The Impact of Innovation Objectives on Industry-Academia Collaboration. A Look Towards Sustainability

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The literature on innovation has been very prolific in highlighting the importance of companies developing new products, processes or business models in order to be more competitive in the marketplace. Empirical studies have shown that this innovative activity has translated into superior results for companies that have engaged in innovation. However, most of these initiatives have been studied mainly from the company's point of view without considering the contribution that academia can make to these innovation processes. This paper explores precisely how it is possible to achieve better results in innovation objectives through industry-academia collaboration (IAC). To this end, a sample of 7638 Spanish companies is analysed, distinguishing between those that have linked their innovation objectives to collaboration between the company and higher education centres. The results reveal that this IAC helps reinforce innovation objectives, demonstrating that the union of the academic and business worlds improves the results of business innovation processes. This has important theoretical implications as it offers new insights into the analysis of innovation processes and business implications as it proves that there is a need to develop platforms that encourage IAC.

Keywords:
Industry-Academy collaboration; innovation objectives; business model innovation; economic, social, and environmental levels, sustainable BMI

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1 Introduction

In the last few years, Business Model Innovation (BMI) has gained significant interest among academics and professionals as an avenue for business development and for achieving above-average performance (Ghinoi & Di Toma, 2022). Its implementation is essential in order to foster long-term sustainable competitive advantage and to recognize new techniques to business organization (Kraus et al., 2020). Despite the growing literature in this research field, there are still many issues regarding BMI that remain limited (Foss & Saebi, 2017). The relationship between BMI and industry-academia collaboration (IAC) is one of them.

The engagement between university and industry or multi-stakeholder collaboration has the potential to generate synergies both for industry and academia (Haug, 2018) and results in higher levels of innovation and advances in knowledge, technological enhancements, and industry objectives (Arshed et al., 2022). Universities provide workforce that can be useful to firms, and are the source of innovative ideas to set up new business ventures (Ahmed et al., 2022). Based on this, when industry require research in unknown areas where they do not have access yet, they look for academia. Besides, this educational institution has the knowledge expertise and the research methods to designed solutions which are valid and relevant, so that industries should benefit from its collaboration (Burova et al., 2021). Several topics regarding IAC and innovation have been addressed in the literature, specially related to technology transfer (Blundi et al., 2019; Ravi & Janodia, 2022). To the best of our knowledge, there is no research that assesses the relationship between BMI objectives and IAC.

We consider that BMI objectives may lead a company to decide to collaborate with research institutions as a means to achieve them. To fill this gap, this research has a twofold objective: on the one hand, to determine whether the importance that firms give to BMI objectives is higher when they collaborate with universities; and, on the other hand, to identify which of these innovation objectives contribute to IAC. On this purpose, data was drawn from the Spanish (Eurostat) Community Survey (CIS) for 2014-2016 in order to evaluate if there is an influence of BMI objectives on the collaboration between industry and university. In addition, through hierarchical logistic regression a set of seven BMI objectives, classified with the Triple Layered

Business Model Canvas (TLBMC), have been identified which contribute to collaboration between companies and universities.

The remaining paper is structured as follow. First, we provide a review of the salient literature on BMI and Industry-Academia Collaboration. Next, the methodology to collect data from 7,638 Spanish organizations is detailed. Then, the results of the empirical analysis are discussed. Finally, conclusions are summarized in section five.

2 Business Model Innovation Objectives and Industry-Academia Collaboration: Literature review

The term business model was introduced for the first time by Bellman et al. (1957) (Groesser & Jovy, 2016), yet it was the arrival of internet and the expansion of information and communication technologies (ICT) that prompted it to be explored to a greater extend in the 1990s (DaSilva & Trkman, 2014). Despite the fact that there is a large number of definitions provided regarding the concept; many contributions to the literature agree with the notion of business model as "the logic the firm follows to operate its resources and to create and capture value for external and internal stakeholders" (Ammar & Chereau, 2018, p. 2). A business model is built on the three main value dimensions of a business: the creation, delivery, and value capture (Clauss et al., 2020). Value creation occurs when a firm matches the customer's demands with a re-organisation of its resources which lead to enhanced efficient (Kraus et al., 2020); value delivery explains the mechanisms how to bring the created value to the customers (Dahan et al., 2010; Spieth et al., 2021), and the value capture indicates how a firm will obtain money from developing its activity (Osterwalder & Pigneur, 2010).

