effects of investment in innovation) occurring in the enterprise under the influence of investment in innovation, such as: rank of an improved product or service among other products, revenues from the market due to support of existing enterprise products, prices of products and services as a result of the depreciation costs of new equipment, quality of improved product or service in the eyes of customers, company market share, new markets, production flexibility, production efficiency, downtime and breakdowns, labor costs, amount of materials and energy, operating costs, sources of supply, new market structures, harmful activity enterprises, work safety, labor standards, employees)

X_1 – company size (micro, small and medium enterprises); variable X_1 takes values from 0 to 3

X_2 – enterprise sector (agriculture, industry, construction, trade, transport, social affairs, services); $X_2 = 1, \dots, 7$

Z – type of investments in innovations (expenditures on machinery and equipment, on ICT, on intellectual property protection, on training, on marketing activities, and expenditures on the implementation of new solutions); $Z = 0$ or $Z=1$

ε_i – random component of the model

i = index indicating the enterprise, among the surveyed enterprises there are 410 innovative companies and 398 non-innovative companies; $i = 1, \dots, 808$

First, a general measure of innovativeness was taken, and later a more accurate measure of innovativeness. In the last step, this more accurate measure was applied to all competitiveness measures (effects of investments in innovations). This made it possible to assess the marginal effect of changing investment in innovation to the level of competitiveness of SMEs.

4. EMPIRICAL RESULTS AND DISCUSSION

Table 1 shows the descriptive statistics for the variables used in this research and Table 2 shows the correlation of variables used in this study indicating that the validity of variables is acceptable.

Table 1

Descriptive statistics

	Variable	Obs.	Mean	Std. Dev.	Variance	Min	Max
1.	The rank of an improved product or service among other company products	729	1.00	1.147	1.315	0	3
2.	Revenues due to crowding out existing company products from the market	698	-.21	.604	.365	-3	0
3.	Prices of products and services as a result of depreciation costs of new equipment	722	-.52	.861	.741	-3	0
4.	The quality of the improved product or service in the eyes of customers	751	.86	1.172	1.374	-3	3
5.	Company's share in the market	751	.62	1.214	1.473	-3	3
6.	New markets	717	.29	1.146	1.313	-3	3
7.	Production flexibility	717	.50	.985	.969	-3	3
8.	Production efficiency	724	.57	.986	.972	0	3
9.	Downtime and failures	693	-.08	.370	.137	-3	0
10.	Labor costs	690	.38	.841	.708	0	3
11.	Amount of materials and energy	694	.27	.716	.512	0	3
12.	Operating costs	712	-.44	.847	.718	-3	0
13.	Sources of supply	714	.20	.718	.516	-3	3
14.	New market structures	716	.03	.644	.415	-3	3
15.	Harmfulness of the company's activity	718	.24	.702	.492	-3	3
16.	Work safety	726	.50	.897	.804	-1	3
17.	Work standards	747	.66	.990	.981	-2	3
18.	Employees	759	.37	.917	.841	-3	3

Source: own calculation

Due to the level of feature measurement, a correlation matrix was made for the explained variable. The results are shown in Table 2. First, in the relationship between production flexibility and production efficiency, there were significant positive correlations between production flexibility and the production efficiency with $r = .813$ ($p < 0.01$). Dependent variables are related to each other. As the value of production flexibility increases, the value of production efficiency increases. Next, as the value of the rank of an improved product or service among other company products increases, the improved product or service in the eyes of customers increases with $r = .668$ ($p < 0.01$), production efficiency increases with $r = .610$ ($p < 0.01$), company's share in the market increases with $r = .606$ ($p < 0.01$), production flexibility increases with $r = .536$ ($p < 0.01$). Finally, as the value of labor costs increases, the amount of materials and energy with $r = .630$ ($p < 0.01$).

The subject of the research is the recognition of the impact on the competitive factor of such company characteristics as size (variable X_1), sector (variable X_2), type of investment (variable Z) and whether the company is innovative or non-innovative (variable P_1).

In order to simulate the occurrence of the competitiveness factor, a *logistic regression model* was constructed. This model was created on the basis of observations made on a group of randomly 808 selected companies that took part in the CATI study. The following method of variable coding has been adopted:

- in the size range: micro - 1, small - 2, medium - 3,
- in the sector range: agriculture - 1, industry - 2, construction - 3, trade - 4, transport - 5, social affairs - 6, services - 7,
- in the type of investments in innovations: expenditures on machinery and equipment, expenditures on ICT, expenditure on intellectual property protection, expenditure on training, expenditures on marketing activities, expenditures on the implementation of new solutions: expended - 1, not expended - 0,
- in the innovativeness range: innovative company - 1, non-innovative company - 0.

Taking into account the characteristics of enterprises that are innovative and the characteristics of enterprises that are non-innovative, it was necessary to estimate *the logistic regression* equation with three types of independent variables.

