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R&D Cooperation and Investments concerning Sustainable Business Innovation: Empirical Evidence from Polish SMEs

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Abstract: The empirical literature provides strong evidence supporting the relation of various innovation activities, including business innovation. The literature, however, continues to be limited in the context of developing countries, especially considering different types of business innovations. The aim of the present research is to fill the gap in the literature concerning the impact of research and development (R&D) cooperation and various types of investments in innovation for the creation of sustainable business innovation in small- and medium-sized enterprises (SMEs). Particular emphasis in this study is placed on the differences in types of business innovations. The research is based on cross-sectional data (n = 406) collected by the CATI (Computer-Assisted Telephone Interview) method in a Polish peripheral region (Subcarpathian Voivodeship). To examine the relation between different innovation activities and the creation of business innovation, logistic regression was employed. The results show that the outputs of both R&D cooperation and investments are highly dependent on the innovation type. The outcomes suggest that R&D cooperation might be a driver of the implementation of development activities and organizational innovation, while the expenditures on machinery and equipment lead to a greater probability for the implementation of process innovation and development activities. We also found that expenditures on marketing activities and investments in the implementation of new solutions may have an impact on business innovation implementation.

Keywords: R&D cooperation; investments in innovation; innovation; sustainability; SME

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1. Introduction

Business innovations in small- and medium-sized enterprises (SMEs), in addition to the function of creating a competitive advantage, often become a matter of the company's being on the market. However, business innovations are a special resource of an enterprise with expected long-term benefits [1]. The results of business innovations in SMEs, such as new or improved products or business processes, higher product quality, or new knowledge, constitute a qualitative factor in the development of enterprises and the entire economy [2]. Business innovation may depend on the quality and variety of knowledge sources available within the company [3]. Building relations between companies in the region and the use of external knowledge streams, e.g., by supporting its purchase or co-creation as part of its cooperation with universities or research and development units, or through the integration with business networks or industrial clusters [4], constitute an important determinant of the effectiveness of innovative processes. Therefore, the assessment of the cooperation of companies from the SME sector with various units creating knowledge would be very useful for the strategic development of efficiency in the area of creating and implementing innovations. Previous research has reported that not every type of investment in innovation affects SME competitiveness [2].

There are studies confirming the link between research and development (R&D) cooperation and innovative entrepreneurial activity [5–8], but the research is mainly confined to the developed country context. A few studies relate to Central and Eastern Europe (CEE). Hájek and Stejskal [9] explained the impact of R&D cooperation on the creation of spillover effects for sustainable companies in the chemical sector in the Czech Republic. Most studies generally focus on technological innovations in a particular industry sector [10]. In this study, we examine innovations that include both technological and non-technological activities in industry and service sectors. This brings us to the question of whether the relation between R&D cooperation and business innovation differs in an underdeveloped region. Zhu et al. [11] investigated the case of the cell phone industry in China in 1998–2008 and found that innovations in business models helped to increase the market share of companies with more limited resources (especially in the emerging markets context). Heredia Pérez et al. [12] also contributed to a broader view of innovation. Financial support and the type of entity that supports the company are also important, whether they are government and regional authorities, business environment institutions (BEIs), consulting and finance institutions, or R&D. The previous work paid attention to that lack of government support and weakness of tax incentives, which are an important barrier to the innovation process [13]. Despite the appearance of a rich and varied literature and numerous empirical research results on whether innovative activities of companies accelerate the implementation of business innovations, several key questions remain unanswered. What is the extent of reducing economic and social differences between regions as a result of innovation activities? What is the impact of financial support addressing SMEs to reduce regional disparities? What is the net efficiency of innovation investment on SMEs? What importance do innovation investments have for sustainable business innovation in SMEs? We have tried to answer one of these questions in this article.

By discussing how firms' investment innovation decisions impact sustainable business innovation, we contribute to the literature on innovation and innovation strategies by proposing to examine many types of investments and R&D cooperation simultaneously in the context of four types of innovations, also taking into account the financing factor and innovation barriers. We identify six types of investment in innovation as well as R&D cooperation. This approach is a result of a willingness to present a more complex picture of innovation and its sources. In addition, the research was conducted in a peripheral region. Some authors [14] indicate that the innovation barriers and limited financing in the peripheral region are more severe than in other regions. The aim of this paper is to explore the impact of innovation activities (e.g., R&D cooperation and investments in innovation) on the creation of sustainable business innovation in SMEs. Related to this aim, two crucial questions appear. Firstly, whether the R&D cooperation leads to the introduction of specific type of business innovation. Secondly, we look at the impact of investments in innovation on the tendency to create innovation businesses by SMEs.

