

Article

# Family Involvement in Management and Product Innovation: The Mediating Role of R&D Strategies

Julio Diéguez-Soto <sup>1</sup> and María J. Martínez-Romero <sup>2,\*</sup> 

<sup>1</sup> Faculty of Economics and Business, Universidad de Málaga, 29071 Málaga, Spain; jdieguez@uma.es

<sup>2</sup> Faculty of Economics and Business, Universidad de Almería, 04120 Almería, Spain

\* Correspondence: mariaj.martinez@ual.es

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**Abstract:** Following calls to capture family firms' innovative behavior and to specifically clarify how family firms manage product innovations to achieve sustainable economic development, this study empirically investigates the mediating role of Research & Development (R&D) strategies (i.e., intramural R&D investments, extramural R&D investments, and the combination of both intramural and extramural R&D investments) in the relationship between family involvement in the management and likelihood of obtaining product innovations. Carrying out a panel data analysis that is based on 7264 observations of Spanish manufacturing firms throughout the 2000–2015 period, our results suggest a negative effect of the level of family management on the likelihood of introducing product innovations. Moreover, we found that intramural R&D investments and the investment strategy consisting of both intramural and extramural R&D mediated the family involvement in management-likelihood of obtaining product innovations relationship. Our findings contribute important insights to the comprehension of which determinants instigate product innovation in family managed firms.

**Keywords:** product innovation; family management; R&D investment; intramural R&D; extramural R&D

## 1. Introduction

According to the Oslo manual conceptualization [1] (p. 48), product innovation can be defined as “both the introduction of new goods and services and significant improvements in the functional or user characteristics of existing goods and services”. The existing research indicates that, in a world increasingly featured by turbulence, frenetic competition, and temporary advantages [2], product innovation becomes crucial in sustainable long-term performance and firm's competitiveness [3]. Nevertheless, product innovation efforts usually involve significant risks that are due to the irreversible expenses incurred and the uncertain future payoffs [4,5].

Family businesses really do matter to the world economy. Family firms represent two-thirds of all firms worldwide, creating approximately 70–90% of annual global Gross Domestic Product (GDP), and providing 50–80% of employment around the world [6]. In Europe, these types of businesses generate around 50% of GDP and they create more than 60 million jobs in the private sector [7]. Furthermore, there are solid motives to support that family involvement influences how resources are managed and deployed [8], as it implies peculiar incentives [9,10], authority structures, and accountability norms [11]. In this regard, families can be involved in a firm through ownership or through management. Family involvement in ownership reflects family participation in the firm property; meanwhile, family involvement in management reflects family participation in strategic decision-making [12]. In any case, family involvement entails unique strengths, such as tacit knowledge or social capital, and weaknesses, as, for instance, nepotism and altruistic behavior [13,14], which may

relevantly impact on the features of product innovation in family firms. Thus, family involvement may be essential in differentiating family and non-family firms regarding product innovation [15].

Nevertheless, family firms are a heterogeneous group [16], and there is also a need for making a comparison between them [17]. A major source of these firms' heterogeneity stands in the extent to which family members occupy the upper echelon positions [18]. Specifically, high or low family involvement could feature the top management team of the firm [19]. The level of family management may directly influence the way in which product innovation is conducted. Therefore, family involvement in management affects the way in which the strategy is planned and developed [20], and it provides a peculiar ability to dynamically orchestrate resources [21], influencing innovation processes [4,22].

The scarce empirical findings regarding the influence of family management on product innovation in public firms are mixed: family management has been shown to have a positive effect on patent counts and the subsequent citation of patents [23], but it has also been confirmed to exert a negative effect on the patent counts [24]. For private firms, according to our knowledge, until now prior empirical literature has not explored how product innovation is related to family involvement in management, thus offering us the opportunity to examine this interplay. In short, notwithstanding the importance of this topic, no studies have empirically investigated the mechanisms and antecedents of product innovation in private family managed firms to date. Hence, we answer the call for the study of family firms' innovative behavior while taking into account their heterogeneity in terms of management [25]. We also respond to the specific call to clarify the way in which family firms manage product innovations, inasmuch as it continues to be an overlooked topic in already published business research [15].

By drawing on the socioemotional wealth (SEW) approach [26,27], we address this gap in the research by analyzing how the level of family management affects the likelihood of introducing a product innovation through intramural (in-house R&D or internal R&D) and extramural R&D spending (R&D outsourcing or extramural R&D) as the mediating variables. We also examine the mediating effect of the investment strategy that simultaneously combines both intramural and extramural R&D in the family management-product innovation relationship. The function of intramural R&D as a source of innovation is indisputable [28], extramural R&D has been recognized as crucial for sustained success in product innovation [29], and the combination of both intramural and extramural R&D has been identified as a successful strategy in obtaining product innovations [30]. However, research regarding innovation in private family firms has overlooked not only how the presence of family members in top management teams influences product innovation, but also the mediating role of R&D processes that underlie the introduction of product innovations, making it difficult to appreciate why some family firms demonstrate more innovative attitudes and behavior than others.

According to the Oslo Manual [1] (p. 97), intramural (in-house) R&D is the "creative work undertaken on a systematic basis within the enterprise in order to increase the stock of knowledge and use it to devise new applications. This comprises all R&D conducted by the enterprise, including basic research". On the other hand, the acquisition of extramural R&D comprises the "same activities as intramural R&D, but purchased from public or private research organizations or from other enterprises (including other enterprises within the group)".

This paper makes several contributions. Specifically, we first explore the relationship between family involvement in management and the likelihood of introducing product innovations in private firms, advancing the understanding on how, why, and to what extent the level of family management influences product innovation in non-quoted firms. Second, we offer insights into how the degree of family involvement in management produces heterogeneity in the likelihood of introducing product innovations. Third, we focus on R&D investments as a mediating factor that helps to explain the relationship between family management and product innovation in a private firm context. To the best of our knowledge, none of the prior studies investigating the role of R&D investment in family firms had used it as a mediator.

Utilizing a balanced and longitudinal dataset that was made up of 7264 time-series cross-sectional observations, which consisted of 454 Spanish firms over the period 2000–2015, carried out the empirical analysis. We test the theory using data on Spanish manufacturing firms from the database ESEE (Survey on Business Strategies).

The paper is structured, as follows: We start with a brief theoretical discussion of product innovation in family firms and of the relationship between R&D investments and product innovation. We derive hypotheses and empirically test them. We present the empirical results and conclude with a discussion of the implications of our research.

