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R & D and Internationalization: Effect on the Performance of SMEs

David K. Chalmers[1*], Emily W. Mannetta[2], Luca Sensini[3]

1. *School of Strategy and Business, UT Toronto, Canada.*

2. *School of Business, CAU Atlanta, U.S.A.*

3. *Department of Management and Innovation System, University of Salerno, Italy.*

*Corresponding Author: David K. Chalmers

Abstract: The purpose of this research is to study the impact of research and development activities on the performance of SMEs operating in non-high-tech sectors. At the same time, this study also investigates the impact produced by internationalization on research and development activities and performance. This choice is driven by the fact that there are several studies focusing on large companies and high-tech companies, while only a few scholars have addressed this topic for non-high-tech SMEs. A sample of Italian companies was chosen to develop the survey. The companies interviewed were obtained from the Amadeus database, in accordance with the definition of SMEs of the European Commission. From all the population, we extracted a probabilistic sample based on stratified random sampling design. Data collection and information was carried out through a questionnaire. The use of this tool has made it possible to collect updated information on research and development, innovation, internationalization and other general aspects useful for research purposes. The results show that non-high-tech SMEs that invest in research and development get performance benefits up to an optimal level of investment. In addition, the results suggest that internationalization can increase performance.

Keywords: *Innovation, R&D, Internationalization, Performance, SMEs.*

Introduction

In the current dynamism of the competitive context, innovation has become a crucial factor to compete in local and international markets [1, 2] for companies of all sizes. The literature has shown that innovative SMEs have higher productivity levels, growth rates, and profitability than other companies of the same size [3, 4]. Research and development activities play a fundamental role [5,6,7,8] in innovation processes as they favor the improvement of processes and products and competitiveness, increasing the chances of survival and development [9,10].

In this regard, investments in research and development represent a fundamental driver capable of increasing the wealth of knowledge and stimulating innovation and business growth [11, 12, 13]. In the face of this growing importance of innovation, some scholars have highlighted that only a part of SMEs is attentive to product and / or process innovation [14]. This makes them more vulnerable. This circumstance may depend on the lack of managerial skills, human or financial resources [15] which make innovation more complex than larger companies or companies operating in the high-tech sectors. In the context briefly outlined, given the importance that SMEs have for the economic and social development of a country [16,17,18], this study investigates the impact of internationalization on companies innovation processes, focusing attention on SMEs that are not part of the high-tech sector.

In this regard, some scholars believe that the absence or lesser presence of research and development activities in SMEs operating in traditional sectors (for example, food and beverage) affects growth [19,20] and limits the competitiveness of these companies [21]. However, other scholars have highlighted that these (non-high-tech) companies develop skills and competences through other tools, such as product development in collaboration with customers [22], collaboration with other

organizations in research activities and development [23], informal relationships, stimuli deriving from internationalization and other factors [24,25]. Therefore, focusing attention on these companies is significant and also represents a field of investigation little explored by literature. Indeed, scholars and policymakers have focused mainly on the impact of innovation on the performance of high-tech SMEs [6, 8, 26, 27, 28, 29]. The aim of this research is to investigate the impact of research and development activities on the performance of SMEs operating in the non-high-tech sectors.

At the same time, this study also investigates the impact produced by internationalization on research and development activities and performance. This choice is driven by the fact that there are several studies that focus on large companies and high-tech companies, while only a few scholars have dealt with this topic for non-high-tech SMEs. A sample of Italian SMEs was chosen to develop the survey, as these companies represent the backbone of the economic system and have a strong impact on the country's employment and added value [30,31].

Therefore, this research seems appropriate to the Italian context [32]. The SMEs surveyed were obtained from the Amadeus database, consistent with the definition of SMEs from the European Commission. From the entire population, we extracted a probabilistic sample based on stratified random sampling design. This approach made it possible to improve the efficiency of the estimates and ensure the representativeness of the extracted sample.

The collection and information of the data were carried out through a questionnaire. The use of this tool made it possible to collect updated information on research and development activities, innovation, internationalization, and other general aspects useful for research purposes. The approach used is consistent with that used by other scholars [33, 34, 35].

The layout of the questionnaire was designed and implemented with the Survey Monkey program, in order to make the paper version of the questionnaire uniform. 128 companies participated in the research, equal to 25.6% of the total sample. The results show that non-high-tech SMEs that invest in research and development obtain performance benefits up to an optimal level of investment. In addition, the results suggest that internationalization can increase performance. The paper is organized as follows. The second section examines the literature and develops the research hypotheses. The next section illustrates the research design and sampling procedures. Section 4 provides a brief overview of the main characteristics of the companies included in the sample. Section 5 develops the analysis and the last contains the concluding remarks.