Table 3 summarizes the results of the random sample from *the logistic regression model*. Not all regressors were statistically significant. There were many statistically significant relationships with positive and negative impacts on the competitiveness of companies. Table 3 clearly shows that the competitiveness of SMEs (effects of innovations implemented) differed depending on the type of investment.

Factors stimulating SME competitiveness

Enterprises investing in machinery and equipment and marketing activities strongly influence (strong statistical dependence) the increase of the rank of improved product / service among other company products, improvement of the quality of improved product / service in the eyes of customers, improvement of flexibility and production efficiency and reduction of labor costs (in the case of the latter, a relationship was observed with expenditures on machines and devices as well as expenditures on intellectual property protection). The estimated coefficients ($z_1 = 0.981064, 0.72508, 1.075819, 1.16881, \text{ and } 1.380924; z_5 = 0.840005, 0.70669, 0.798799, \text{ and } 0.8892$) are statistically significant at the 0 level. The same applies to expenditure on intellectual property protection - a strong impact on the creation of new market structures, reduction of health and environmental impact of the company's functioning, increase in work safety, and reduction of labor costs per product was observed.

Weak dependence (however, still statistically significant) was observed in the case of expenditure on intellectual property protection - there is an improvement in the quality of the improved product / service in the eyes of customers, reduction of the amount of materials and energy per product, development of supply sources, improvement of work standards and employment new employees. The estimated coefficient ($z_3 = 0.51237, 0.6082, 0.44261, \text{ and } 0.577843$) is statistically significant at the 0.01 level. Similarly, with the expenses for marketing activities - it is clear in developing sources of supply and reducing the harmfulness to the health and environment of the company. Enterprises that have expenditures for the implementation of new solutions affect the creation of new market structures and reduce the harm to the health and environment of the company's operations. And those companies that spend more on training affect employment growth.

That is, on average, enterprises investing in machinery and equipment and marketing activities achieve a higher level of competitiveness than enterprises investing in intellectual property protection, training or implementation of new solutions. This result supports in the part the arguments of other authors (Squicciarini, 2017; Report "Badanie wpływu ...", 2009).

Factors destabilizing SME competitiveness

A statistically significant dependence of the negative impact of expenditures was also observed. For example, companies spending more on machinery and equipment affect the increase in prices of products

and services as a result of the cost of depreciation of new equipment and the increase in operating costs of new machines. All the estimated coefficients are negative ($z_1 = -0.68566$ and -0.97307) and statistically significant at the 0 level. Similarly, the expenses for the implementation of new solutions show a weak statistically significant relationship with the reduction of production flexibility. The estimated coefficient ($z_6 = 0.733465$) is statistically significant at the 0.01 level.

Next, the marginal effect of changing investments in innovations to the level of competitiveness was calculated. The results are presented in Table 4.

Regarding the interpretation of the marginal effect of changing investment in innovation on the level of competitiveness of SMEs, the values of the model indicate that the rank of the improved product or service, the quality of the improved product or service, flexibility and production efficiency, as well as the operating costs show a statistically significant relationship with expenditures on machines and devices and expenditures on marketing activities. For example, spending on machinery and equipment increases the chance of increasing the rank of an improved product or service among other company products by 167 percent, improving the quality of the improved product / service in the eyes of customers by 106 percent, improving the production flexibility by 193 percent, and production efficiency by 222 percent. The same is true of the costs of protecting intellectual property – it increases the chances of creating new market structures by 195 percent, reducing the harmfulness of business operations by 141 percent, improving work safety by 86 percent, reducing labor costs by 95 percent. In turn, expenses for training increase the chance of employing new employees by 150 percent and increase of the company's market share by 53 percent.

Being an innovative company increases the chance of becoming more competitive, for example, being innovative increases the chance of increasing the rank of an improved product / service among other company products by 703 percent. The analysis confirmed a statistically significant relationship between the company's introduction of another type of innovation and almost all factors of SME competitiveness. In the majority of competitiveness factors, the ratio is significant at the level of 0.001. For example, the introduction of each subsequent type of innovation increases the chance of increasing the rank of an improved product or service among other company products by 151 percent, improving the quality of an improved product / service in the eyes of customers by 102 percent, improving production efficiency by 83 percent, and increasing the company's market share by 70 percent. There was no statistically significant relationship between the introduction of another type of innovation and the change in revenues caused by the support from the market of the company's existing products. This suggests that innovative companies achieve greater effects of innovations implemented (benefits and costs) than non-innovative enterprises. This empirical finding is an interesting contribution to the extant literature, because it proves Audretsch's argument that both innovation and innovation capacities together are important drivers of firm growth and its competitiveness (Audretsch *et al.*, 2014).

5. CONCLUSION

SME are more and more often engaged in innovative activities. Enterprises can achieve many economic benefits, above all that they remain on the market and compete with other entities by focusing on various types of improvements and new products.