## 2. Theory Background

### 2.1. Product Innovation in Family Firms

To date, there has been little research regarding product innovation that is generated in family firms [31,32]. In the context of public firms, some studies identify a negative relationship between family involvement and product innovation [24,33,34], while other investigations appear to show the contrary [23,35]. In this vein, the presence of a family controlling shareholder as a CEO or as a chairman of the board has been demonstrated to be negatively associated with the quantity and the quality of the patents received due to the concentration of power affects the flow of corporate resources toward innovation [33]. Moreover, firms where the capital shares are broadly distributed file *ceteris paribus* more patents than other companies, such as family firms [34]. Besides, family managed firms receive fewer patent citations when compared to other firms, while controlling for R&D spending [24]. However, family management has also been demonstrated to positively moderate the relation between internationalization and the number of patents that were granted to a firm [35]. Likewise, family participation in management has been revealed to have a positive influence on product innovation, being captured by relying on patent counts and the forward citation of patents [23].

Studies addressing product innovation on private family firms are even more scant. Family firms initiate (discussion of ideas for new products and services) and implement (introduction of new product and services) more product innovation than the non-family firms due to their unique characteristics that are related to innovation [36]. Furthermore, family firms demonstrate a better ability to facilitate environmentally friendly firm policies that are associated with enhanced firm innovation than non-family firm [37]. Finally, family firms surpass non-family firms with respect to the percentage of new products that are also new to the market [38], inasmuch as family businesses with great technical staff and high degree of cooperation yield new products according to the clients' requirements.

### 2.2. R&D Investments and Product Innovation

R&D investments lead to various firms' benefits given the importance of successful innovations, such as product innovations, to improve the firms' abilities to compete and survive [39–41]. R&D investments have the potential for generating technological innovations that are able to transform enterprises and industries [42,43]. Thereby, R&D expenses could help to develop sustainable competitive advantage and enhance firm performance [44].

The importance of R&D investments in obtaining innovation outcomes has been widely analyzed in the previous literature [45–47]. One solid result is that the probability of being an innovator is positively linked to the R&D intensity [48,49]. However, it might be the case that the firms do not innovate despite engaging in R&D, meanwhile others are innovators without investing in R&D [50].

In this vein, R&D intensity has an important effect on the firms' ability to obtain product (and also process) innovation [48]. Moreover, firms that are in R&D have a greater possibility of realizing product innovation [49], also for the case of small and medium enterprises [50]. Thus, there is clear evidence that R&D investments are needed to successfully develop new products and services [51].

R&D activities that were performed by organizations include intramural R&D as well as extramural R&D [1]. Intramural R&D consists of all R&D performed within the organization and

extramural R&D embraces the purchase of R&D services [1,52]. On the one hand, the role of intramural R&D as a source of innovation is undisputed [28,53,54], inasmuch as it creates firm-specific knowledge, absorptive capacity, and integrative capabilities [21,53,55]. On the other hand, extramural R&D, which has gradually increased since the 1980s [56–58], has been identified as a crucial factor for sustained success in both product and process innovation [29], because it works as an instrument to achieve knowledge resources [59,60] and it increases firms' efficiency [28,61], allowing for potentially improving their innovation performance [62–64].

Furthermore, some studies highlight that extramural and intramural R&D could be complementary activities in the firm's innovation strategy [55,65]. In this way, organizations that complement intramural with extramural R&D activities could better assess and adopt knowledge from the external environment [61]. Furthermore, the higher the internal capabilities of the organization, the greater the consequences of extramural R&D strategies on innovation outcome [58]. Nevertheless, although most studies have demonstrated that intramural and extramural R&D are complementary innovation activities [66,67], and that extramural R&D may stimulate rather than substitute own R&D activities [68–71], there is also a stream of research that has found no complementarity, or even substitutability, among these activities [72,73]. In any event, those businesses that use both intramural and extramural R&D strategies are more successful in obtaining product innovations [30,47,74].

Finally, in the family firm context, it has been generally argued that family firms usually decrease the level of R&D intensity [75,76]. However, the influence of family management on R&D intensity is not as obvious: while some authors found a negative impact of family managers on R&D [44], others found higher R&D intensity in family managed firms [77]. There is only one study that specifically analyzes the influence of family management on extramural R&D investments, revealing that family managers are more reluctant to engage in external technological acquisitions than their nonfamily counterparts [29].

Lastly, the joint study of R&D investment and the acquisition of product innovation in family firms is also an understudied issue in extant research. Some authors reached the conclusion that family management has a negative effect on R&D intensity and a positive influence on innovation output [23]. In line with the above, there is evidence revealing that family firms invest less in innovation, but they are more efficient in their conversion of innovation input into output, achieving higher levels of innovation output than their nonfamily counterparts [78]. Conversely, there are also studies showing that family management negatively moderates the relationship between R&D and technological innovation [79,80].

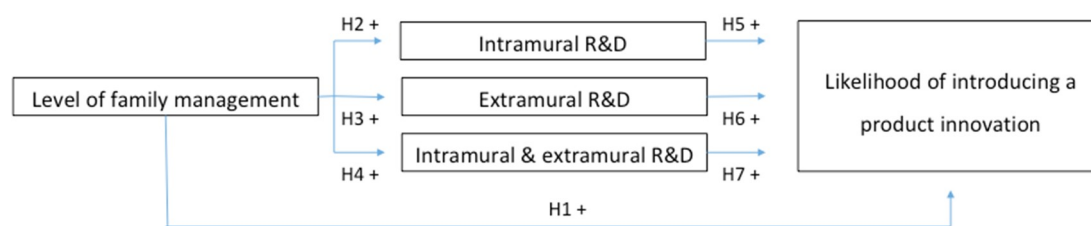
Therefore, due to the scarce and controversial findings in the relationships between family management and innovation success in family firms, deepening in the abovementioned connection seems necessary. Thus, our thesis is that the mediating effect of R&D intensity in the relationship between family management and the probability of introducing a product innovation needs clarification in terms of two specific expenses: extramural R&D expenses and intramural R&D expenses.

### 3. Hypotheses Development

Figure 1 represents our theorized model for the relationships among the level of family management, the likelihood of introducing product innovations, and the intramural R&D/extramural R&D/intramural and extramural R&D strategy.

This epigraph elaborates on the hypothesized relationships. By drawing on the SEW view, we begin by theoretically building our model by creating a direct relationship between the amount of family management and the probability of introducing product innovations. We then suggest direct relationships between the level of family management and intramural R&D, extramural R&D, and the combination of both intramural and extramural R&D. In this regard, the level of family management may condition how and to what extent family firms take potential gains or losses of SEW as their main frame of reference, shaping the business behavior and decision making [81,82] Subsequently, we

analyze the hypothesized mediating effects of intramural R&D, extramural R&D, and the combination of both types of R&D on the likelihood of introducing a product innovation.



**Figure 1.** Theoretical model for the relationships between level of family management, likelihood of introducing product innovations, and intramural R&D, extramural R&D, and intramural & extramural R&D strategy.