Literature Review and Research Hypotheses

The literature has widely described the positive impact that research and development investments have on productivity and business growth [5, 36, 37, 38, 39]. Some authors highlighted that these investments are more effective in the high-tech sectors [20, 26, 40, 41]. However, these positive effects of an investment in research and development do not seem to have the same effects in other SMEs [28, 29].

In this regard, the literature has shown that investments in R&D are easily imitable [20], risky [42], and excessively expensive. These circumstances lead companies not to invest or to invest moderately in research and development [43]. However, as anticipated, some scholars have highlighted that companies non-high-tech develop skills and competences through other tools, such as product development in collaboration with customers [22], collaboration with other organizations in the research and development [23], informal relationships, stimuli deriving from internationalization and other factors [24,25].

In other words, these companies are oriented first to organizational and market innovations and then to process and product innovations [29, 40]. In the context outlined, in accordance with recent research [44], we formulate the following research hypothesis:

HP 1-The relationship between R&D intensity and performance is inverted U-shaped.

The current dynamism of the economic and competitive context significantly affects companies. In recent decades, the growing globalization of markets, the speed of trade and technological progress have reduced the

constraints on technological innovation, and the internationalization of businesses.

The reduction of the life cycle of products and services [45] requires attention to the continuous improvement of existing products and services and at the same time the constant search for new products and services to offer to the market.

In addition to the obvious advantages in terms of performance, competitiveness, and risk, internationalization also plays a fundamental role in the learning processes of companies [46, 47]. In the context briefly outlined, innovation [48] and internationalization represent a relevant factor for competing. Previous studies have studied this theme focusing mainly on large companies [49]. Given the major resource constraints of SMEs, internationalization can play a fundamental role [50].

Some researchers have studied the effect of innovation on internationalization, achieving mixed results [49, 51, 52 ,53]. In this regard, some authors have suggested that the industrial context affects the results [54]. Another group of scholars examined the impact of internationalization on innovation [55], highlighting that the International orientation increases the chances of innovation [56] and exports increase product and process innovations [57].

In this perspective, the know-how and skills developed with internationalization become an important driver of innovation generating a virtuous effect on companies with positive effects in the management of processes and products. These studies show that the degree of internationalization (DOI) can intensify the intensity of research and development activity by acting as moderator [50, 58, 59, 60]. Therefore, in accordance with the literature just cited, the second research hypothesis is the following:

H2 - DOI moderates the relationship between R&D intensity and business performance

Research Design

This section describes the phases and methodology used in the design and implementation of the sample statistical survey. First, we selected all the small and medium-sized companies headquartered in Italy from the Amadeus database. The number of companies selected was in line with the recommendations of the European Commission.

A probabilistic sample was selected on the whole population on which to collect data and information. In line with the literature [61,62], we considered it appropriate to favor a stratified random sampling design to improve the efficiency of the estimates and ensure the representativeness of the extracted sample, in order to highlight some factors of interest for the investigation. In terms of efficiency, this approach made it possible to reduce the variability of the estimates compared to the random sample.

In terms of representativeness of the sample, the domains of interest for the survey were identified based on geographical and economic criteria. The use of a criterion of nature geographical allowed to consider the structural diversity of the national territory. The use of an economic criterion made it possible to consider that the behavior and strategies of companies are strongly affected by the size of their organization. Therefore, small and medium-sized enterprises are adequately represented in the sample. The sample size was set at n = 500 units in such a way as to guarantee, with reference to the estimate of a hypothetical proportion p, an error | d | ≤ 0.055 with a probability of 0.95 based on the following:

$$n = \frac{n_0}{1 + \frac{n_0}{N}}$$

Where N is the population size and n_0 is given by:

$$n_0 = \frac{z^2(0.975)p(1-p)}{\varepsilon^2} .$$

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The level of p has been fixed assuming a maximum level for the variability of any hypothetical dichotomous variable, reached for p=0.5. The samples units belong to each stratum have been selected according to the incidence of each sub-group within the population. After identifying the sample, we sent an email to all companies explaining the purpose of the study and providing other general information.

A total of 166 companies, accounting for 33.2% of the sample, agreed to participate in the research. Subsequently, we sent the questionnaire to all the companies that had joined. The use of the questionnaire allowed to collect updated data on innovation and internationalization and is consistent with the approach used by other scholars in research on the same topic [33, 34, 35].

The structure of the questionnaire was created according to the cognitive objectives and the research hypotheses. In particular, the questionnaire is organized in a modular way and is divided into 6 sections. The questionnaire included 80 questions, structured as multiple-choice questions. The sections were as follows: 1. General information on the company and the entrepreneur; 2. Organizational structure; 3.