The study explains how the characteristics of the surveyed enterprises (size of the scale), the type of investment, and the fact of implementing another type of innovation affect SME competitiveness. The results of the research showed that the size of the company affects the improvement of labor standards and employment growth, and to a lesser extent the increase in the company's market share. As far as industries

are concerned, the highest statistically significant dependence on the occurrence of competitiveness has been demonstrated by the industrial sector (relation to production flexibility, labor costs, company market share and new markets), trade sector (relation to revenues, price of products / services, operating costs, costs work, labor standards, the amount of materials and energy), the construction industry (relation to operating costs and labor costs) and the transport industry (connection with employees).

When answering the research questions, two issues should be noted. First, being an innovative company increases the chance of becoming more competitive. An innovative company which invests in innovation increases the chance of improving competitiveness more than a non-innovative company which invests in innovation. Second, it is important that not every type of investment affects (shows statistically significant dependence) the competitiveness of SMEs. The greatest dependence is on expenditures on machinery and equipment, expenditures on marketing activities, expenditures on intellectual property protection, expenditures on training, and expenditures on the implementation of new solutions. The probable reason for the relationship between expenditures on machinery and equipment and the majority of competitiveness factors is the fact that expenditures on innovations leads to improved productivity and production flexibility, lower labor costs, and new products, which increases the value of sales, however increasing operating costs.

It is difficult to indicate a clear reason for the lack of dependency between expenditures on machinery and equipment and variables that determine the value of revenues due to market support of the company's existing products. The first reason may be that the value of incurred expenditures is too low to find here any dependence. And only at higher expenditures and their greater variance would it be possible to determine. The second probable cause of the difficulty in estimating the actual dependence is its long-term nature. Expenditures on ICT incurred in many companies have a chance at pay back only after a long period of time. Meanwhile, a sample covering a relatively short period makes it impossible to check the existence of dependence over a longer time horizon. In the case of expenditure on ICT, no statistically significant impact on the occurrence of any factor of competitiveness was noted. However, it is difficult to believe in the actual lack of this relationship. One can only assume that in this case the main reason for not confirming the dependence is that the total value of expenditures is too low for their impact in this field to be noticeable. This is consistent with the literature. Arendt and Grabowski (2017) argued that the relationship between innovation, ICT and productivity is more complex and depends on a company's distance to the technological frontier. In other words, the more productive a company is, the more effort in terms of co-innovative sources of productivity is required to boost productivity by introducing new technologies (including ICT). Moreover, the results confirmed that the investments in and the use of ICT are significant factor of the innovativeness of SMEs (Torrent-Sellens & Ficapal-Cusi, 2010).

The study also showed the existence of negative factors, which, by increasing their size, lead to a reduction in the level of competitiveness. First, the more innovative companies spend on machinery and equipment the more they increase the prices of products and services as a result of the cost of depreciation of new equipment and the increase in operating costs of new machines. Moreover, expenditures on the implementation of new solutions reduce production flexibility.

It must be noted that the presented results refer to the term "innovation" as the improvement that is made at least on a company level, and not necessarily an introduction of a solution that is new to the region, country or the world. Moreover, developing regions such as Podkarpackie are fund-sensitive because companies have limited access to finance high-risk activities including innovations. It has been argued that some types of funding did not contribute to permanent improvement but served only as demand factors. We think that this type of innovative activity has a chance for success only if it invests in an appropriate type of investment. The periphery is changing, and the changes may well be driven by the growth of SMEs as a result of investments in innovation. The entrepreneurs through the operation of their businesses have

an important role in fixing change. These changes are economies of innovative activities, in contrast to the passive operation of companies without appropriate type of investments.

In most cases, the obtained results confirm the conclusions from other studies devoted to the analysis of effectiveness of investment and innovation activity in the small and medium-sized enterprise sector (Arendt & Grabowski, 2019, 2017; Lewandowska & Stopa, 2019; Moen, 2018; Szczygielski *et al.*, 2017; Kim & Mauborgne, 2004). It should be noted that the conclusions from this paper considerably develop the existing knowledge about effectiveness of different types of investments in innovation. The originality of the approach presented in this paper relies on comparing results among innovative and non-innovative firms, and examination of effectiveness of many different types of investments in innovation and using the logistic regression method.

The author's main contribution is the identification of how the characteristics of the surveyed enterprises, the type of investment, and the fact of implementing another type of innovation affect competitiveness. In further studies, this approach should be further developed by, for example, focusing on the impact of cooperation on scale and quality of SME innovation activities. Evaluation of SME cooperation with different businesses, R+D, universities and others would be very useful for strategic effectiveness.

ACKNOWLEDGEMENT

This research was performed as project as «The Study of the impact of investments in innovation on the competitiveness of the SME sector in Podkarpackie voivodship» (2014-2016) which was financed from the funds granted to the University of Information Technology and Management as a grant for the maintenance of research potential.