### 3.1. Family Management and the Likelihood of Introducing Product Innovations

Findings regarding the influence of family management on product innovation remain scarce, inconsistent, and controversial. Regarding public firms, some scholars showed a detrimental interplay between family management and both patent counts and their forward citations [24], meanwhile others researchers found opposite results [23]. On the one hand, family managed firms develop innovations with low economic and technological relevance as they are inclined towards nepotism and entrenchment, and because these firms often suffer from a scarcity of CEO expertise that restricts the human resource available to manage complex innovations [24,83]. These disadvantages are supposed to be more marked as the level of family management increases. On the other hand, the more family members are involved in management, the more efficient the firms in exploiting their innovation inputs are, because they are more likely to be involved in valuable and unique processes of social capital building and they are more focused on their innovation activities [23].

A recent meta-analysis has highlighted that family firms conduct towards the development of specific resources and capabilities that enhance the innovation process, due to their desire to maintain control and the pursuit of non-financial goals [78]. In particular, and if we borrow that meta-analysis' arguments [78] regarding family CEO-innovation output relationship, we may expect that, as the degree of family management augments, family managed firms have an increased willingness and ability to efficiently monitor the innovation process due to the greater alignment of long-term aims and interests between owners and managers. Furthermore, as the level of family management increments, the firms are more able to access to long-established, trust-based relationships with customers, suppliers, and other (family) firms, which is quite favorable for obtaining product innovations. Finally, as family managers increase, the more likely they are to have superior knowledge, namely tacit knowledge, regarding their business' staff, routines, and stakeholders, which also foster the likelihood of achieving product innovations.

Therefore, and although the literature on the level of family management-product innovation relationship in private firms, as far as we know, is non-existent, based on the immediate former arguments [78], we postulate the following hypothesis:

**Hypothesis 1 (H1).** *The higher the level of family management, the higher the likelihood of introducing product innovations.*

### 3.2. Family Management and Intramural R&D Investments

Family managed firms have motives to undertake intramural R&D projects. As the level of family management increases, long-term considerations, such as transgenerational intentions, wealth creation, and extended horizons, will prevail in family managed firms. The long-term orientation crates family managers tackling investments with longer payback periods [84,85], which augment the productivity, allows for maintaining competitive advantages, and in the end, increase the firm value [86].

Furthermore, the higher the family management, the larger the importance given to non-economic family centered goals. These non-economic goals force family managers to protect their accumulated endowment of socioemotional wealth and to guarantee the firm's transfer to their offspring [87]. Family managers' longer investment horizons, along with their emotional attachment to their business, generate a greater environment of trust and higher communication flow [88], increasing the commitment of staff by contagion [89] and facilitating increased intramural R&D investments. Accordingly, as family presence in the firm management augments, family executives will have a special interest in perpetuating the family dynasty, and thus will increase their influence on intramural R&D decisions. That is, whether family managers are focused on the long-term survival of the firm, they will not develop opportunistic behavior and self-serving manner, on the contrary, they will place higher emphasis on strategies that guarantee the firm's future competitiveness and sustainability [90]. Thus, as the family managers increase, their intentions for transgenerational succession will be greater, making them less risk averse and thus more willing to invest in intramural R&D [75]. Consequently, as family management increases, family-managed firms will be less likely to seek short-term earnings by reducing projects with a longer payback time [91], such as investments in in-house R&D projects [92]. From the above literature, we propose the following hypothesis:

**Hypothesis 2 (H2).** *The higher the level of family management is, the higher the intramural R&D investments are.*

### 3.3. Family Management and Extramural R&D Investments

A higher presence of family managers decreases the likelihood of opportunistic behavior when R&D contracting, increasing the credibility of their social relationships [93], and leveraging their personal social network for the firm [94]. Family managed firms' social network, where reciprocal family bonds are often extended beyond the family itself, becomes an essential technological source through which businesses can gain access to R&D outsourcing [95]. Consequently, the larger the presence of family managers, the easier the possibility of obtaining indispensable extramural R&D due to their closed and trusted social relationships, providing the firm access to resources that are not internally available. Furthermore, family managers are considered to have greater ability in recognizing opportunities and in obtaining knowledge from external sources due to their long-term perspective, non-economic objectives, and special bonds with stakeholders [96,97]. Specifically, through binding social ties with external stakeholders, family managers develop knowledge networks that are essential for their innovative capability, and consequently for their survival in the long term [98]. Certainly, despite the benefits of extramural R&D to achieve product innovation, these investments may give power to external agents over innovation process and may lead to a loss of control over innovation decision-making [29]. However, a higher family management is likely to ensure remaining in the office for longer time, having enormous latitude to set a strategic focus and owning greater vision to succeed across generation, increasing a managers trustworthiness and authority with external stakeholders and decreasing the risk aversion to engage in extramural R&D [96]. Furthermore, the greater the degree of family management, the higher the probability of having superior skills to generate capabilities from acquired extramural R&D, which can then be blended with the business' internal knowledge core [99]. Thus, we formally state:

**Hypothesis 3 (H3).** *The higher the level of family management is, the higher the extramural R&D investments are.*

### 3.4. Level of Family Management and Intramural & Extramural R&D Strategy

A higher level of family management may also stimulate the complementarity between intramural and extramural R&D. Family managers usually amplify a unique collection of economic and noneconomic family-centered goals and they influence the way in which valuable, rare, inimitable, and non-substitutable resources are managed and deployed [8]. A higher presence of family executives might involve an increased awareness of the importance that knowledge, which is one of the unique

resources in family firms, has in the guarantee of the firm survival [100]. On the one hand, family managed firms' tacit knowledge provides opportunities to generate competitive advantages [100]. On the other hand, family managed firms might experience a lack of know-how to develop certain innovation projects [101]. Consequently, family managers are induced to developed close relationships with external partners to achieve higher innovation results that ensure the firm's sustainability in the long term. In this vein, family managers are aware that extramural R&D may facilitate access to resources that are not internally available, in order to eventually launch innovative products and services. Consequently, as the presence of family managers augments, family executives will develop an open attitude toward social networks, which are advantageous for joint innovation with both internal and external partners [98,102]. In this regard, internal resources may result in being more relevant when they co-evolve with outsourced resources [60], enhancing the particular systemic conditions of the firm [88] and bettering their specific set of economic and non-economic resources and capabilities [103,104]. That is to say, the combination of both types of R&D investments becomes more attractive as family management augments, inasmuch as when intramural and extramural R&D are deployed together in an attempt to achieve a benefit for the family, the firm, and for external partners; this combination results in new capabilities for the firm. Although the objective of maintaining SEW may lead to a risk averse behavior regarding the strategy that combines intramural and extramural R&D, as family management increases, the likelihood of extending the timeline over which R&D choices are framed will be higher [75], as well as the managers' credibility and influence over stakeholders [96]. Therefore, as family management augments, the probability of combining intramural with extramural R&D will be higher, entailing a paramount opportunity to enhance firms' product innovations, and in the end, firms' continuity.

