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State and Dynamics of the Innovative Performance of Medium and Large Firms in the Manufacturing Sector in Emerging Economies: The Cases of Peru and Ecuador

María Elena Murrieta-Oquendo [1,2,3,*] and Iván Manuel De la Vega [1,2]

[1] CENTRUM Catolica Graduate Business School, Lima, Peru
[2] Pontificia Universidad Catolica del Peru, Lima, Peru
[3] ESPOL Polytechnic University, Escuela Superior Politécnica del Litoral, ESPOL, Facultad de Ingeniería en Mecánica y Ciencias de la Producción, Campus Gustavo Galindo Km. 30.5 Vía Perimetral, P.O. Box 09-01-5863, Guayaquil, Ecuador
* Correspondence: mmurriet@espol.edu.ec

Abstract: The purpose of this study was to analyze the current state and dynamics of the innovative behavior of medium and large manufacturing firms in Peru and Ecuador. It has been shown that the factors that enhance or enable the possibilities of innovation in organizations can be internal or external. This study took a quantitative approach, and regression models were applied to samples composed of firms. The relationships between external factors and business resources following the implementation of innovation were analyzed, as was the impact that these factors had on sales performance, considering the effect of the size and age of the firms. The innovations most implemented in firms in Ecuador were processes, and in Peru, organizational innovations were predominant. There were no external factors or business resources statistically related to these types of innovation for each country. For Peruvian firms, the age of the firm presented an inverse relationship to its performance. The study confirms the results of other studies conducted in Peru, and for Ecuador, these findings represent one of the first contributions on this topic. This study contributes to the discussion of the effects, in emerging Latin American countries, of a firm's age on its ability to innovate.

Keywords: innovation; economic performance; large firms; medium firms; firm age; emerging countries

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1. Introduction

Firms usually have difficulties being competitive in the market, and establishing networks with external organizations or institutions [1,2]; in addition, most firms face problems in terms of resources. In the face of these obstacles, innovation is the key determinant of the competitive advantage that improves the productivity and long-term growth of firms [3]. Innovation is also the key to determining the reduction of gaps in productivity, and to determining the wages paid by developing medium-sized firms compared to larger firms [4]. Within the specialized literature, studies exist that focus on determining which factors influence the implementation of innovation in companies [2,5,6], including internal factors—such as the size of the company, how long it has been established in the market, its organizational structure, its resources available for innovation, its team work, and its active and functional strategies [7–9]—and external factors, which vary according to the sector, industry and regions within the same country itself, and which include the unequal effects of government policies, business networks and knowledge acquisition [6].

Other studies document that efforts made by firms to innovate include collaboration with their customers, suppliers, competitors, universities, and other organizations [10,11]. Overcoming these barriers to acquiring or integrating resources with external partners [12] and other organizations has been shown to have positive effects on innovation performance [13], and on increasing knowledge and complementary assets [6]. In the same

sense, the job network between firms, entrepreneurships, the government and citizens is essential [14] to the development of countries [15]. Thus, the need to reduce the cost and risk of innovation has heightened the importance of collaboration, especially in the early stages of innovation development or in the commercialization stage [16].

In the context of emerging economies [17], such as Chile, institutions that facilitate collaborative actions are rare, and firms have little access to advanced technology and infrastructure [18]. In addition, high productivity in Latin America is hindered by inoperative institutions and limited infrastructure [5]. The scientific literature shows that environment, the size of firms, their age, and the commitment of the government are important factors that impact the economic performance of firms [6,7].

Other specialists have studied these factors and their relationship with innovation and performance in emerging economies. For example, the geographical location of Chile negatively affects its export performance [19]. On the other hand, Heredia Pérez et al. [17] demonstrated that internal capabilities and resources are important for all types of innovation in Chile and Peru, and that nontechnological innovations (organization and marketing) have a greater impact on performance than technological innovations (product and processes). Expósito et al. [20] concluded that young firms in low-income regions are more committed to institutional collaboration, and tend to implement organizational innovation. In addition, young firms are friendly in entrepreneurial environments. They also found that the effect of a firm's age on the development of new products and services indicates that mature firms can employ collaboration as a strategic advantage, especially with market agents. On the other hand, Angelidou et al. [7] observed that flexibility to innovate grows as a company ages, and that it becomes more innovative when economic performance is lower than that of its peers.