The article is organized as follows. The first section of the research presents a literature review on the relation between business innovation and innovation activities. The second section presents the data and methodology. The third section contains a presentation and discussion of the results. The paper ends with concluding remarks.

2. Literature Review

One of the most important conditions for the survival and development of a company in the global economy is innovation. This is the response of enterprises to change, often dynamically growing; customer requirements; as well as the actions taken by competitors. These findings correspond with Baldwin and Johnson's [15] research that found that innovation was positively correlated with a company's growth potential. In many sectors, innovations are mentioned among the key success factors that determine the future of the organization. Various scientists have largely employed innovations to explain their role in the search for new, sustainable sources of development and competitiveness [1,16–19].

Earlier studies conducted by Coad and Rao [20] stated that innovative activity positively influences mainly the development of the fastest growing companies, while for other enterprises, this influence may be negative. These studies were logical because companies with good dynamics of development are more innovative and they have better access to information. However, neglecting companies with poor economic conditions is unwise as new ideas throughout the world require support on every level. According to Porter [21], a company can build a competitive advantage mainly due to the ability to be innovative; it can constantly increase the level of innovation and thus obtain appropriate efficiency. Introducing new, significantly improved products, processes, and methods is becoming a key to productivity as well as job creation. In this vein, it was found that during economic expansions, companies increase innovation, while during economic contractions, they decrease innovation [22]. Weakly developed regions lack the resources to be able to increase innovation during recessions in a Schumpeterian way. Many studies try to explain the importance of investments in research and development for the performance of an organization [23].

According to the European Commission [24] (p. 20), sustainable business innovation is described as:

> *'(. . .) a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm'.*

Some studies have emphasized that sustainable business innovations must go beyond gradual modifications [25,26]. The company's ability to conduct and finance innovative activities is determined by many factors. It is generally accepted that economic; sociological; and psychological conditions determine whether an enterprise wants to implement innovations, and technical, production, and organizational determinants determine that it can create and apply new solutions [27,28].

Innovation activities (such as investments in innovation) are the activities of a company of a developmental, financial, and commercial nature aimed at implementing innovation [29]. The potential investments in innovation can represent the following types of activities: (1) R&D cooperation; (2) investments in machinery and equipment; (3) investments in ICT; (4) investments in intellectual property; (5) investments in knowledge; (6) investments in marketing activities; and (7) Investments in the implementation of new solutions (for more details see Table 1).

Table 1. Data description.

Variable Type	Short Form	Denotation	Source
Dependent variable	Type of innovation [1]	Y	[30]
Independent variables of interest [2]	R&D cooperation [3]	X_1	[30–36]
	Expenditures on machinery and equipment	X_2	
	Expenditures on ICT	X_3	
	Expenditures on intellectual property protection	X_4	
	Expenditures on training	X_5	
	Expenditures on marketing activities	X_6	
	Expenditures on the implementation of new solutions	X_7	
	Financial support	X_8	
	Barriers	X_9	
Independent (control) variables	Company size	X_{10}	[37]
	Enterprise sector	X_{11}	[38]
	Export	X_{12}	[39,40]

Notes: All variables are binary. [1] For all types of innovation activity, 1—company introduced innovation, 0—company did not introduce innovation. [2] For all types of expenditure (i.e., investments), 1—company invested, 0—company not invested. [3] If company has cooperated in R&D—1, 0—if has not.

Business innovation rarely occurs in isolation—it is an interactive process of cooperation in a diverse network of stakeholders. R&D cooperation leads to the expansion of the scope of development activities and increases the company's competences. This view is also supported by previous innovation scholars, e.g., [41–43]. Furthermore, referring to the theory of innovation, it can be argued that the R&D plays an important role in innovation. This is especially evident in the manufacturing sector. For example, according to Doloreux et al. [44], R&D enterprises show a greater propensity to innovate. Another study by Doloreux et al. [3] determined that business service innovation requiring expertise, reporting internal R&D, is more likely to improve technological innovation mainly related to new products. They also found that there was no interaction between the combined R&D results and external information gathering. Although the level of cooperation and innovation is not especially high in Poland, the process of transition has increased the involvement of companies in these activities [45]. As part of innovative activities, R&D cooperation was conducted by 23.6% of innovation active industrial enterprises and 20.9% of service enterprises in the years during 2018–2020 in Poland [37]. The majority of innovatively active industrial and service enterprises that cooperated in the field of innovative activities were large enterprises in during the years of 2018–2020.