Based on the former arguments, we therefore propose:

**Hypothesis 4 (H4).** *The higher the level of family management is, the higher the investments combining both intramural and extramural R&D are.*

### 3.5. The Likelihood of Introducing Product Innovations and Intramural R&D Investments

Intramural R&D spending is often recognized as a source of long-term benefits to the firm [105,106] and as a prerequisite for generating new or enhanced products and/or technologies [77]. Thus, the function of intramural R&D activities as a source of innovation is indubitable [28], either because the absorptive capacity is closely related to realizing intramural R&D efforts [55] or due to intramural R&D is contemplated as a dynamic capability that refocuses a business's knowledge base using iterative learning processes [107,108].

Combining the hypothesized relationships between the level of family management-likelihood of introducing product innovations (H1), family management-intramural R&D (H2), and the previously argued intramural R&D-likelihood of introducing product innovations, we suggest that in-house R&D is a relevant overlooked mediator in the family management-product innovation relationship.

Therefore, we propose that:

**Hypothesis 5 (H5).** *Intramural R&D investments positively mediate the relationship between the level of family management and the likelihood of introducing product innovations.*

### 3.6. The Likelihood of Introducing Product Innovations and Extramural R&D Investments

The strategy consisting of outsourcing R&D to contract research and technology in order to improve products is not modern [109,110]. R&D outsourcing, by exploiting certain benefits that are connected with the essence and objective of extramural R&D contractors, augment firm efficiency and decrease the development time and costs. The accomplishment of extramural R&D also shares risks and enhances innovation by accessing important resources that are unavailable internally [28,111]. Extramural R&D spending improves the firm's knowledge stock and takes advantage of external

technical resources [112,113], which consequently increases innovation success [114]. In fact, this sort of R&D has significantly grown in relevance [57] and it represents an important portion of the firms' total innovation expenditures [115]. In short, opting for extramural R&D appears as a decision that allows for potentially enhancing the likelihood of introducing a product innovation.

Adding up the relationships between the level of family management and the likelihood of introducing product innovations (H1), extramural R&D investments (H3), and the hypothesized relationship between outsourcing R&D and the likelihood of introducing product innovation, we suggest that extramural R&D constitutes an important unstudied mediator in the family management-product innovation relationship. The following hypothesis reflects this reasoning:

**Hypothesis 6 (H6).** *Extramural R&D investments positively mediate the relationship between the level of family management and the likelihood of introducing product innovations.*

### 3.7. The Likelihood of Introducing Product Innovations and the Combination of Both Intramural and Extramural R&D Investments

Only concentrating efforts on intramural R&D and internal capabilities and routines is no longer enough to deal with a more and more competitive environment demanding lower costs, shorter product life cycles, and higher technological intricacies [61]. Organizations are relying on both intramural and extramural R&D to successfully develop new products and services [66,116], because these knowledge combinations usually imply greater competitive advantage and inimitability [28]. Thus, there has been prior literature showing that extramural R&D expands the effectiveness of intramural R&D in obtaining innovation success [51,66], and also the converse effect, highlighting the relevance of absorptive capacity [55]. In other words, being an expert 'buyer' also demands being a skillful "maker" [117]. Consequently, the importance of complementing internal with extramural R&D has rapidly grown in the last decades [118].

In short, while prior literature suggested that a higher level of family management will enhance the likelihood of introducing product innovation due to superior family managers' willingness and the ability to efficiently monitor the innovation process [78], we argue that this may specifically occur due to their ability and willingness to combine intramural and extramural R&D, that is, due to the mediating effect of the firm innovation strategy consisting of simultaneously engaging in both intramural and extramural R&D. Accordingly:

**Hypothesis 7 (H7).** *The investment strategy combining intramural and extramural R&D positively mediates the relationship between the level of family management and the likelihood of introducing product innovations.*

## 4. Methods

### 4.1. Sample

The dataset that was used for this study was drawn from Encuesta Sobre Estrategias Empresariales (Survey on Business Strategies, ESEE), a yearly survey conducted by the Spanish Ministry of Industry through the SEPI Foundation since 1990. The ESEE is designed for being representative of Spanish manufacturing firms. The sample covers the population of Spanish manufacturing firms with 200 or more employees, and smaller companies with more than 10 employees are selected on the basis of random sampling scheme in the initial year. In the following years, businesses leaving the original sample are substituted with businesses of like characteristics based on the sampling procedure that is utilized in the base year, so as to avoid decreases in population coverage throughout sectors and size segments. Thereby, the dataset emulates the entry and exit process that occur in the economy, and it is valid to content sufficient degrees of performance and business risk. Moreover, the overall rate of response varies throughout the years, approximately ranging between 81 and 95%; then, nonresponse bias is not of an important concern. The quality of the data is also guaranteed by the data collection



process, which requires multiple firm members. Indeed, this database has already been utilized in past innovation, management, and family businesses studies [119,120].

As we are interested in the firms' likelihood of introducing product innovations, a focus on manufacturing industries is regarded as suitable, to the extent that the typically high level of obsolescence of manufacturing firms' products makes them specifically willing to draw on innovation. Moreover, even though families operate in a wide array of firms, family firms are especially usual in manufacturing industries [121,122].

The full sample included 5040 firms (see Table 1). An ESEE question regarding whether the firm is publicly listed allowed for us to focus on private firms. After disconsidering observations with missing data, we acquired 7264 time-series cross-sectional observations, comprising 454 firms functioning in twenty distinct manufacturing sub-industries throughout the period 2000–2015.

As shown in Table 1, in consideration of size, most of the sample firms were small and medium, 47.22% and 20.51%, respectively, against the 32.26% that were classified as large firms.

**Table 1.** Distribution of firms by size (2015).

<b>Panel A. Number of Observations/Firms by Size (2015)</b>				
	<b>Initial Sample</b>		<b>Final Sample</b>	
Small firms	591	50.29%	214	47.22%
Medium-size firms	320	27.23%	93	20.51%
Large firms	261	22.21%	147	32.26%
Without classification	3,867			
Total	5,040		454	

Note: Small, medium and large firms have been classified following the criteria of European Commission (2003/361/CE, 6th may). The number of employees has not been taken into account.

## 4.2. Measures

### 4.2.1. Dependent Variable

Likelihood of introducing product innovations. Product innovation occurs when a firm introduces completely new products, or products with new functions, important modifications, or changes in their designs, presentations, materials, or compositions. Thus, a dummy variable was used to capture whether or not a firm introduced innovations in product functionalities and/or design [120,123,124].