Investments made; 4. Purchase, production, and sale cycle; 5. Research, development, and innovation; 6) Internationalization. To facilitate the data entry phase, the layout of the questionnaire was designed and implemented with the Survey Monkey program, in order to make the paper version of the questionnaire uniform. At the end of the survey, 128 companies completed the questionnaire, equal to 25.6% of the total sample. The Italian companies in our sample operate in various sectors such as the food and beverage industry, fashion, furniture and construction.

The prevailing literature suggests that investments in intangible assets, such as research and development, do not produce effects immediately but can only give benefits after a certain period of time [63] which varies according to the sector of activity.

Therefore, in accordance with the literature, to evaluate the impact of R&D investments on company performance, we verify the results two years after the investment. In line with the literature, the questionnaire was constructed to identify four constant performance indicators: turnover, profit margin, market share, and company value [64].

These main components served to create a Likert scale, which was reliable and showed a Cronbach α of 0.84 with single factor correlations over the total greater than 0.67 and correlations between factors greater than 0.52. To assess the intensity of research and development activities, we have considered an internal and external investment in research and development [65].

The two types of investment in research and development have been evaluated in the cases in which they present valid values for both of the constituent variables, including a linear term and a square to allow an inverted U-shaped relationship of the R&D intensity on performance company. To evaluate the DOI we used the percentage of the company's foreign turnover, in order to obtain the ratio between the foreign turnover and the total turnover. The literature has shown that the company's performance can be influenced by different variables. Among these variables, the sector, the corporate structure and age play a fundamental role [66].

Therefore, we have created a dummy variable to distinguish between manufacturing and service companies. At the same time, we created a dummy variable to distinguish a group's companies from individual companies. Finally, we created a dummy variable to distinguish between young and old businesses.

Overview of Companies Characteristics

Table 1 summarizes the main characteristics of the companies analyzed, highlighting some important elements that emerged from the questionnaire. The further elements, strictly related to the research hypotheses, will be shown in the following sections.

Tabe1: The main characteristics of the companies

Size	
Small Firms	56,8%
Medium Firms	43,2%
Founder of the Company	
Current owner	50,1%
Parents of the current owner	24,4%
Grandparents of the current owner	6,3%
Current owner group	5,8%
Other founders	5,5%
Other answers	7,9%
Company Members/Shareholders	
1	12,5%
2	42,4%
3-5	32,2%
6 or more	12,9%
Average turnover	
<= 2 millions	10,5%
<= 10 millions	29,8%
>= 10 millions	42,5%
>50 millions	18,2%
Purpose of investments	
Increase in production capacity	31,6%
Increase in product lines	21,8%
Market share increase / Entry into new markets	20,1%
Adaptation to regulations	10,2%
Others	16,3%
Factors driving innovations	
Internal know-how and resources	25,5%
Sources of information (conferences, fairs, trade magazines, etc.)	17,5%
Customer requests	16,1%
Suppliers	12,4%
Competitors	4,4%
Universities and research centers	2,9%

The companies in the sample are small (56.8 %) and medium (43.2 %) sized and were founded in most cases by the current owner (50,1%) or family members (30.7%). The number of members generally does not exceed 5 (87.1 %). Most of the companies have a turnover of between 2 and 50 million (72.3 %), while 18,2% of the companies have a turnover of more than 50 million Euros. Most of the investments are intended to increase production capacity (31.6%), product lines (21.8 %) or market share/Entry into new markets (20.1%). Innovation derives mainly from the development of internal knowledge (25.5%). However, all players in the competitive environment (32.9 %) also play an important role in innovation processes.

Results and Discussion

To test the research hypotheses, we used a hierarchical multiple regression as it is the most suitable model for measuring different variables and incorporating the moderating effects and the control variables.

The Regression Model is as Follows

$$Y = \beta_0 + \beta_1 SER_i + \beta_2 GR_i + \beta_3 YN_i + \beta_4 SIZE_i + \beta_5 DOI_i + \beta_6 R\&D_i + \beta_7 R\&D_i^2 + \beta_8 R\&D_i DOI_i + \beta_9 R\&D_i^2 DOI_i + \varepsilon_i$$

Where Y represents constant performance, R&D describes the intensity of R&D activities and DOI expresses the intensity of the level of internationalization. The other factors, services (SER), company of a group (GR), young age (YN), and company size (SIZE) represent the control variables. To avoid asymmetric data, we determine the logarithm of the size of the company and the intensity of the research and development activity, adding a constant (+1) to the log transformations to include zero values in the

analysis. Given the variance inflation factors (VIF), we verified the absence of multicollinearity in our model.