As mentioned above, sustainable innovations are usually radical rather than gradual. Furthermore, they often require collaborative efforts that go beyond traditional business alliances [46]. Various internal and external partners cooperating in the innovation process should be involved. Another strength of undertaking cooperative activities leads to the optimization of outlays on innovation, as they are distributed among all cooperating entities [47]. According to Fuentes-Solis et al. [48], an enterprise that collaborates in the innovation process with other entities organizes more innovative activities annually than an enterprise that does not cooperate. In this context, the type of entities with which the company cooperates is also important—other companies as well as clients and advisors show the strongest and more stable results in this aspect. The study obtained data from Chilean firms in Latin America. On the other hand, cooperation in the field of innovative activities with other enterprises allows them to significantly reduce the risks for the cooperating parties and contributes to the improvement of their position on the market [49]. In addition, cooperation leads to a reduction in expenditure on R&D and thus reduces the intensity of expenditure on innovation. In another study, Chun and Mun [50] suggested that despite the importance of external knowledge for SMEs, they may face difficulty in creating external R&D relations due to their absolute size limitations. In this regard, as the R&D cooperation is perceived by enterprises as an extra-role commitment, business innovation is not always due to R&D cooperation. Thus, it is expected that in response to R&D cooperation, companies do not cooperate for all types of business innovations. Therefore, the following hypotheses may be stated:

H1a. *SME that had R&D cooperation is more likely to have product innovation implemented.*

H1b. *SME that had R&D cooperation is more likely to have process innovation implemented.*

H1c. *SME that had R&D cooperation is more likely to have development activities implemented.*

H1d. *SME that had R&D cooperation is more likely to have organizational innovation implemented.*

A factor contributing to an increase in expenditure on research and development activities is, for example, the type of implemented innovations. As confirmed by Daveri et al. [51], process innovations are associated with investments in new machines and devices that are the carriers of objectified knowledge, while R&D expenditure is directly related to product innovations. The amount of expenditure on research and development also depends on the source of their financing. These outlays are higher in the case of enterprises financing innovations from their own funds (compared to entities using external funds). Brown et al. [52] indicated that most of the funding for high-tech enterprises was obtained from internal sources. They were the first to emphasize the importance of public funding of R&D in the high-tech industry. The results of their research indicate that entities from

the high-tech sector finance innovative activities mainly from cash flows, due to high costs and difficulties related to obtaining external financing.

Another factor influencing the number of implemented innovations is the scope of the entity's influence. Enterprises that operate not only in the country, but also abroad, show a greater propensity to conduct innovative activity compared to entities operating on regional or national markets. There are several studies that confirm the fact that there is a positive relation between the presence of a company on foreign markets and the level and growth of its technological knowledge, e.g., [53,54]. Researchers agree that increased pressure from competitors in international markets is forcing companies to improve their products and adapt to new market conditions. A similar conclusion was reached in another study [55]. It was indicated that complex innovative firms, if they are large and/or belong to medium-technology sectors, may benefit from a higher propensity to export than non-innovative and simple innovative firms. It is important for enterprises, in particular SMEs, to implement complex innovations. This is essential to increase productivity and competitiveness [56]. Wu et al. [39] suggested that innovative activity has a much greater impact on the extensive export margin than on the intensive one, which may mean that innovative activity promotes companies' export behavior on average. Nevertheless, the research pertaining to seven European countries' firms suggests that [40] both product innovation and tangible investments are linked to the export power of European manufacturing companies.

It is also worth mentioning that Love and Roper [57] formulated their own hypothesis of learning through exports, analyzing whether innovation drives the internationalization of enterprises or whether internationalization prompts economic actors to take more innovative actions.