In this context, innovation constitutes one of the cornerstones of business model (Budler et al., 2021). BMI is essential for business sustainability (Breier et al., 2021) and represents a source of a firm's competitive advantage (Latifi et al., 2021; Pieroni et al., 2019). Although there is no consensus on its definition, we follow Foss & Saebi, (2017, p. 201) who state that it can be understood as "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements". While business model objectives refer to the overall business objective that a company seeks to achieve in developing or shaping its business model (Molina-Castillo et al., 2019); innovation objectives comprises a

firm's distinguishable aims that depict intentions and strategies that involve innovation efforts (OECD & European Comission, 2018). Based on this, we refer to BMI objectives as those that involve innovation efforts and imply novel, trivial and designed modifications in a firm's business model. Thus, these innovation objectives may lead to innovation activities and performance (Meroño-Cerdan & López-Nicolas, 2013).

Literature on BMI has pointed out several tools and path to design and assist it (Heikkila et al., 2016). Nowadays, businesses are required to innovate their business models by creating sustainable value on its economic, social, and environmental levels (López-Nicolás et al., 2021). The TLBMC thus constitutes a tool which provides a full understanding of the business model of a company, includes the three levels previously mentioned and that support sustainability-oriented BMI (Joyce & Paquin, 2016). More specifically, the economic layer consists of the Business Model Canvas proposed by Osterwalder & Pigneur (2010), which distinguish nine modules which are interrelated with each other, being these: customer value proposition, segments, customer relationships, distribution channels, key resources, key activities, partners, costs and revenues. Moreover, Joyce & Paquin (2016) describe the aim and composition of the aforementioned two other layers of the business model, the environmental and the social. These authors state that the former has as its main purpose to assess how a firm can produce further environmental benefits than environmental effects and encompasses functional value, materials, production, supplies and outsourcing, distribution, use phase end-of-life and environmental impacts and benefits; the latter attempts to capture what are the key social impacts of the organization that derive from its relationships; and its components are social value, employee, governance, communities, societal culture, scale of outreach, end-users and social impacts and benefits.

We consider that there are several BMI objectives that not only do focus on specific areas of the business model, but they also drive firms to collaborate with other stakeholders. The IAC may be a way for achieving BMI and for generating synergies both for industry and for academia (Arshed et al., 2022). In fact, among the main benefits resulting from this collaboration, we can remark the emergence of general solutions to issues related to products or service offering, which encourages innovation in the business model (Sjöö & Hellström, 2021). For achieving this, (Vico et al., 2015) find as the main reasons to start a collaboration the following: assistance

in problem solving, provision of specialized services, patent generation and introducing innovations (e.g., new products, processes, findings from research, etc.).

In this research, several BMI objectives have been classified within the different layers of the TLBMC to determine which of them encourage the company to collaborate with universities or IAC. Specifically, Table 1 shows to which business model dimension and layer the analyzed BMI objectives would correspond – remarking that most of the objectives are linked to the dimension of value creation.

Table 1: Integration of dimensions layers of business model and business model innovation objectives

Dimension	Layer	BMI Objective
Value creation	Economic	Expand the grade of good and services
		Replace obsolete products or processes
		Improve quality of goods or services
		Improve flexibility for producing goods or delivering services
		Increase the capacity of producing goods or delivering services
	Environmental	Reduce material per unit of output
		Reduce energy per unit of output
		Reduce negative environmental impacts/ deliver environmental benefits
		Improve public health, safety or security
		Comply with mandatory regulations
	Social	Total employment growth
		Increase in qualified employment
		Maintenance of employment
Value delivery	Economic	Enter new markets
		Increase market share
Value capture	Economic	Reduce labour costs per unit of output
	Environmental	Reduce energy per unit of output
		Reduce negative environmental impacts/ deliver environmental benefits
		Improve public health, safety or security
		Comply with mandatory regulations

Source: Own ellaboration based on Joyce & Paquin, (2016) and OECD & European Comission, (2018)