The author is grateful for the helpful critiques and comments received from colleagues at Rzeszów, especially Elżbieta Ingot-Brzęk and Robert Pater.

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APPENDIX

Table 2

Correlation matrix

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1. The rank of an improved product or service among other company products	PC	1																		
	Significance																			
	N	729																		
2. Revenues due to crowding out existing company products from the market	PC	-.006	1																	
	Significance	,871																		
	N	677	698																	
3. Prices of products and services as a result of depreciation costs of new equipment	PC	-.343**	.247**	1																
	Significance	,000	,000																	
	N	692	675	722																
4. The quality of the improved product or service in the eyes of customers	PC	,668**	,062	-.271**	1															
	Significance	,000	,104	,000																
	N	716	688	713	751															
5. Company's share in the market	PC	,606**	,301**	-.204**	,586**	1														
	Significance	,000	,000	,000	,000															
	N	717	685	708	731	751														
6. New markets	PC	,389**	,228**	-.057	,349**	,641**	1													
	Significance	,000	,000	,138	,000	,000														
	N	689	672	688	706	707	717													
7. Production flexibility	PC	,536**	,081*	-.291**	,502**	,521**	,397**	1												
	Significance	,000	,037	,000	,000	,000	,000													
	N	693	670	683	703	703	689	717												
8. Production efficiency	PC	,610**	-.057	-.408**	,517**	,525**	,374**	,813**	1											
	Significance	,000	,140	,000	,000	,000	,000	,000												
	N	695	673	691	710	709	691	706	724											
9. Downtime and failures	PC	-.148**	,257**	,175**	-.064	-.069	-.058	-.071	-.147**	1										
	Significance	,000	,000	,000	,097	,070	,134	,065	,000											
	N	670	651	671	681	683	669	676	681	693										
10. Labor costs	PC	,512**	-.115**	-.355**	,447**	,428**	,287**	,604**	,682**	-.258**	1									
	Significance	,000	,004	,000	,000	,000	,000	,000	,000	,000										
	N	664	644	659	676	673	664	673	678	659	690									
11. Amount of materials and energy	PC	,441**	-.058	-.225**	,381**	,377**	,256**	,498**	,532**	-.318**	,630**	1								
	Significance	,000	,139	,000	,000	,000	,000	,000	,000	,000	,000									
	N	665	650	662	682	676	669	673	679	660	679	694								
12. Operating costs	PC	-.353**	,215**	,569**	-.257**	-.176**	-.047	-.317**	-.418**	,156**	-.368**	-.259**	1							
	Significance	,000	,000	,000	,000	,000	,223	,000	,000	,000	,000	,000								
	N	683	670	687	704	697	684	684	689	672	666	677	712							
13. Sources of supply	PC	,309**	,029	-.144**	,227**	,224**	,255**	,306**	,269**	,019	,228**	,133**	-.096*	1						
	Significance	,000	,458	,000	,000	,000	,000	,000	,000	,621	,000	,001	,011							
	N	682	672	687	704	699	685	683	688	671	665	671	691	714						
14. New market structures	PC	,286**	,256**	-.022	,332**	,353**	,425**	,249**	,248**	-.021	,276**	,152**	-.015	,231**	1					
	Significance	,000	,000	,573	,000	,000	,000	,000	,000	,589	,000	,000	,700	,000						
	N	682	674	685	705	700	689	684	690	668	663	671	691	694	716					
15. Harmfulness of the company's activity	PC	,327**	-.011	-.127**	,333**	,220**	,222**	,285**	,310**	-.055	,399**	,437**	-.131**	,199**	,254**	1				
	Significance	,000	,775	,001	,000	,000	,000	,000	,000	,156	,000	,000	,001	,000	,000					
	N	680	661	673	700	698	678	676	682	661	662	668	682	683	692	718				
16. Work safety	PC	,345**	,061	-.123**	,342**	,332**	,337**	,333**	,305**	-.041	,390**	,296**	-.148**	,212**	,256**	,536**	1			
	Significance	,000	,113	,001	,000	,000	,000	,000	,000	,296	,000	,000	,000	,000	,000	,000				
	N	688	664	681	708	703	682	682	689	666	666	670	687	691	696	713	726			
17. Work standards	PC	,415**	,009	-.154**	,418**	,353**	,232**	,345**	,332**	-.089*	,367**	,350**	-.239**	,211**	,199**	,415**	,641**	1		
	Significance	,000	,820	,000	,000	,000	,000	,000	,000	,020	,000	,000	,000	,000	,000	,000	,000			
	N	704	682	697	727	722	699	701	706	681	675	681	700	702	710	715	722	747		
18. Employees	PC	,454**	,059	-.202**	,405**	,455**	,324**	,396**	,433**	-.050	,444**	,401**	-.218**	,221**	,263**	,331**	,357**	,398**	1	
	Significance	,000	,123	,000	,000	,000	,000	,000	,000	,191	,000	,000	,000	,000	,000	,000	,000	,000		
	N	715	684	707	734	729	702	704	710	683	680	685	704	705	711	711	719	738	759	

** Correlation coefficient is significant at 0.01 level (two-tailed); * Correlation coefficient is significant at 0.05 level (two-tailed).