ICT expenditures incurred in many companies have a chance to pay off only after a long period of time. Earlier studies [58] documented that ICT spending did not have a statistically significant impact on the occurrence of any type of business innovation. The authors suggested that the lack of confirmation of the relationship was due to the very low value of the inputs. Moreover, this type of investment in ICT is typical at the stage of company formation. The research conducted by Arendt and Grabowski [58] confirmed the view that the relationship between innovation, ICT, and productivity was more complicated and depended on the company's distance to the technological frontier. This means that the more productive an enterprise is, the more effort is needed in terms of co-innovative sources of productivity to increase productivity by introducing new technology (including ICT). In broadly based studies of the determinants of innovation, investment and the use of ICT are important factors of innovation in SMEs [33,59]. The adoption of ICT is an important factor in developing business strategies, encouraging creativity and innovation [60]. This result was also obtained by Higón [61], according to which the impact of ICT depends on the type of ICT uses and innovation activity, different company and management characteristics, and other external factors. The author stated that ICT acts primarily as technology that reduces costs or increases efficiency, although certain market-oriented applications (e.g., web development) have the potential to create a competitive advantage through product innovation. Higón [61] emphasized the diverse nature of the relationship between ICT and innovative activity, which depends on the type of innovation—mainly process and product innovations.

Another factor that may contribute to the growth of implemented innovations is the scope of training for employees. The increase in expenditure on employee training leads to an increase in expenditure on research and development due to increasing employees' awareness of the importance, opportunities, and benefits of implementing innovations. Among the benefits of acquiring external knowledge, one should mention the possibility of hiring employees with a high level of education and experience, who bring specific competences in the field of innovation to the enterprise. Among the few empirical studies conducted on this issue, Ballot et al. [35] proved that training in the workplace has a positive impact on the productivity of research and development activities. Human capital is a factor that determines the ability to absorb, manifested in the ability to acquire, assimilate,

and use new knowledge, including technological knowledge [62]. A link between the type of innovation and appropriate training has been reported in another work [63]. In this regard, organizational innovations are linked to higher investments in (formal and informal) internal training. The authors also found that the common indicator of technological innovation does not show any significant relationship with training activities, although individual technological innovations are linked to internal training. According to Mihret Dessie and Shumetie Ademe [64], small companies wishing to improve their results should train the creativity and innovation of employees, in particular, by developing their creative thinking in search of new business ideas. Following the theme of the current study, the investment in innovation is expected to positively influence business innovation introduction. Although the literature documents the benefits of investment in innovation for firms' innovativeness, e.g., [51,59,63], it is expected that not all types of innovation are positively linked to investments in innovation. Therefore, the current study states the following hypotheses:

H2a. *The impact of investments in machinery and equipment on innovative entrepreneurial activity depends on the innovation type.*

H2b. *The impact of investments in ICT on innovative entrepreneurial activity depends on the innovation type.*

H2c. *The impact of investments in intellectual property on innovative entrepreneurial activity depends on the innovation type.*

H2d. *The impact of investments in knowledge on innovative entrepreneurial activity depends on the innovation type.*

H2e. *The impact of investments in marketing activities on innovative entrepreneurial activity depends on the innovation type.*

H2f. *The impact of investments in the implementation of new solutions on innovative entrepreneurial activity depends on the innovation type.*

3. Materials and Methods

3.1. Materials

The data used in the present research were obtained from the project titled "The Study of the Impact of Investments in Innovation on the Competitiveness of the SME sector in Podkarpackie Voivodeship", which was conducted in 2016. The sample selection in the CATI survey was conducted by a stratified sampling method according to the size of the enterprise (number of employees: micro-, small-, and medium-sized enterprises) and its sector (NACE rev. 2 section, for more details see Eurostat 2008) [38]. The sampling criteria were rendered according to GDP contribution. According to the Polish Agency for Enterprise Development, the share of SMEs in generating GDP during the period considered was 48.5%, including micro-sized enterprises—29.7%, medium-sized entities—11%, and small—7.8%. In the latter part of the CATI study, a numbered list of all groups was made separately for micro-, small-, and medium-sized enterprises, and the necessary numbers were drawn proportionally to the share of enterprises in generating the GDP in individual strata. The relevant respondent in the CATI survey was the owner, co-owner of the company, or the head of the development department. The research tool used was a questionnaire containing closed questions. In addition to demographics, the questionnaire included information on the characteristics of the research, investment, and expenditure on innovation. Some of the questions concerned the level and volume of expenditure on innovation among SMEs, the scale of innovation, and the effects of implemented innovations. The final part of the questionnaire included information on the characteristics of the sources of investment financing and innovative activity barriers. The research was very complex and sophisticated, so the analysis of all data and the publication of the results took a few years (this project used a complex research approach, including (1) a CATI survey among

SMEs; (2) in-depth interviews (IDIs) among SMEs, business environment institutions, R&D entities, and local government; (3) focused group interviews (FGIs) testing entrepreneurs introducing innovative solutions and representatives of the R&D sector; and (4) a panel of experts).