### 4.2.2. Independent Variables

We establish two additional measures: intramural R&D intensity and extramural R&D intensity to measure the distinct effects of intramural and extramural R&D expenses on the likelihood of introducing product innovation. We consider those investments devoted to promote R&D activities within the confines of the firm as intramural R&D, while extramural R&D are those that were carried out by agents operating externally.

Intramural R&D intensity is measured as the ratio between intramural R&D expenditures and total sales [28,65]. This measure acts as a proxy of absorptive capacity [29,125] to the extent that the sourcing decisions might be affected by the firms' capacity to absorb new capabilities [55].

Extramural R&D intensity is measured as the ratio of extramural R&D spending to total sales [29,65], focusing on the total expenses that were made by a firm to buy R&D services from other organizations, such as universities, suppliers, competitors, and public research organizations.

Moreover, we also created a variable Intramural&Extramural R&D intensity, which encompasses intramural and extramural R&D intensity of those firms that simultaneously develop both investments. All of the firms that do not meet this condition are coded with 0, making the variable left-censored. We used a continuous approach that identifies those firms that combines intramural and extramural R&D expenses at once [51,61].

Family management. Family managed firms usually pursue family and noneconomic goals besides purely financial objectives [26,81,126]. Thus, their way of addressing (product) innovation might be different from that of their non-family managed counterparts [31,79]. In this study, we adopt an objective measure of family influence, that is, for all of those firms that are family owned the database establishes the number of owners and owner's relatives who occupy top managerial positions. Therefore, in line with recent studies [29,44,127], we defined family management as a continuous variable that takes into consideration the number of family members that are involved in top management, as it can be considered a direct, objective, and suitable measurement of testing the hypotheses of this research [29,128].

#### 4.2.3. Control Variables

We control for other variables that might be significant in the model for product innovation introduction. First, we include firm age (number of years between the foundation of the firm and the observation year) and firm size (natural logarithm of sales) as the controls for organizational inertia [129]. Second, we include the return on assets ratio (ROA) at time  $t-1$  to control for overall firm efficiency [75,130]. Third, leverage (total liabilities that were provided by third parties adjusted by equity) and liquidity (current assets over current liabilities) were also incorporated to the extent that firms with greater financial resources have higher levels of financial slack to invest in new projects [79,131,132]. Furthermore, as intramural R&D might affect extramural R&D, and vice versa [30,133], in order to control the simultaneous contribution of intramural and extramural R&D, we added as control variables, in the intramural R&D equation, the extramural R&D indicator at  $t-1$ , and in the extramural R&D equation, the intramural R&D indicator at  $t-1$ . Finally, we controlled for the potential industry-level influences on innovation outcomes because of the different degrees of innovation propensity that they might have [79,119]. Subsequently, 20 sub-industry dummies were included in the regression models.

Table 2 provides all of the definitions of the variables used in the analysis.

**Table 2.** Variable definitions.

	Variable	Definition
1	Product Innovation	Dummy variable that takes the value 1 when, in a particular year, the firm has introduced innovations in product functionalities and/or design
2	Intramural R&D	Ratio of intramural R&D spending to total sales.
3	Extramural R&D	Ratio of extramural R&D spending to total sales
4	Intramural&Extramural R&D	The variable is set 0 if neither intramural nor extramural R&D investments are carried out and also when only intramural or exclusively extramural R&D investments are developed; thus, Intramural&Extramural R&D is truncated on the left. If the firm invests in both intramural and extramural R&D simultaneously, then the ratio of total R&D spending (intramural plus extramural R&D) to total sales is coded as a continuous variable.
5	Family Management	Continuous variable counting the number of family members involved in the top management team of the firm
6	Firm age	This value is calculated as follows: the record of the years since a firm's inception. Natural logarithm.
7	Firms size	This value is calculated as follows: the record of the book value of the total assets of a firm. Natural logarithm.
8	ROA <sub><i>t-1</i></sub>	Return on assets of the year $t-1$
9	Firm leverage	This value is calculated as follows: the total liabilities divided by the total assets.
10	Liquidity	This value is calculated as follows: the working capital divided by the total assets.
11	Industry	Dummy variables for each two-digit Nomenclature statistique des activités économiques (NACE) codes to capture the subindustry effects.

### 4.3. Data Analysis

We used the panel data regression analysis to test the hypotheses in our model. Due to the dichotomous nature of the dependent variable, i.e. product innovation, we perform a random effects probit model [124,134] to test the effect of family management on the likelihood of achieving product innovation (H1). Binary probit models are appropriate, because firms could be repeatedly sort on a binary outcome for the dependent variable [79,135], and thus individuals should be considered to share features that produce similar responses. In such a way, we control for unobserved heterogeneity or the spurious dependence between individuals [136]. We also use random-effects probit regression models to capture the relationship between the mediators and product innovation (H5, H6, and H7). Subsequently, to test the effect of family management on the continuous measurements of intramural, extramural, and intramural&extramural R&D expenses (H2, H3, and H4 respectively), we use random-effects panel data regressions.

Moreover, we follow the proposal of Baron and Kenny to check our mediating effects [137]. Four conditions have to be met for the mediation to be present: first, the independent variable will invariably have an influence on the dependent variable; second, the independent variable invariably will have an influence on the mediator; third, the mediator invariably will have an influence on the dependent variable, which is checked by analyzing the simultaneous influence of the mediator and independent variable on the dependent variable; and fourth, the influence of the independent variable on the dependent variable must be less significant than under the first situation (when analyzing the effect of the independent variable on the dependent variable), which indicates the partial mediation, or it will become non-significant when simultaneously researching the influences of the independent variable and the mediator on the dependent variable, which indicates full mediation [137].

Additionally, to perform the mediation analysis, we used Sobel tests [138] and the Monte Carlo Method to calculate the confidence intervals [139]. Due to the large scale of our dataset and being aware of Type I errors (that appears when claiming that an indirect effect exists, but it does not [140], Sobel tests are considered to be a proper choice [140,141], being commonly applied in recent research [142–144]. Likewise, Monte Carlo confidence intervals are an alternative to the construction of asymmetric confidence intervals to test for mediation [140,141,145].

## 5. Results

Table 3 provides descriptive statistics, frequencies for the categorical variable, and the correlation matrix. Table 3, Panel B, reflects that the likelihood of obtaining product innovation is reached in 22.21% of the analyzed firms. As reflected in Panel C, multicollinearity should not be a concern in our sample, because the correlations between the various items are well below the 0.80 threshold, above which multicollinearity threats could arise [146], with the exception of the correlations among intramural&extramural R&D expenses and, intramural R&D on the one hand, and extramural R&D on the other hand, which are not considered in the same regression models. Furthermore, variance inflation factor tests did not exceed 3.01 and the condition index did not exceed 3.271, also suggesting the absence of multicollinearity (results are available from the authors). Therefore, there is sufficient evidence to discard multicollinearity in the data [147]. We also conducted the Ramsey test to look for model misspecification concerns and concluded that the models were adequately specified [148].