PC - Pearson correlation

Source: own calculation

Table 3

Model illustrating the impact of investments in innovation on the level of competitiveness

	The rank of an improved product or service among other company products		Revenues due to crowding out existing company products from the market		Prices of products and services as a result of depreciation costs of new equipment		The quality of the improved product or service in the eyes of customers		Company's share in the market		New markets	
	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)
Size	0.043501	0.6995	0.31141	0.08653	-0.20723	0.074512	0.21202	0.044156	0.28742	0.005472	0.20308	0.0693
Sector												
Agriculture	-1.444756	0.0424 *	-0.0601	0.93947	0.14666	0.796166	-0.50885	0.300925	-0.33367	0.47699	-0.39280	0.3974
Industry	0.478154	0.0250 *	-0.02341	0.94357	-0.02522	0.911782	-0.05229	0.796887	0.69923	0.000483	0.43673	0.0366 *
Construction	-0.000343	0.9992	-0.54795	0.27905	-0.31604	0.372845	-0.50314	0.13466	0.23166	0.482117	-0.13748	0.7019
Trade	0.167083	0.6594	-1.44968	0.00488	-0.98549	0.006331	0.37010	0.29093	0.82448	0.022296	-0.22757	0.5565
Transport	0.325077	0.5109	0.86980	0.41130	-0.49298	0.263338	-0.14423	0.74195	0.06017	0.880118	0.34735	0.4064
Social affairs	0.309196	0.6392	-0.09131	0.93448	-0.04391	0.952153	-0.06485	0.91348	-0.61257	0.335069	-0.58459	0.4087
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	0.981064	2.86e-07 ***	-0.43226	0.15367	-0.68566	0.000944 ***	0.72508	8.96e-05 ***	0.49565	0.006072 **	0.10243	0.5927
Expenditures on ICT	-0.090811	0.6338	-0.33865	0.26107	-0.07418	0.706443	-0.07362	0.679701	0.03305	0.847751	0.11039	0.5489
expenditure on intellectual property protection	0.375826	0.0979 .	0.32827	0.38911	-0.26966	0.235349	0.51237	0.016444 *	0.31439	0.142460	0.31203	0.1752
Expenditure on training	0.275806	0.1593	-0.11395	0.71333	0.06907	0.738821	0.17249	0.351046	0.42669	0.021511 *	0.24806	0.2229
Expenditures on marketing activities	0.840005	3.26e-05 ***	-0.3253	0.29382	0.14069	0.510175	0.70669	0.000237 ***	0.75535	0.000110 ***	0.97777	4.31e-06 ***
Expenditures on the implementation of new solutions	0.25891	0.4222	-0.55123	0.23611	0.36034	0.269223	0.29825	0.314028	-0.02697	0.926123	0.23617	0.4425
Company type (innovative / non-innovative)	0.919072	< 2e-16 ***	0.04376	0.75984	-0.34443	0.000193 ***	0.70342	1.51e-14 ***	0.53274	1.82e-09 ***	0.39453	2.94e-05 ***

Table 3 (continued)

Model illustrating the impact of investments in innovation on the level of competitiveness