The research was based on cross-sectional data (n = 406). The survey was conducted among 406 innovative companies (207 micro-sized companies and 119 small- and 80 medium-sized enterprises) in the Polish peripheral region (Subcarpathian Voivodeship) and performed using the CATI (Computer-Assisted Telephone Interview) method. The companies were randomly selected; however, they remained within stratums because micro-sized enterprises represent the vast majority in the structure of the SME sector in Poland. A description of variables used in the research are presented in Table 1.

The dependent variable represents the introduction of a particular type of business innovation, such as product, process or organization innovation, and development activity. In the survey, the companies were asked whether they implemented each of the above-described innovation types. The answer for this question had a dichotomous scale: "Yes" for companies that implemented innovation, "No" otherwise.

The independent variables of interest used in the research described R&D cooperation and various investments in innovation.

In the survey, the companies were asked about the type of R&D activity or cooperation they had. There were three possible types of R&D activity: only internal, only external, and both. Each type of R&D activity was featured as a separate question with a dichotomous scale:

- Whether the company had only internal R&D activity (i.e., 1—if they had, 0—otherwise),
- Whether the company had only external R&D activity (i.e., 1—if they had, 0—otherwise),
- Whether the company had both internal and external R&D activities (i.e., 1—if they had, 0—otherwise).

In our research, we focused on R&D activity; thus, we introduced a new variable that described whether a company had R&D activity and cooperation or not (no matter what type of cooperation they had). We were only interested in whether the company had R&D cooperation or not.

The companies were also asked about their investments in innovation. The questions were related to various outlays. Within each type of investment, the companies were asked about the particular type of tangible and intangible assets in which they had invested. We did not consider the particular type of assets. We were interested in whether the company invested or not in a particular type of asset (in machinery and equipment, for instance: 1—if they had, 0—otherwise).

- Expenditures on machinery and equipment included—computers for automation or control of the production process, industrial robots and manipulators, machining centers, computer-controlled production lines, automatically controlled production lines, modernized production line, or other specialized devices and tools.
- Expenditures on ICT included—installing a server, accessing the Internet using a broadband connection, creating an internal LAN network, creating an internal wireless network, creating an internal intranet, joining an external extranet, using voice over IP or ERP, and enabling remote access to resources companies.
- Expenditures on intellectual property protection meant—to acquire a license, patent, or buy a new technological idea; develop utility models; develop a trademark; create technical knowledge in the form of know-how; create or buy new computer software; and expenditures on training (training focused on the development and/or implementation of new products/processes/organizational solutions).
- Expenditures on training—related to participation in training focused on the development and/or implementation of new products/processes/organizational solutions.
- Expenditures on marketing activities—related to internal or external marketing activities aimed at ensuring that the market learns about the new products.

- Expenditures on the implementation of new solutions—related to design and preparation activities, and developing new procedures to implement new products, processes, or organizational solutions.

We also used variables to describe:

- Financial support—to obtain financing from a bank loan; loan fund; issue of shares/bonds; local government; and the European Union funds (i.e., 1—company had financial support, 0—otherwise);
- Barriers—high risk of failure in implementing novelty products; cost of implementing new products; and insufficient qualified personnel (i.e., 1—company faced barriers, 0—micro- and small-sized enterprises).

As previously noted, we were interested in whether a company had financial support and faced a barrier. We did not care about the types of financial support or kinds of barriers. As an independent control variable, we used:

- Company size (i.e., 1—medium-sized enterprises, 0—micro- and small-sized enterprises);
- Enterprise sector (in the study, the participating companies operated in either production or service sectors, i.e., 1—production sector; 0—service sector);
- Whether the company was an exporter (i.e., 1—for companies that were an exporter, 0—otherwise).

As was previously mentioned, all the variables used in the present research were binary (i.e., 1—if something happened, 0—otherwise).

3.2. Methods

According to the economic theories [2,8,14,34,65,66], business innovation is mainly determined by investments in innovations (i.e., knowledge infrastructure), transfer technology, human capital, cooperation, financial capital or financial support, or clustering. We assumed that business innovation was related to systems of relations between business, the research community, government, and industries.

In order to investigate the impact of investments in innovation, R&D cooperation, barriers, and financial support on the implementation of business innovation, we performed a regression analysis. The matrix representation of the model can be presented as:

$$Y = X\beta + \varepsilon \tag{1}$$

where:

Y—is a vector of observations on the dependent variable of length $n \times 1$, where n is the number of observations.