The results of the analysis are shown in Table 2 and Table 3

Tabe 2: Descriptive Statistics

	FP	SER	GR	YN	SIZE	DOI	R&DI
Mean	1.41	0.56	0.25	0.14	1.22	0.00	0.00
SD	0.981	0.487	0.438	0.431	0.518	0.414	27.857

Table3: Correlation Matrix

	1	2	3	4	5	6	7
Firm performance (FP)	1						
Services (SER)	0.043	1					
Group (GR)	0.051	-0.039	1				
Young Firm (YN)	0.023	0.076	-0.001	1			
Size (SIZE)	0.039	-0.304	0.146	-0.147	1		
DOI	-0.043	-0.087	0.121	0.051	0.036	1	
R&D intensity (R&DI)	0.218	-0.051	-0.002	0.019	0.011	0.024	1

Table 4 highlights the different models. In particular, the former includes the control variables; the second includes predictive variables to evaluate the main effects; the third and fourth include the quadratic term of the R&D and DOI intensity respectively; finally, the fifth includes all the variables considered.

Table 4: Multiple regression

	1	2	3	4	5
Intercept	1.498***	1.473***	1.521***	1.522***	1.522***
	(0.153)	(0.151)	(0.151)	(0.151)	(0.151)
Services (SER)	0.018	0.038	0.059	0.059	0.059
	0.051	0.051	(0.051)	0.051	0.051
Group (GR)	0.046	0.049	0.066	0.067	0.067
	(0.056)	(0.057)	(0.057)	(0.057)	(0.057)
Young Firm (YN)	0.047	0.048	0.062	0.059	0.061
	(0.079)	(0.078)	(0.079)	(0.079)	(0.079)
Size (SIZE)	0.109*	0.112*	0.106*	0.106*	0.106*
	(0.053)	(0.054)	(0.053)	(0.053)	(0.053)
DOI		-0.001	-0.001	-0.001	-0.001
		(0.001)	(0.001)	(0.001)	(0.001)
R&D intensity		0.387***	0.631***	0.627***	0.627***
		0.069	(0.100)	0.100	0.100
R&D intensity^2			-0.439**	-0.443**	-0.446***
			(0.139)	(0.139)	(0.139)
R&D intensity x DOI				0.003*	0.004
				(0.01)	(0.003)
R&D intensity^2 x DOI					-0.001
					(0.003)
R^2	0.151	0.179	0.191	0.194	0.194
R^2 Adjusted	0.126	0.153	0.164	0.166	0.167

Significance levels: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$;

As is evident, the 5 models are statistically significant ($p < 0.001$). Among the different models, model four is the one that has the most significant improvements ($p < 0.05$) compared to the others. Therefore, we use model 4 to test our research hypotheses. Hypothesis 1 suggests that the intensity of R&D has a negative inverted U-shaped impact on the company's performance.

In this regard, the significance of models 2 ($p < 0.001$), 3 and 4 ($p < 0.01$) highlight an inverted U-shaped relationship between R&D intensity and constant performance. Consequently, the first hypothesis is verified. Hypothesis 2 suggests that increasing the level of internationalization produces a further positive impact of research and development on performance.

In this regard, models 4 and 5 show that research and development activities have a positive and significant impact ($p < 0.05$), also indicating an insignificant level of interaction ($p > 0.05$). In particular, the increase in DOI produces a positive impact up to a certain level. To verify the solidity of the results and the inverted U-shaped relationship, we verified the regression behavior by dividing the data into two sets. The test confirmed our results by highlighting a positive relationship to the optimal point and a negative relationship afterward.

Conclusions

The purpose of this research is to study the impact of research and development on the performance of SMEs operating in non-high-

tech sectors, also considering the impact of internationalization. This research topic is still little explored by literature. A sample of Italian SMEs was chosen to develop the survey.

The European Commission definition was used to identify SMEs. Company data was extracted from the Amadeus database. From the whole population, we extracted a probabilistic sample based on stratified random sampling design, in order to improve the efficiency of the estimates and ensure the representativeness of the extracted sample.

The collection and information of the data were carried out through a questionnaire, allowing the collection of updated data and information. The approach used is consistent with that used by other scholars (Alegre et al., 2013; Bresciani and Ferraris, 2016; Tang et al., 2018). The layout of the questionnaire was designed and implemented with the SurveyMonkey program, in order to make the paper version of the questionnaire uniform. 128 companies participated in the research, equal to 25.6% of the total sample. The results show that non-high-tech SMEs that invest in research and development obtain performance benefits up to an optimal level of investment. These empirical results suggest that investing in research and development is convenient even for non-high-tech SMEs within certain optimal levels. Furthermore, the results also suggest that internationalization can improve performance.

This research contributes to the existing literature on the relationships between

research and development, internationalization, and performance. In addition, empirical results can help SME owners and managers to orient investments towards optimal values. Finally, the results can also be useful for policy-makers to guide incentives and support for research and development activities.

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