	Production flexibility		Production efficiency		Downtime and failures		Labor costs		Amount of materials and energy		Operating costs	
	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)
Size	0.137656	0.254732	0.19129	0.1088	NA	NA	-0.043338	0.754169	0.04604	0.76215	-0.23327	0.05813
Sector												
Agriculture	-0.915207	0.202325	-0.38106	0.58227	NA	NA	0.387690	0.635531	-0.27112	0.801731	-0.98548	0.07117
Industry	0.829186	0.000703 ***	0.71854	0.00332 **	NA	NA	1.020686	0.000962 ***	0.46645	0.165825	-0.35458	0.18129
Construction	-0.149172	0.724392	-0.31317	0.46333	NA	NA	0.912992	0.041255 *	0.42235	0.405018	-1.09653	0.00423 **
Trade	0.364844	0.391304	0.50954	0.19958	NA	NA	1.360093	0.002923 **	1.22359	0.010503 *	-1.79815	1.55e-06 ***
Transport	-0.447392	0.468646	-0.78255	0.24581	NA	NA	0.101018	0.877459	0.66050	0.295927	-0.22858	0.67702
Social affairs	-0.045632	0.958396	0.37629	0.62046	NA	NA	-0.005629	0.995472	1.07464	0.243797	-1.06435	0.19221
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	1.075819	2.31e-06 ***	1.16881	3.00e-07 ***	NA	NA	1.380924	9.31e-07 ***	0.81018	0.008235 **	-0.97307	3.78e-05 ***
Expenditures on ICT	0.003983	0.984592	-0.06049	0.76932	NA	NA	-0.161419	0.486869	-0.05886	0.825215	0.01503	0.94458
Expenditure on intellectual property protection	0.099997	0.672814	0.26873	0.25356	NA	NA	0.668900	0.008272 **	0.6082	0.034936 *	-0.39544	0.09093
Expenditure on training	0.288605	0.181137	0.20297	0.34454	NA	NA	0.281413	0.243714	0.35674	0.192451	-0.19278	0.38162
Expenditures on marketing activities	0.798799	0.000214 ***	0.8892	2.83e-05 ***	NA	NA	0.166182	0.500989	0.52295	0.051754	-0.19170	0.39209
Expenditures on the implementation of new solutions	-0.733465	0.021713 *	-0.5623	0.07441	NA	NA	0.274394	0.409863	0.47179	0.182599	0.35776	0.29418
Company type (innovative / non-innovative)	0.509864	2.86e-07 ***	0.60183	1.03e-09 ***	NA	NA	0.374578	0.000795 ***	0.43628	0.000344 ***	-0.31410	0.00146 **

Table 3 (continued)

Model illustrating the impact of investments in innovation on the level of competitiveness

	Sources of supply		New market structures		Harmfulness of the company's activity		Work safety		Work standards		Employees	
	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)	Estimate	Pr(> z)
Size	0.13755	0.31298	0.364773	0.015314 *	0.05421	0.70951	0.28324	0.01425 *	0.38718	0.00032 ***	0.435783	0.000202 ***
Sector												
Agriculture	-0.14558	0.81186	0.039422	0.949775	-0.36241	0.68425	0.28303	0.56537	0.42041	0.35877	0.143068	0.786766
Industry	-0.07739	0.76903	0.196794	0.486555	0.72191	0.02663 *	0.21563	0.33957	0.11343	0.59131	0.449348	0.052311 .
Construction	-0.48934	0.27019	0.044979	0.922099	0.25158	0.63150	-0.17418	0.64881	-0.24463	0.48258	0.632840	0.072159 .
Trade	-0.41320	0.39381	-0.223965	0.671636	1.16140	0.01609 *	-0.05452	0.89431	0.75965	0.02471 *	0.339135	0.384472
Transport	0.10740	0.84672	-0.769255	0.166283	0.30930	0.63830	0.16400	0.74125	0.41450	0.33271	0.898241	0.049322 *
Social affairs	0.06706	0.94143	-0.086544	0.912658	-1.71422	0.15047	0.77825	0.24304	0.69614	0.29936	0.900044	0.128053
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	0.75934	0.00289 **	-0.159550	0.530181	0.81639	0.00803 **	0.40208	0.05287 .	0.50889	0.00707 **	0.618250	0.003075 **
Expenditures on ICT	-0.05023	0.82870	0.176344	0.480925	-0.39057	0.13091	-0.22579	0.25117	-0.18602	0.30673	0.003668	0.985163
Expenditure on intellectual property protection	0.58843	0.02682 *	1.082745	0.000282 ***	0.88036	0.00241 **	0.61927	0.00782 **	0.44261	0.03975 *	0.577843	0.010368 *
Expenditure on training	-0.31777	0.19596	-0.007742	0.976566	0.13335	0.63120	0.13532	0.51750	0.21322	0.26847	0.917336	9.03e-06 ***
Expenditures on marketing activities	0.62556	0.01199 *	0.542585	0.053065 .	0.35823	0.18369	0.13123	0.54355	0.22932	0.24749	0.247597	0.240624
Expenditures on the implementation of new solutions	0.07416	0.82739	1.091468	0.003590 **	0.74112	0.03548 *	0.51143	0.09510 .	-0.18077	0.56293	-0.515413	0.107275
Company type (innovative / non-innovative)	0.45790	1.89e-05 ***	0.269430	0.024105 *	0.37354	0.00131 **	0.26676	0.00514 **	0.45298	4.18e-07 ***	0.466567	5.33e-07 ***

Source: Based on the CATI survey. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 (*** The factor is significant at the significance level of 0.001. ** The factor is significant at the significance level of 0.01. * The factor is significant at the significance level of 0.05).