Ecuador's and Peru's business structures determined by economic activity are similar, in that the most important activity in both countries is the automotive trade, and they share other economic activities. Thus, in both countries the manufacturing industry is the third-most important economic activity (for Ecuador, 14%, and for Peru, 8%). The manufacturing industry in both countries is therefore of great relevance to the creation of employment and national production [21,22].

The findings previously described for countries with emerging economies [17,23], as well as the limited number of similar studies identified in less developed regions, such as South America [17,24], reveal a knowledge gap: for example, Ecuador did not present similar studies during the literature review of this research, while for Peru, although there are previous studies, knowledge on innovation is still limited. Therefore, this study analyzed the state and dynamics of the innovative performance of medium and large firms in the manufacturing sector of Ecuador and Peru. The purpose of this study was to identify the effect of external factors and the use of business resources on types of product, process, organizational and marketing innovation and, in turn, the effect of these on the economic performance of medium and large manufacturing firms in Peru and Ecuador—considering, in addition, the moderating effect of a firm's size and age (Figure 1).

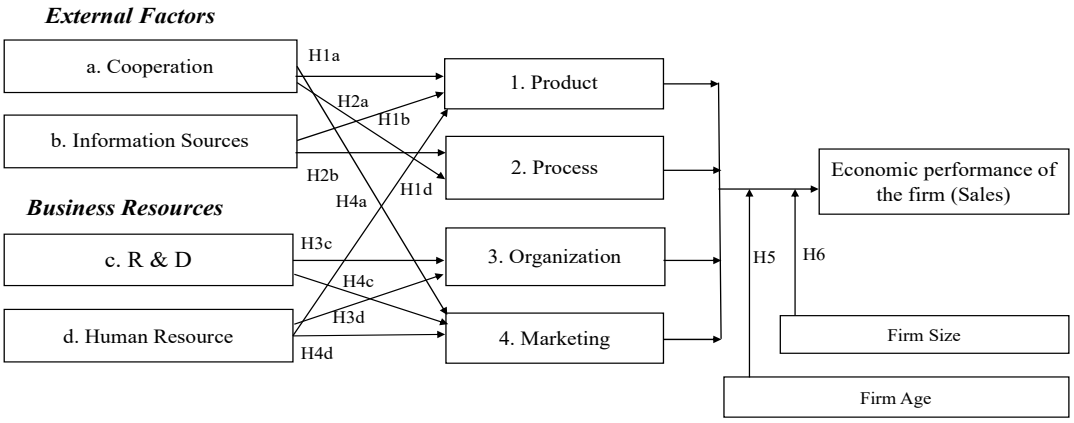

Figure 1. Relationship between business resources and external factors, types of innovation, and economic performance, with control variables of firm age and firm size. Note: adapted from "New approach to the innovation process in emerging economies: The manufacturing sector case in Chile and Peru" [17] Heredia Pérez, J.; Geldes, C.; Kunc, M.; and Flores, A.; 2019; Technovation 79, pp. 35–55.

Finally, this study identifies the importance of continuing to study innovation processes in firms in emerging countries that do not have the relevant knowledge and resources necessary to implement R&D [25], and where some governments still own the sources of resources [26]: such countries are characterized by a weak regulatory infrastructure that is inadequate to support transactions in markets and to protect intellectual property rights [27]. This paper is organized into several sections: Section 2 presents the literary review; Section 3 explains the methodology; Section 4 analyzes the results; Section 5 focuses on the discussion and conclusions of the research, and its limitations; future research is outlined in Section 6.

2. Literature Review

2.1. Innovation in Emerging Economy Countries

The theoretical perspective that culture is supranational, and is not determined by national boundaries, is supported by empirical evidence for the differences in cultures being mostly rooted in regional culture rather than in national culture [28]. The grouping of countries according to cultural profile explicitly helps to distinguish between the effects of the country and the effects of culture on the outcomes of the national innovation system or other national business systems [28].