We provide tests for our hypotheses in Tables 4 and 5, in which the causal step approach is followed [146]. In Table 4, Model 1 corresponds to the first condition of mediation. Models 2–4 in Table 4 correspond to the second condition of mediation and Models 5–7 allow for the evaluation of the third and fourth conditions [137].

**Table 3.** Descriptive statistics, frequencies, and correlation between variables.

Panel A. Descriptive Statistics										
Variable	Mean		SD							
Family Management	0.704		0.971							
Intramural R&D	0.005		0.017							
Extramural R&D	0.003		0.018							
Intramural & Extramural R&D	0.007		0.024							
Firm age	33.344		22.723							
Firm size	$1.39 \times 10^8$		$7.54 \times 10^8$							
ROA	0.11		0.155							
Liquidity	0.352		0.555							
Leverage	0.51		0.229							
Panel B. Categorical variables: Frequency										
Value/number of observations	0		1		Total					
Product Innovation	N	%	N	%	N					
	5651	77.79	1613	22.21	7264					
Panel C. Correlations										
	1	2	3	4	5	6	7	8	9	10
1. Product Innovation	1									
2. Family Management	−0.052 ***	1								
3. Intramural R&D	0.229 ***	−0.04 ***	1							
4. Extramural R&D	0.109 ***	−0.038 ***	0.306 ***	1						
5. In&Ex R&D	0.027	0.071 ***	0.884 ***	0.82 ***	1					
6. Firm age	0.077 ***	−0.031 ***	0.093 ***	0.067 ***	0.024	1				
7. Firm size	0.224 ***	−0.312 ***	0.157 ***	0.106 ***	−0.132 ***	0.325 ***	1			
8. ROA	0.013	0.0165	−0.0236 **	0.005	−0.045 *	−0.053 ***	0.013	1		
9. Liquidity	−0.031 ***	0.053 ***	0.029 **	0.052 ***	0.08 ***	0.073 ***	−0.023 *	−0.114 ***	1	
10. Leverage	−0.003	0.05	0.023 **	0.044 ***	0.094 ***	−0.125 ***	0.027 **	−0.079 ***	−0.265 ***	1

Note: Standard deviation in parenthesis; \*\*\*, \*\* and \* significant at 1%, 5% and 10%.

Table 4. Mediation of Family Management on Product Innovation.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
<i>Dependent Variable</i>	Product Innovation	Intramural R&D	Extramural R&D	In&Ex R&D	Product Innovation	Product Innovation	Product Innovation
<i>Independent variable/Mediator</i>							
Family Management	−0.0771 ** (0.0356)	0.0004 ** (0.0001)	−0.00002 (0.0002)	0.0004 ** (0.0002)	−0.079 * (0.0435)	−0.0762 * (0.0357)	−0.0808 * (0.0358)
Intramural R&D					9.5616 *** (1.7751)		
Extramural R&D						12.8205 *** (2.575)	
In&Ex R&D							10.2344 *** (1.457)
<i>Control variables</i>							
Firm Age	−0.3472 *** (0.077)	0.0007 ** (0.0003)	0.0005 * (0.0003)	0.005 ** (0.0003)	−0.3469 *** (0.0323)	−0.3529 *** (0.0769)	−0.3626 *** (0.0768)
Firm Size	0.1894 *** (0.0591)	0.005 *** (0.0001)	0.0003 ** (0.0001)	0.0002 *** (0.0001)	0.1795 *** (0.0584)	0.1792 *** (0.0327)	0.189 *** (0.0316)
ROA <sub>t−1</sub>	0.3332 * (0.1821)	0.0004 (0.001)	0.004 *** (0.0013)	0.0024 ** (0.0064)	0.3797 ** (0.1831)	0.3533 ** (0.1841)	0.3360 * (0.1835)
Liquidity	−0.0548 (0.0528)	0.0005 * (0.0003)	0.0023 *** (0.0003)	0.0005 * (0.0003)	−0.0643 (0.053)	−0.0666 (0.0534)	−0.0681 (0.0533)
Leverage	0.1083 (0.1687)	0.0003 (0.0009)	0.0027 *** (0.001)	0.0007 * (0.0008)	0.0796 (0.1689)	0.0654 (0.1696)	0.0823 (0.1694)
Intramural R&D <sub>t−1</sub>			0.173 *** (0.0074)			2.8372 *** (1.056)	
Extramural R&D <sub>t−1</sub>		0.2457 *** (0.0063)			3.0818 ** (1.0763)		
In&Ex R&D <sub>t−1</sub>				0.7766 *** (0.007)			
Intercept	−2.9948 *** (0.6629)	−0.0098 *** (0.0026)	−0.0084 *** (0.0025)	−0.0071 *** (0.0019)	−2.8188 *** (0.653)	−2.788 *** (0.6617)	−3.36408 *** (0.5581)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	6.810	6.810		6.810	6.810	6.810	6.810
Number of Firms	454	454	454	454	454	454	454
Wald chi2	129.21 *** (25)				172.96 (27)	165.55*** (27)	171.71 *** (19)
Log likelihood	−2441.511				−2419.113	−2419.435	−2418.742
R <sup>2</sup> : within		0.058	0.004	0.119			
between		0.729	0.666	0.981			
overall		0.462	0.189	0.673			

Note: Standard deviation in parenthesis; \*\*\*, \*\* and \* significant at 1%, 5% and 10%.

**Table 5.** Regression analysis results—direct effect of Intramural R&D, Extramural R&D and In&Ex R&D on Product Innovation.

	Mode 1	Model 2	Model 3
<i>Dependent variable</i>		<i>Product Innovation</i>	
<i>Independent variable</i>			
Intramural R&D	<b>9.469 *** (2.9293)</b>		
Extramural R&D		<b>12.7593 *** (3.4323)</b>	
In&Ex R&D			<b>10.2302 *** (1.4576)</b>
<i>Control variables</i>			
Firm Age	−0.3478 *** (0.952)	−0.3537 *** (0.1372)	−0.3642 *** (0.0769)
Firm Size	0.1871 *** (0.0361)	0.1863 *** (0.0367)	0.1853 *** (0.0325)
ROA <sub>t−1</sub>	0.3926 * (0.2319)	0.3656 * (0.2311)	0.3511 ** (0.3329)
Liquidity	−0.0655 (0.0691)	−0.0678 (0.0753)	−0.0654 (0.0534)
Leverage	0.0716 (0.2061)	0.0579 (0.2097)	0.0973 (0.1696)
Intramural R&D <sub>t−1</sub>		2.865 *** (1.7284)	
Extramural R&D <sub>t−1</sub>	2.1206 * (1.4374)		
Intercept	−3.0125 *** (0.7196)	−2.9739 *** (0.7316)	−2.9461*** (0.1128)
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Number of Observations	6.810	6.810	6.810
Number of Firms	454	454	454
Wald chi <sup>2</sup>	170.08 *** (26)	162.94 *** (26)	171.73 *** (25)
Log likelihood	−2421.328	−2421.703	−2416.664

Note: Standard deviation in parenthesis; \*\*\*, \*\* and \* significant at 1%, 5% and 10%. In bold, significant coefficients. Variables are defined in Table 2.