Table 4

The marginal effect of changing investment in innovation on the level of competitiveness of SMEs

	The rank of an improved product or service among other company products		Revenues due to crowding out existing company products from the market		Prices of products and services as a result of depreciation costs of new equipment		The quality of the improved product or service in the eyes of customers		Company's share in the market		New markets	
Size	1.04	4%	1.37	37%	0.81	-19%	1.24	24%	1.33	33%	1.23	23%
Sector												
Agriculture	0.24	-76%	0.94	-6%	1.16	16%	0.6	-40%	0.72	-28%	0.68	-32%
Industry	1.61	61%	0.98	-2%	0.98	-2%	0.95	-5%	2.01	101%	1.55	55%
Construction	1.00	0%	0.58	-42%	0.73	-27%	0.6	-40%	1.26	26%	0.87	-13%
Trade	1.18	18%	0.23	-77%	0.37	-63%	1.45	45%	2.28	128%	0.8	-20%
Transport	1.38	38%	2.39	139%	0.61	-39%	0.87	-13%	1.06	6%	1.42	42%
Social affairs	1.36	36%	0.91	-9%	0.96	-4%	0.94	-6%	0.54	-46%	0.56	-44%
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	2.67	167%	0.65	-35%	0.5	-50%	2.06	106%	1.64	64%	1.11	11%
Expenditures on ICT	0.91	-9%	0.71	-29%	0.93	-7%	0.93	-7%	1.03	3%	1.12	12%
expenditure on intellectual property protection	1.46	46%	1.39	39%	0.76	-24%	1.67	67%	1.37	37%	1.37	37%
Expenditure on training	1.32	32%	0.89	-11%	1.07	7%	1.19	19%	1.53	53%	1.28	28%
Expenditures on marketing activities	2.32	132%	0.72	-28%	1.15	15%	2.03	103%	2.13	113%	2.66	166%
Expenditures on the implementation of new solutions	1.30	30%	0.58	-42%	1.43	43%	1.35	35%	0.97	-3%	1.27	27%
Company type (innovative / non-innovative)	2.51	151%	1.04	4%	0.71	-29%	2.02	102%	1.7	70%	1.48	48%

Table 4 (continued)

The marginal effect of changing investment in innovation on the level of competitiveness of SMEs

	Production flexibility		Production efficiency		Downtime and failures		Labor costs		Amount of materials and energy		Operating costs	
Size	1.15	15%	1.21	21%	NA	NA	0.96	-4%	1.05	5%	0.79	-21%
Sector												
Agriculture	0.40	-60%	0.68	-32%	NA	NA	1.47	47%	0.76	-24%	0.37	-63%
Industry	2.29	129%	2.05	105%	NA	NA	2.78	178%	1.59	59%	0.7	-30%
Construction	0.86	-14%	0.73	-27%	NA	NA	2.49	149%	1.53	53%	0.33	-67%
Trade	1.44	44%	1.66	66%	NA	NA	3.9	290%	3.4	240%	0.17	-83%
Transport	0.64	-36%	0.46	-54%	NA	NA	1.11	11%	1.94	94%	0.8	-20%
Social affairs	0.96	-4%	1.46	46%	NA	NA	0.99	-1%	2.93	193%	0.34	-66%
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	2.93	193%	3.22	222%	NA	NA	3.98	298%	2.25	125%	0.38	-62%
Expenditures on ICT	1	0%	0.94	-6%	NA	NA	0.85	-15%	0.94	-6%	1.02	2%
expenditure on intellectual property protection	1.11	11%	1.31	31%	NA	NA	1.95	95%	1.84	84%	0.67	-33%
Expenditure on training	1.33	33%	1.23	23%	NA	NA	1.33	33%	1.43	43%	0.82	-18%
Expenditures on marketing activities	2.22	122%	2.43	143%	NA	NA	1.18	18%	1.69	69%	0.83	-17%
Expenditures on the implementation of new solutions	0.48	-52%	0.57	-43%	NA	NA	1.32	32%	1.6	60%	1.43	43%
Company type (innovative / non-innovative)	1.67	67%	1.83	83%	NA	NA	1.45	45%	1.55	55%	0.73	-27%

Table 4 (continued)

The marginal effect of changing investment in innovation on the level of competitiveness of SMEs