3 Methodology

Our dataset comes from Spanish Community Innovation Survey (CIS). The CIS questionnaire is extensively used in most European countries, especially in the UK, France, Spain, and Italy (e.g., Aronica et al., 2022; Evangelista & Vezzani, 2010; Ganter & Hecker, 2013; Hervas-Oliver et al., 2014, 2015; Lubacha & Wendler, 2021; Wei et al., 2022) but also considered the most influential innovation questionnaire even in non-EU countries (Wei et a., 2022). It has become an interesting source of research data to study complementarities between different forms of innovation (Ballot et al., 2015). This survey, conducted by the Spanish National Statistics Institute, provides information about the innovation process, its structure, the relationships between that process and firms' technological strategy, the factors affecting their capability to innovate and companies' performance. The respondent units (companies) are sent a letter of presentation of the survey, which includes the user and password for online completion. Since 2013, access to web completion is carried out via the secure protocol page https://iria.ine.es. Once this letter has been received, companies have a period of 15 days to complete and send the questionnaire. The Statistics Institute establishes an initial telephone contact with the company to check that the questionnaire has been received. If the completed questionnaire has not been received by the deadline, the necessary telephone and written complaints will be made. The monitoring of the data collection schedule and the quality control of the information has been carried out by Statistics Institute's Central Services. The response rate was 93,17 percent.

The 2016 survey addressed innovation activity for the period 2014-2016. The sample for that period consisted of 7,638 companies with a minimum size of 10 employees operating in different sectors (agriculture, construction, industry, commerce, and services). When using CIS data, a potential bias may arise related to the sample selection problem. Because of the CIS questionnaire structure, some variables regarding innovation are available only for firms which have introduced at least one process or one product innovation. This may create a selection bias if the econometric analysis is limited to that sub-sample of companies which is likely to be not randomly drawn from the larger population. This type of bias may distort coefficients. As in other studies (Evangelista & Vezzani, 2010), the choice of variables used here and our estimation strategy allows us to include all the firms present in the CIS sample, avoiding the selection bias problem mentioned.

A description of variables included in the analysis is given in Table 2. All of them comes from Oslo Manual (OECD & European Comission, 2018; OECD & Eurostat, 2005).

Table 2: Variable in the analysis

Variable	Scale
Dependent variable: Industry-Academia Collaboration (in the 2014-2016 period)	Dummy variable (1=collaboration, 0=non-collaboration)
Independent variables: Importance of business model innovation objectives	Continuous variables from 1 (noimportance) to 4 (high importance)
Economic objectives: - Wider range of goods or services (OBJ_1) - Substitution of outdated products or processes (OBJ_2) - Penetration into new markets (OBJ_3) - Increased market share (OBJ_4) - Higher quality of goods or services (OBJ_5) - Greater flexibility in production or service provision (OBJ_6) - Greater production capacity or provision of services (OBJ_7) - Lower labour costs per unit produced (OBJ_8) - Less materials per unit produced (OBJ_9) - Less energy per unit produced (OBJ_10) Specifically, objectives 1 to 5 refer to "product innovation" and objectives 6 to 10 refer to "innovation in process".	1-4 interval
Environmental objectives: - Less environmental impact (OBJ_11) - Improved health and safety (OBJ_12) - Compliance with Environmental, Health or Safety Regulatory Requirements (OBJ_13)	1-4 interval
Social objectives:	1-4 interval

- Increase in total employment (OBJ_14)
- Increase in qualified employment (OBJ_15)
- Maintenance of employment (OBJ_16)

Control variables	
Firm year	Dummy variable: 0= mature company (more than 10 years); and 1= young company (up to 10 years).
Firm sector	Continuous variable that takes the values: 0=Agriculture, 1=Industry, 2=Construction, 3=Commerce and 4=Services)

4 Results

Before stimating the regression model, ANOVA tests were carried out. Although not presented here due to extension limits, ANOVA results show the importance that companies give to BMI objectives depending on whether or not they collaborate with universities in the 2014-2016 period. In general, the means obtained in each objective are higher when the company collaborates with a higher education institution. In addition, these means are especially high regarding economic objectives –both those referring to product innovation and to process innovation. Going further, the differences in means are statistically significant in all objectives. This allows us to affirm that the importance that companies give to innovation (economic, environmental, and social) objectives are greater when the organization collaborates with the university compared to those firms which do not collaborate with higher education institution.

Table 3 shows the results of the hierarchical logistic regression. The dependent variable in all the models is the company-university collaboration, while the independent and control variables vary depending on the model; in particular, Model 1 includes the constant and firm age; Model 2 adds the sector; and Model 3 adds economic, environmental, and social objectives. Focusing on Model 3 (which is the one that includes BMI objectives as independent variables), we obtain that the seven

objectives that statistically contribute to collaboration between companies and universities are: (i) wider range of goods or services; (ii) penetration into new markets, (iii) increased market share; (iv) less environmental impact; (v) improved health and safety; (vi) increase in total employment; and (vii) increase in qualified employment. Among them, we appreciate how three are economic objectives (all of them related to product innovation), two are environmental objectives, and the remaining two are social objectives.