X—is a matrix of regressors with $k + 1$ number of elements (k-independent variables; for more details, see the previous section and Table 1) and length $n \times k + 1$.

β—is a vector of parameters to be estimated for length $k + 1 \times 1$,

ε—is a vector of residuals of length $n \times 1$.

Since our dependent variables (types of business innovation) are binary, the Probit and Logit regressions are appropriate. In this study, logistic regression was employed. Equation (2) provides a logistic link function for our model:

$$Llgit(P) = \ln\left(\frac{P}{1-P}\right) = \beta_0 + \sum_{i=1}^{n}\beta_i x_i \tag{2}$$

P represents the probability of a particular event (in our case, the implementation of a new business innovation) under the given conditions. P can be expressed as a logistic function:

$$P = \frac{1}{1+e^{-Z}} \tag{3}$$

where

$$Z = \beta_0 + \sum_{i=1}^{n} \beta_i x_i \quad (4)$$

In order to obtain interpretable results, we also calculated the marginal effects of the estimated parameters for all independent variables at means of regressors.

To prevent the negative impact of multicollinearity on the models' output variances, an inflation factor [67] (VIF) was used. For all models presented in Table 2, the VIF was below 3.0, which was the appropriate level for economic studies. To evaluate the quality of the models, McFadden's Pseudo R^2 was employed.

Table 2. The marginal effect of investment in innovation and R&D cooperation on the business innovation of SMEs.

Variable	Product Innovation	Process Innovation	Development Activities	Organizational Innovation
R&D cooperation	−0.09	0.07	0.4 ***	0.19 ***
	(0.31)	(0.27)	(0.35)	(0.35)
Expenditure on machinery and equipment	0.05	0.15 **	0.09 *	0.002
	(0.29)	(0.24)	(0.39)	(0.39)
Expenditure on ICT	−0.04	−0.02	0.05	0.04
	(0.3)	(0.23)	(0.39)	(0.39)
Expenditure on intellectual property protection	0.07	0.09	0.02	0.03
	(0.37)	(0.27)	(0.4)	(0.37)
Expenditure on training	0.03	0.02	0.002	0.15 ***
	(0.3)	(0.24)	(0.37)	(0.41)
Expenditure on marketing activities	0.11 *	−0.08	0.08 *	−0.02
	(0.32)	(0.24)	(0.37)	(0.37)
Expenditure on the implementation of new solutions	0.05	0.2 **	0.09 *	0.19 ***
	(0.51)	(0.36)	(0.41)	(0.4)
Financial support	−0.1 *	0.19 ***	−0.05	0.04
	(0.29)	(0.24)	(0.36)	(0.34)
Barriers	0.05	−0.02	−0.1 **	−0.01
	(0.28)	(0.24)	(0.36)	(0.37)
Company size	−0.003	0.03	0.01	0.13 **
	(0.41)	(0.3)	(0.42)	(0.41)
Enterprise sector	0.03	−0.05	−0.06	−0.06
	(0.29)	(0.23)	(0.35)	(0.36)
Export	0.11 *	0.01	0.08 *	−0.04
	(0.39)	(0.26)	(0.37)	(0.39)
McFadden's pseudo R^2	0.11	0.09	0.34	0.3
Sample size	406	406	406	406

Notes: Standard errors in parentheses. Table contains marginal effects at means of regressors calculated for logistic regression coefficients. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

4. Results and Discussion

Table 2 presents the results for the logistic regression, which describe the impact of investments in innovation and R&D cooperation on product innovation, process innovation, development activities, and organization innovation.

The outputs of both R&D cooperation and investments were highly dependent on innovation type in the SMEs. It was possible to form the following conclusions about the research hypotheses that were established (see Table 2).

H1a and H1b, which proposed linking R&D cooperation with product innovation and process innovation implementation, was negatively verified. In fact, only certain types of innovation were positively linked to R&D cooperation. The results suggest that R&D cooperation can be the driving force behind the implementation of development activities and organizational innovations. Therefore, H1c and H1d were positively verified. R&D cooperation was not related to product and process innovations.

The results show some similarities, but also some significant differences to those found in R&D research and external source of information in manufacturing companies. For example, Doloreux et al. [34] observed that R&D developed all types of innovations (except human resource innovation). Enterprises declaring the use of both sources of knowledge (external sources of information and internal R&D) implemented innovations more often than companies using only one type.