In Table 4, Model 1 reveals a negative effect of Family management on the likelihood of obtaining product innovation, not supporting Hypothesis 1. Models 2–4 analyze the impact of family management on intramural, extramural, and both intramural&extramural R&D expenses, respectively. In this case, we find support for Hypotheses 2 and 4, to but not for Hypothesis 3. Thus, family management significantly influences intramural R&D and the strategy of jointly developing intramural and extramural R&D investments, but it does not lead to extramural R&D. Model 5 and Model 7 show that the effect of family management on product innovation is mediated by intramural R&D and by intramural&extramural R&D, respectively. Thus, hypotheses 5 and 7 are supported. In both cases, the data show partial mediation [137].

Table 5 confirms the direct effect of intramural, external, and intramural&extramural R&D on product innovation, which is a necessary condition for mediation.

Hypothesis 6 is not supported to the extent that family management does not lead to extramural R&D. Thus, Model 3 in Table 4 shows that extramural R&D expenses do not mediate the relationship between family management and product innovation. In this case, conditions 1, 3, and 4 in the mediation model were supported. As stated above, family management negatively influences the likelihood of obtaining product innovation (Table 4, Model 1). Moreover, the simultaneous effect of family management and extramural R&D on product innovation is significant (Table 4, Model 6).

We also executed the regression analysis of extramural R&D over product innovation, confirming a positive and significant effect (Table 5, Model 2), as established in previous literature [61]. Nevertheless, inasmuch as the relationship between family management and extramural R&D is not accomplished, not all of the conditions are met to find mediation [137]. Specifically, the second condition is lacking, which is the direct effect of the independent variable on the mediating variable. The Sobel test confirmed non-mediation [138] (Table 6).

Table 6 reports the results of Sobel (1982) tests [138] and Monte Carlo confidence intervals [139] for all potential mediators. The z-score column contains the Sobel statistic. The mediation relationship exists and there is a significant indirect effect, if the Sobel test z-value is above 1.9 [144]. The last columns in this table contain the lower and upper limits of a 95% confidence interval on the indirect

effect while using a Monte Carlo simulation with 20,000 repetitions [139]. When considering the normal sampling errors for the analyzed coefficients, random draws from the coefficients' distributions are developed to simulate the magnitude of the indirect effect, and then a confidence interval is built from these simulations.

**Table 6.** Mediation Model Test Statistics.

Product Innovation	<i>c</i>	<i>a</i>	SE <sub><i>a</i></sub>	<i>b</i>	SE <sub><i>b</i></sub>	<i>Z</i>	Effect Ratio	MCMAM 95% CI	
Mediator: Intramural R&D	−0.07902	0.00040	0.00020	9.56161	1.77506	1.89525	−0.04858	0.00012	0.00818
Mediator: Extramural R&D	−0.07616	−0.00003	0.00023	12.82048	2.57502	−0.11074	0.00421	−0.00618	0.00544
Mediator: In&EX R&D	−0.08079	0.00044	0.00019	10.23443	1.45704	2.18860	−0.05561	0.00064	0.00866

Notes:  $z = a \times b / \sqrt{a^2 SE_b^2 + b^2 SE_a^2}$ . Effect ratio =  $a \times b / c$ . MCMAM 95% CI = 95% confidence interval for the magnitude of the indirect effect using MCMAM (Monte Carlo Method. for Assessing Mediation) with 20,000 repetitions [139].

The results in Table 4 show that intramural R&D and the joint intramural&extramural R&D expenses met the conditions for the mediating relationship between family management and product innovation, while the extramural R&D do not satisfy the requirements for mediation. The tests in Table 6 reinforce these results: the Sobel test is weakly significant for intramural R&D, insignificant for extramural R&D, and strongly significant for intramural&extramural R&D. Moreover, the Monte Carlo simulation suggests the confidence intervals of the indirect effect associated with intramural and intramural&extramural R&D are statistically significantly different from 0, which allows for us to reject the null hypothesis that these variables have no indirect effect.

Thus, these findings give strong support to Hypotheses 5 and 7, but they are not consistent with Hypothesis 6.

Therefore, intramural R&D, extramural R&D, and the joint development of intramural and extramural R&D investments lead to product innovation, but extramural R&D does not act as a mediator in the family management-product innovation relationship.

Furthermore, although we control for complementarities among intramural and extramural R&D expenses by adding alternative past R&D expenses in both equations, we also checked for multiple mediation by simultaneously introducing both mediators. The findings (not reported) were similar to those in the individual models.

## 6. Discussion

Product innovation is a major decider factor of firm performance [149] and it is quite essential in the firm's survival, competitiveness, and sustainability [150]. This is also true for family firms, which require product innovation to survive throughout different generations [151] and to achieve their goals [152]. However, the study of product innovation in the family business field has been very limited and it mainly focused on public companies. Surveys distinguishing between family and non-family firms [36–38] and family ownership [153] have served as a useful lens for examining product innovation in the scant studies that were conducted in a context of private firms. However, prior literature did not explore how such product innovation is related to the level of family involvement in management in non-quoted firms, thus giving us the opportunity to investigate not only the differences between family and non-family firms, but also the heterogeneity within the pool of family firms [104].

Our findings reveal that the level of family management negatively influences the likelihood of introducing a product innovation, which is in line with previous research hypothesizing a negative relationship between family management and patents citations [24]. Our results seem to confirm that the product innovation performance depends on hiring and maintaining greatly competent staff [154]. However, as family management increases, the level of professional executives will decrease [155]. Family managers might suffer of a lack of expertise, skills, and resources due to altruism and/or

nepotism [83]. In these situations, untalented family members without the appropriate expertise benefit, provoking an inability of the firm to retain qualified workers [8]. In short, as family management increases the dark side of SEW [156], it is more likely to limit merited human capital and intensify conflicts [157] through nepotism and the generation of jobs for unskilled family members [158], which seems to result in a reduced likelihood of introducing product innovations.

Second, this research sheds new light on the consequences of the degree of family management on product innovation, exploring the mediating effects of intramural R&D, extramural R&D, and the strategy of simultaneously investing in both intramural and extramural R&D. Our findings show that the level of family involvement in management has a positive and significant effect on in-house R&D and on the investment strategy that combines intramural and extramural R&D and, through them, exerts a positive impact on the introduction of product innovations. Therefore, this manuscript goes beyond input-output models showing that in-house R&D and the investment strategy combining intramural and extramural R&D play a mediating role in the understanding of the connection between the level of family involvement in management and the achieving of product innovations.