	Sources of supply		New market structures		Harmfulness of the company's activity		Work safety		Work standards		Employees	
Size	1.15	15%	1.44	44%	1.06	6%	1.33	33%	1.47	47%	1.55	55%
Sector												
Agriculture	0.86	-14%	1.04	4%	0.7	-30%	1.33	33%	1.52	52%	1.15	15%
Industry	0.93	-7%	1.22	22%	2.06	106%	1.24	24%	1.12	12%	1.57	57%
Construction	0.61	-39%	1.05	5%	1.29	29%	0.84	-16%	0.78	-22%	1.88	88%
Trade	0.66	-34%	0.8	-20%	3.19	219%	0.95	-5%	2.14	114%	1.4	40%
Transport	1.11	11%	0.46	-54%	1.36	36%	1.18	18%	1.51	51%	2.46	146%
Social affairs	1.07	7%	0.92	-8%	0.18	-82%	2.18	118%	2.01	101%	2.46	146%
Services	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Type of investment												
Expenditures on machinery and equipment	2.14	114%	0.85	-15%	2.26	126%	1.49	49%	1.66	66%	1.86	86%
Expenditures on ICT	0.95	-5%	1.19	19%	0.68	-32%	0.8	-20%	0.83	-17%	1	0%
expenditure on intellectual property protection	1.8	80%	2.95	195%	2.41	141%	1.86	86%	1.56	56%	1.78	78%
Expenditure on training	0.73	-27%	0.99	-1%	1.14	14%	1.14	14%	1.24	24%	2.5	150%
Expenditures on marketing activities	1.87	87%	1.72	72%	1.43	43%	1.14	14%	1.26	26%	1.28	28%
Expenditures on the implementation of new solutions	1.08	8%	2.98	198%	2.1	110%	1.67	67%	0.83	-17%	0.6	-40%
Company type (innovative / non-innovative)	1.58	58%	1.31	31%	1.45	45%	1.31	31%	1.57	57%	1.59	59%

Source: Based on the CATI survey.

 The factor is significant at the significance level of 0 (positive impact).

 The factor is significant at the significance level of 0,001 (positive impact).

 The factor is significant at the significance level of 0,01 (positive impact).

 The factor is significant at the significance level of 0 (negative impact).

 The factor is significant at the significance level of 0,001 (negative impact).

 The factor is significant at the significance level of 0,01 (negative impact).

Table 5

Description of Variables

Variable	Description	Measurement	Source
<i>Dependent variable</i>			
A measure of competitiveness (the effects of investment in innovation) occurring in the enterprise under the influence of investment in innovation	Rank of an improved product or service among other products Revenues from the market due to support of existing enterprise products Prices of products and services as a result of the depreciation costs of new equipment Quality of improved product or service in the eyes of customers Company market share New markets Production flexibility Production efficiency Downtime and breakdowns Labor costs Amount of materials and energy Operating costs Sources of supply New market structures Harmful activity enterprises Work safety Labor standards Employees	These variables are classified from “-3” (largest negative) to “3” (largest positive) and are rescaled from 0 (negative) to 1 (positive). *However, the description of the value may vary depending on the feature, e.g. at a cost of "-3" means a big increase, and at a quality of "-3" means a big decrease.	[Oslo Manual, 2005:35; Leal Filho & Weresa, 2007; Report “Badanie wpływu...”, 2009]
<i>Independent variable</i>			
The company size	Micro enterprises Small enterprises Medium enterprises	1 – micro 2 – small 3 – medium	Statistics Poland (Polish: Główny Urząd Statystyczny, popularly called GUS – stat.gov.pl)
The enterprise sector	Agriculture Industry Construction Trade Transport Social affairs Services	1 – agriculture 2 – industry 3 – construction 4 – trade 5 – transport 6 – social affairs 7 – services	Statistics Poland (Polish: Główny Urząd Statystyczny, popularly called GUS – stat.gov.pl)

The type of investments in innovations	<p>Expenditures on machinery and equipment (<i>e.g. computers for automation or control of the production process, industrial robots and manipulators, machining centers, computer-controlled production lines, automatically controlled production lines, modernized the production line, used other specialized devices and tools</i>),</p> <p>Expenditures on ICT (<i>e.g. install a server, access the Internet using a broadband connection, create an internal LAN network, create an internal wireless network, create an internal intranet, join an external extranet, use voice over IP or ERP, enable remote access to resources companies</i>),</p> <p>Expenditures on intellectual property protection (<i>e.g. to acquire a license, patent or buy a new technological thought, develop utility models, develop a trademark, create technical knowledge in the form of know-how, create or buy new computer software</i>),</p> <p>Expenditures on training (<i>training focused on the development and / or implementation of new products / processes / organizational solutions</i>),</p> <p>Expenditures on marketing activities (<i>internal or external marketing activities aimed at ensuring that the market gets to know new products (including preliminary market research, initial advertising, excluding the construction of the distribution network)</i>),</p> <p>Expenditures on the implementation of new solutions (<i>design and preparation activities, develop new procedures to implement new products, processes or organizational solutions</i>)</p>	1 - expended 0 - not expended	[Oslo Manual, 2005:29; PARP, 2007:23-24; Doloreux and Dionne, 2008; Vaz et al., 2014 ; Report “Badanie wpływu...”, 2009]
The innovation range	<p>An innovative company is a one that has implemented new or significantly improved solutions in relation to the process and / or product (or service) and / or marketing and / or organization in the last six years.</p> <p>A non-innovative company is one that hasn't implemented new or significantly improved solutions in relation to the process and / or product (or service) and / or marketing and / or organization in the last six years.</p>	1 - implemented a minimum of 1 type of innovation 0 - did not implement any innovation	[Oslo Manual, 2005:8]

Source: own compilation