Hypothesis H2a was confirmed only for two (process innovation and development activities) types of innovation; it was rejected in the case of product and organizational innovations. SME, which had investments in machinery and equipment, was more likely to show process innovation and the implementation of development activities. Investments in machinery and equipment were not related to product and organizational innovations. Enterprises investing in machines and devices had a strong, positive impact on the flexibility and efficiency of production and the reduction in labor costs [2]. It should be emphasized that process-oriented innovators are mainly those companies that usually only implement process innovations, not product innovations [46]. The results obtained by the other researchers show that process innovations without the complement of organizational innovations limit innovative performance. Moreover, complex process-based innovations result from the simultaneous development and integration of new machines and organizational innovations. We concluded that while product and process innovations are interrelated, they are not always driven by the same factors.

Hypothesis H2c was rejected in all types of innovation. Expenditures on intellectual property protection seemed to be insignificant for any type of business innovation. We believe that a logical process is, first, the company implements the innovation and then the license or patent application, or the company collects information and knowledge through patents and then develops a creative idea, or both innovation and patent are implemented at the same time. Some studies clearly show that information and knowledge are essential drivers of innovation and technological development, which translates into the competitiveness of companies. Storing information and knowledge increases opportunities and provides access to opportunities that may lead to a stronger competitive position in the market [68]. However, acquiring a license or patent or developing utility models itself are not enough to implement innovation. The value of a patent is in the additional profit that a firm earns by exploiting its invention, compared to the value that it earns without having a patent [69].

Hypothesis H2b was rejected in all types of innovation. We did not identify the evidence supporting the relation between investments in ICT or intellectual property and the creation of any types of business innovation. The lack of relation between ICT investments and innovation activities, however, might be associated with a type of equipment considered in the survey. The ICT equipment and application considered in the survey are typical in the early phases of a company. Our results are in line with the results of a literature study on the role that ICT plays in innovation activities. The literature not only confirms that the impact of ICT depends on the type of ICT used and innovation activity, but also on various company and management characteristics, as well as external factors. Arendt and Grabowski [58] indicated that the relationship between innovation, ICT, and efficiency is sophisticated and depends on the company's distance from the technological frontier. In this case, ICT is used to reduce costs or increase the efficiency of technology. Higón [61] indicated that the diverse nature of ICT applications not only has a particular impact depending on the innovation activity, but may imply different requirements in terms of resources and incentives required for implementation.

Hypothesis H2d was confirmed only for organizational innovation; it was rejected in the case of product and process innovation and development activities. The results also show that expenditures on training may impact organizational innovation. These results are consistent with the findings of other researchers. For instance, Antonioli and Della Torre [63] demonstrated a quite complex picture of the effects of innovation on training in Italian manufacturing SMEs. Organizational innovation seems to be related to greater

investments in internal training. The general index of technological innovation does not show any significant relation with training activities, whereas the individual technological innovation variables are associated with internal training. According to them, SMEs have a limited awareness of the risks associated with underinvesting in training during the implementation phase of process innovation. The company can only achieve economic success with an in-depth knowledge of manufacturing technology and production processes that makes innovation possible. Different combinations of knowledge and learning that lead to innovation and profit are very helpful [70].

Hypothesis H2e was confirmed only for product innovation and development activities; it was rejected in the case of process and organizational innovations. We also found that investments in marketing activities may have an impact on business innovation implementation (i.e., product innovation and development activities). These results are consistent with the findings of Higón et al. [71] who emphasized complementarities between R&D and advertising investments, and between advertising and human capital in manufacturing firms. However, they were not conclusive in the case of R&D and human capital. This is inconsistent with the other research, which only found complementarities between R&D and patents [72].

Marketing investments are primarily used to communicate a new product to consumers, as well as build a brand and improve the company's reputation. They also support the commercialization of the results of the innovation process. The interaction between marketing investments and development activities is critical to understanding how companies operate in terms of disparities. These results indicate some similarities to the Teece [73] model, in which certain complementary advantages are used by companies as mechanisms adequate for the results of the innovation process. Higón et al. [71] also emphasized the importance of a comprehensive approach to the innovation strategy of enterprises, including the consideration of the role of intangible assets that may be related to innovative activities, and not only as a result of independent planning by the R&D department.

Hypothesis H2f was confirmed only for three types of innovation (process and organizational innovation, and development activities); it was rejected in the case of product innovation. Our findings show that the outlays for the implementation of new solutions seem to be significant for all types of business innovations, except for those based on products. The company that conducted design and preparation activities developed new procedures to introduce new products, processes, or organizational solutions, which is relevant to process innovation, development activities, or organizational innovation. It is consistent with the literature—according to Lewandowska [2], companies that incur expenditures on the introduction of new solutions contribute to the creation of new market structures and reduce the damage to the health and environment of the company's operations. The author also stated that the expenditure on introducing new solutions reduced the flexibility of production.