This study underlines the importance of R&D investments for family firms and the relevance of explicitly measuring their heterogeneity when addressing different R&D strategies, because the behaviors of family firms are more heterogeneous than those of nonfamily firms [75]. Specifically, our results support a strong effect of family management on intramural R&D spending. In this way, we extend family business literature illustrating how the level of family management increases intramural R&D investments and disentangle the mixed findings found until now regarding the influence of family management on R&D intensity—without distinguishing between intra and extramural R&D [44,77]. Our research shows that when firms decide to specifically carry out intramural R&D investments, the higher the number of family members that are actively involved in firm management, the greater the priority of long-term orientation over risk aversion [77], and in the end, the higher the spending. As family management augments, family firms seem to lose their fear of jeopardize both their firm's economic performance and their family goals, when they are making decisions regarding increasing the more controllable in-house R&D. However, there appears to be a trade-off between long-term perspective and risk aversion when making a decision concerning extramural R&D, which results in a non-significant influence of the level of family management on extramural R&D investments. The lower expected pressure of family managers to achieve short-term results and their longer investment horizons [159] might compensate for the apparent conflict between the pursuance of family-centered goals and extramural R&D investments. This confirms that firms' governance structures determine their R&D behavior. These results contribute to a better comprehension of family businesses on the whole, family managed firms in particular, and their R&D decisions.

In addition, we refined the product innovation model by introducing and testing the mediating effect of three different R&D strategies: intramural R&D, extramural R&D, and investment strategy combining both intramural and extramural R&D. In support of this thesis, we found different results for intramural and extramural R&D. Our data showed that the level of family management does not lead to increasing extramural R&D. Thus, extramural R&D does not mediate the level of family management-product innovation relationship, but it is found to be a direct antecedent of product innovation. Our findings do reveal a very important role of intramural R&D and the investment strategy in both in-house and extramural R&D, in explaining the influence of the level of management on product innovation. Particularly, we argue that, as family management increases, firms invest more in in-house R&D, because they are seen as a source of alignment between economic and family goals. The higher the level of family management, the greater the likelihood of firm awareness that failing to invest in intramural R&D results in a loss of opportunity to ensure and create future socioemotional wealth [75]. Our empirical results confirm that economic goals, far to collide with, are aligned with family goals [75,160,161], because, as family management intensifies, firms are more likely to invest more in intramural R&D and, in turn, to obtain product innovation. This type of intramural investment may be seen by family managers as a method to defend products from imitation



by rivals [21]. Furthermore, our results suggest that family managers contemplate extramural R&D as a means of obtaining external know-how that can then be applied to internal knowledge of the firm in such a way that this combination will be unique, particular to this business, and thus relevant for obtaining a better likelihood of the achievement of product innovation [8,28]. Therefore, this study also confirms the essential role of the intramural R&D investments in balancing the extramural and intramural R&D spending for a greater likelihood of introducing product innovation as the level of family management increases [61].

The findings of this study have notable implications, both academic and practical. A more nuanced comprehension of the R&D-product innovation relationship in family businesses is essential for investigators and policy planners. Scholars do not only need to consider that family firms are quite heterogeneous, but they may also address distinct R&D strategies to achieve product innovation. The fact of simply considering family firms as homogeneous firms, while only looking at the direct effects on innovation success or neglecting the indirect effects of distinct R&D strategies, may also result in over-simplistic interpretations and biased policy implications. Therefore, heterogeneity in both family firms and R&D strategies should not be disregarded when analyzing the innovative behavior of family firms. Policy makers should abandon the opinion of family business as a type of firm that is deficient in making investments in R&D. Alternatively, they should recognize that different types of family firms might carry out distinct R&D strategies to increase their likelihood of achieving product innovation. Likewise, this study highlights the relevance of R&D investments in introducing product innovations. The significant mediating effect of intramural R&D and the strategy of combining intramural & extramural R&D suggest that practitioners should help top managers to find the right balance between these types of R&D (intramural vs. extramural) to achieve better product innovation outcomes. Furthermore, policy makers, in an attempt to improve the likelihood of introducing product innovations, may be aware of the strengths and weaknesses that are associated to the level of family management, to better align their policies with the particular situation of family businesses. For instance, policy makers might consider new legislation that includes specific policy instruments to incentive the use of intramural R&D and the development of strategies combining intramural and extramural R&D.

In spite of the interesting outcomes that are derived from our study, it has some limitations, which provide opportunities for future research. Given that top managers have immediate power over firm actions and strategies, their decisions are essential in explaining the behavior of family firms regarding R&D investments and product innovation. However, our study does not aim to investigate the impact of the presence of family management, but the influence of the level of family management. Our choice of focusing on the level of family involvement in management is justified, because the degree of family top executives has immediate power over organizational decisions and actions. Nevertheless, differentiating the effects between the mere family presence in management and the level of family management may be helpful in future studies. Furthermore, directly measuring the multiple effects of different types of family involvement (ownership, governance, . . . ) can also be very useful in future studies. It would allow for a more nuanced view of product innovation in family firms by addressing whether different sorts of family involvement conduct distinct R&D strategies and obtain dissimilar results regarding product innovation. We also suggest that future research considers distinct knowledge acquisition modes, while taking into account not only intramural R&D, extramural R&D, and the combination of both types of R&D, but also business acquisitions or the in-licensing of technology. The findings may also be restricted by the use of a particular sample of Spanish manufacturing firms, disregarding public family businesses and family businesses in other countries [162]. Nevertheless, this database has been already utilized in numerous prior innovation studies among family firms [44], since it includes firms that tend to particularly rely on innovation because of the great level of obsolescence of their products. Future work may further improve our understanding of the relationship between the family management and firm innovation through

the mediating role of R&D, disentangling research activities from development activities, instead of capturing R&D through a single measure [163].

## 7. Conclusions

This empirical article offers a relevant new understanding for studies on product innovation in family businesses. We found that the level of family management negatively impacts on the probability of introducing product innovation. Furthermore, this research clarifies the level of family management-product innovation relationship, while considering three different R&D strategies as the mediating factors. By using the mediation models, we indeed found that intramural R&D investments and the investment strategy consisting of combining intramural and extramural R&D mediate the connection between the level of family management and the likelihood of introducing product innovation. As the level of family management increases, the alignment between economic and non-economic goals lead to more in-house R&D spending and investments strategies that simultaneously combine intramural and extramural R&D, which in turn improves the probability of introducing product innovation. These findings increase our understanding of the heterogeneity in family firm' innovation strategic behavior and contribute important insights to our comprehension of determinants instigating product innovation in this type of firm.

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