Table 3: Hierarchical Logistic Regression

	Collaboration with universities		
	Model 1	Model 2	Model 3
Wider range of goods or services (OBJ_1)			0.170***
Substitution of outdated products or processes (OBJ_2)			-0.058
Penetration into new markets (OBJ_3)			0.186***
Increased market share (OBJ_4)			-0.154**
Higher quality of goods or services (OBJ_5)			0.085
Greater flexibility in production or service provision (OBJ_6)			0.000
Greater production capacity or provision of services (OBJ_7)			-0.017
Lower labour costs per unit produced (OBJ_8)			-0.023
Less materials per unit produced (OBJ_9)			-0.040
Less energy per unit produced (OBJ_10)			0.111
Less environmental impact (OBJ_11)			0.379*
Improved health and safety (OBJ_12)			-0.063***
Compliance with environmental, health or safety regulatory requirements (OBJ_13)			-0.034
Increase in total employment (OBJ_14)			-0.250***
Increase in qualified employment (OBJ_15)			0.467***
Maintenance of employment (OBJ_16)			0.103
Firm year	0.520	0.500	0.598
Constant	-1.436***	-1.429***	-3.761***
Sector Control	No	Yes	Yes
Chi-squared (model)	2.114	47.778***	433.795***
R-squared	0.001	0.017	0.146

5 Conclusions

As highlighted at the beginning of this paper, the study of IAC requires further analysis to discover how to improve the innovation processes that can be developed. The results show that there are essential benefits at a business level when the company actively collaborates with the academic world, demonstrating how unity is a strength and allows better results to be achieved than when this collaboration is not carried out (Yi et al., 2022). There is no doubt that the company has a deep understanding of the needs of its customers as it has developed its products precisely to meet those needs (Keiningham et al., 2020). But academia also has much to offer to complement this activity as it is responsible for analyzing in detail the cognitive processes by which customers decide to purchase one product rather than another from among those available in the set under consideration (Wijekoon et al., 2021). In the academic world, this is usually carried out with experimental studies with subjects and nowadays it is very common to analyze aspects of neuromarketing applied to the marketing of new products (Kansra et al., 2022).

In this vein, we observe how IAC is fundamental when it comes to achieving innovation objectives related to the development and launch of new products on the market (Liu et al., 2022). Analogously, we see how the study results demonstrate that IAC is very useful for penetrating new markets and increasing market share (Canabal & White, 2008). Companies collaborating with universities have probably benefited from all the predictive models of new product adoption that have long been developed in academia (Rogers, 2003). Researchers devote significant effort to understanding how a new product can reach the market earlier and better than the product with which it competes (Suarez et al., 2015). In fact, the modelling of consumer adoption processes developed by academics is becoming increasingly complex.

We also see how the results clearly demonstrate the impact on employment aspects through IAC. In this way, objectives related to improving employment and job quality are actively promoted when a business collaborates with academia (Mohammadi et al., 2017). This is undoubtedly a fundamental fact that should be actively considered from a governmental policy point of view. Companies require a skilled workforce but at the same time a workforce that matches the specific skills demanded by these organisations (Schweisfurth & Raasch, 2018). The academic

world must try to adapt its teaching processes, learning methodologies and contents to the business reality. Our results show that this IAC could have significant social implications in this sense.

However, we also find that other innovation objectives have not shown significant results from IAC. It is, therefore essential to further explore how to improve IAC to better design collaborative business models that allow for fewer materials per unit produced or greater flexibility in production or service provision (Heirati & Siahtiri, 2019). In the same way, longitudinal studies on these collaborative processes could shed light on the barriers that may exist in these types of collaborations that are difficult to analyze in cross-sectional studies (Bitetti & Gibbert, 2022). To this end, it is essential to support initiatives at the European level to develop platforms that favour IAC. A clear example of this is the venture alliances platform (https://www.venturealliances.eu) that, for the last year has been helping companies and academics to find the right partner so that they can achieve innovation objectives that to date, have been studied in isolation between industry and academia. This work also reveals the need to replicate this work in other countries to verify the benefits of collaboration and how it contributes to improving the development of new products, processes, and innovative and sustainable business models.

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