The results also show that financial support is significant for product and process innovations (financial support for investments is observed to have a stronger effect on process than product innovations). However, financial support tends to have a negative impact on product innovation implementation. This result may be due to the high costs of product innovation and a weak link between financed investment and product innovation. The specific character of the behavior of micro-sized and small firms and the tendency towards self-financing also might be important. In addition, strict bank polices and the reluctance of financial institutions in providing loans also do not support SMEs in this case [74].

This result is partially consistent with the present literature. Brancati [75] indicated that financial constraints are observed to have a stronger effect on process than product innovations. Moreover, the author did not detect any significant impact of lending on innovation per se. According to Hewitt-Dundas [76], the lack of funding for Irish firms was the key to innovating small businesses. They explained that this may be because these companies heavily invested in product development and were more adapted to financial constraints. Moreover, the results described by SBRC [77] show that for many

entrepreneurs, the availability of financing was limited in the development and introduction of new processes.

Moreover, the results confirm that barriers to innovation activities may have a negative and significant impact on the implementation of development innovation. We believe that the high cost of implementing development innovation and insufficiently qualified personnel might be important.

Raghuvanshi and Agrawal [78] observed that the lack of both financial resources and well-qualified employees can be an obstacle for SMEs in the process of business innovation. The financial barrier also affected the level of R&D activity in the company. The authors also observed that a lack of skilled workers limited the company's ability to take risks and grow. Moreover, employees did not want to adapt to the changes or new techniques and strategies. A lack of skilled workers can also affect feasibility issues, and hence the success of an innovation. In other words, it can be said that innovation is considered as organizational knowledge because it influences the thought and behavior of creative people [79]. Therefore, skilled workers are crucial for any enterprise and are an important factor of innovation [80]. This result confirms the argument of Raghuvanshi and Agrawal that several barriers (e.g., lack of skilled workers, high costs of implementing innovation, and limited institutional support) prevent SMEs from acting as intelligent and pro-development companies [78].

5. Conclusions

SMEs are increasingly involved in innovation activities. Companies perform many different investments that result in the company's innovation. SMEs can obtain various economic benefits, such as strengthening their market position and competing more effectively with other enterprises, focusing on various types of improvements and introducing new products to the market.

The present study explained how the type of innovation activities (e.g., R&D cooperation and investments in innovation) affected the implementation of certain types of innovations. The results of the empirical research show that R&D cooperation plays an important role in the creation of sustainable business innovation. However, not all types of innovation are positively related to R&D cooperation. The results of the research suggest that R&D cooperation might be a driver of the implementation of development activities and organizational innovation. However, R&D cooperation is not associated with product and process innovations. Future research should define the types of R&D collaborations in more detail, taking into account who the company is working with and how this differs between sectors and the size of the company to obtain all the details.

Our paper underlined the crucial role of investments in innovation: the results suggest that it affects the propensity of firms for innovative entrepreneurial activity. However, the results are more nuanced than we expected and depend on the type of investments in innovation and type of innovation. In particular, the investments in ICT or intellectual property seem to be insignificant for all type of business innovations whose propensity to innovative depend on the nature of the investment (and the development phase company) in the sector. Our findings also show that expenditures on the implementation of new solutions seem to be significant for all types of business innovation, except product innovation. Moreover, we observed that investments in machinery and equipment lead to a higher probability of implementation of process innovation and development activities; investments in training may impact organizational innovation; and investments in marketing activities and investments in the implementation of new solutions may impact product innovation and the implementation of development activities.

To summarize, it is necessary to mention certain shortcomings of this study. The very first limitation was that the quantitative research presented just one regional perspective. The relatively small sample size was also a potential limitation of the study. Secondly, single and irregular research attempts led to an increase in data, but we postulate a more systematic and, more importantly, longitudinal research project. Finally, in this study, we

used data obtained from a research project conducted in 2016. Despite this, we believe that these findings are still applicable in 2022. In further research, the approach will continue by, for example, focusing on the importance of various types of business innovations when studying the drivers of business innovation and/or specific forms of public support and their influence on R&D cooperation effects. Moreover, such a study could be conducted in different regions, as well as in other countries.

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