The literature on emerging economies indicates that firms are inclined to adopt existing knowledge and technology, known to the market, instead of innovating [29]. To reach the knowledge frontier and maintain high levels of income, these economies need innovation related to their skills and capabilities [29,30]. This is because studies have found that a large investment in innovation does not increase the percentage of income from the sales of new products and services [31]. In addition, countries with emerging economies are characterized by relatively unstable political systems, legal frameworks and market structures, which present firms in those countries with additional strategic challenges [32]. Some researchers suggest that firms with a larger capacity for adaptation are better equipped to deal with environmental changes, and to achieve superior performance [33].

The relationship between innovation activities, the effects of external knowledge and firm performance is positive in certain regions, whereas the opposite occurs in countries with emerging economies, where this relationship is not positive, and does not directly affect productivity, because there are few resources allocated to R&D [34]. In the specific context of emerging economies, where institutions that facilitate joint actions are rare, firms have little access to technology and superior infrastructure [18]. The importance of technology in the development of economies has been noted by certain developing countries, e.g., Chile, where innovation is supported by government programs [17]. Unfortunately,

the results indicate that geographic location has a negative effect on export performance in this environment [19]. Finally, affiliation in business groups is crucial for emerging economies, as it has been shown to have a positive effect on the resources to innovate. Firms that seek to innovate alone find it difficult to obtain resources to finance themselves, especially in the emerging markets of developing countries [35].

2.2. External Factors of the Firm in the Development of Innovation

The cornerstone of resource-based theory is that firms require a unique set of difficult-to-imitate resources, competencies and competitive abilities [36]: for this, it is important to know the origin of the resources, and their use in the implementation process. Thus, the acquisition of information and resources, as central qualities, is relevant to the strategic competitive advantage of firms [17]. In this sense, the firms should balance internal and external knowledge through support, such as internal research and development processes, learning processes about the changing needs of consumers, and exogenous processes such as science, technology, suppliers and consumers [37]. In some cases, a shared innovation strategy is implemented, which focuses on the collaboration of several agents that influence the life of the organization [38]. In this context, [10] highlighted the value of identifying knowledge outside the organization, and finding partners who would share the risk in innovation projects, thus reducing costs and using resources efficiently. The role of users and competitors has stimulated concepts such as open innovation, open science, collective experimentation and community innovation [39]. Professional interaction and the potential to establish a relationship of trust are necessary, in order to absorb and assimilate different knowledges, which can boost the efficiency of organizational vision [37].

In this sense, several authors consider universities to be potential engineers of economic growth, and argue that they should assume a leadership role in the creation of technological innovation, thus contributing to economic growth [40]. Due to the global growth of the knowledge economy, many universities have evolved toward an entrepreneurial approach, with strong ties to industry, and with a more active role in promoting the transfer of knowledge to industry [24,41]. On the other hand, firms with network ties can exchange resources and knowledge, with their own activities helping to create new knowledge and innovation [42,43]. In addition, ties between firms and policies are considered an important social capital that can influence the innovation capacity of firms and their performance outcomes [29]. The ties that a firm develops in its business and commercial activities (suppliers, competitors and customers), and the political ties it develops with its government, can influence innovation [44]. Collaborative engagement with market partners (consumers, suppliers and competitors) leads to innovation, as consumer preferences and needs change and tend to evolve [24,45]. Firms cannot achieve product success alone, without mobilizing resources through moderate extensions of strong and weak ties [46].

Thus, most research confirms the positive effect of collaboration on innovation [37], on the overall performance of the firm, and on the outcome of innovation specifically [13]. Collaborative innovation strategies, either with market agents or institutions, have positive effects on innovation in product, processes and marketing, in the case of medium-sized technology firms [20]. An advantage of firms that collaborate with other firms is being able to secure financial, technological and human resources for the development of new products [47]. A study by Stojčić [29] explored how public incentives and private incentives contribute to the creation of social and private benefits in firms in emerging Central European economies. Firms deliver innovation with end-user benefits only if these innovations return benefits. With this background, the following hypotheses were proposed:

Hypothesis 1 (H1a). *Cooperation is positively related to the implementation of product and service innovations in firms in emerging economies.*

Hypothesis 1 (H1b). *Sources of information are positively related to the implementation of product and service innovations in firms in emerging economies.*

Hypothesis 2 (H2a). *Cooperation positively influences the implementation of process innovations in firms in emerging countries.*

Hypothesis 2 (H2b). *The use of information sources positively influences the implementation of process innovations in firms in emerging countries.*

Hypothesis 4 (H4a). *Cooperation is positively related to the implementation of marketing innovations in firms in emerging economies.*

2.3. Business Resources for the Development of Innovation

A firm with extensive knowledge not only maximizes the benefits of external sources of knowledge but also strengthens internal innovation processes, thus concentrating its efforts on building and refining the relationships between its external ties and the outcomes of innovation [14]. In this sense, a system that supports innovation activities needs, among other factors, employees from the company's different departments, and to ensure the mechanism of innovation activities, which includes designing an organizational system, building a culture of innovation and establishing learning in organizations. The integration of various resources and capabilities creates value for the company and society [48].

Regarding internal company relationships [49], focus on the working relationship between the firm and its employees, valuing informal communication for creativity, will result in the generation of new ideas. Ideas which are not useful to, or are little used by, organizations should be shared with agents outside of their innovation ecosystem, so that they can be used by them. The state as owner positively moderates the effect of R&D intensity on innovation performance. However, the benefits are not equal, as they depend on the commercialization of the region, and the institutional policy of the industry, to enhance the effects of state ownership on innovation [50].

Technological changes are commonly motivated by the opportunity for high productivity or profitability. These processes can be developed through the introduction of original technology, by the adoption of knowledge and capital goods, by the entry of intermediaries or by organizational procedures that are known by the company's collaborators, or through the imitation or replication of the activities, products, processes or organizational procedures known to the competition. The firm's decision depends on the costs of searching, selecting, adapting and implementing [30,51]. This background gives rise to the following hypotheses:

Hypothesis 1 (H1d). *The effect on the implementation of product innovation is greater when the firm has more human resources with university degrees.*

Hypothesis 3 (H3c). *The use of R&D resources positively influences the implementation of organizational innovations in firms in emerging countries.*

Hypothesis 3 (H3d). *The effect on the implementation of organizational innovations is greater when the firm has more human resources with university degrees.*

Hypothesis 4 (H4c). *The use of R&D resources is positively related to innovations in the marketing of firms in emerging countries.*

Hypothesis 4 (H4d). *The effect on the implementation of innovations in marketing is greater when the firm has more human resources with university degrees.*

2.4. The Types of Innovation and the Economic Results of Innovation Influenced by the Resource of Time and the Size of the Company in the Market

Firms that manage the reconfiguration of their skills and organizational processes are capable of innovating, competing and surviving in a global competitive landscape [52]. Therefore, a continuous strategy oriented toward innovation and flexibility is characterized by proactivity, which allows firms to anticipate future risks and take the necessary actions toward competitors, track global advances in technology, respond to changes in the environment and focus on the needs of the customer [44].

Resources and capabilities should be analyzed, prioritizing those channels in the sector which contribute to developing and achieving the economic performance of the firm's innovation collaboratively, emphasizing the number of people involved in the innovation process and their degree of involvement [44,53]. Additionally, considering the business environment as a function of the uncertainty of the firm, an environment with high uncertainty positively moderates the relationship between the types of product innovation and marketing, and the firm's performance [54]. Meanwhile, the relationship is negative in regard to process and organizational innovation [55].

A company's performance varies as a result of its relationship with different agents. For example, it is common that the relationship with academia or universities returns products such as academic publications [56], emphasizing the educational aspects of the collaboration and its associated patents [57]. The activities of the marketing department have a significant impact on the innovation performance of firms, as market knowledge intervenes in innovation processes, and converts information into new products and services [58]. Some researchers have studied user involvement in the development of new products, and have identified factors that govern the involvement and design of practices in developing new products [59]. Effective engagement early in the process of developing new products enables the company to absorb the consumer's explicit and implicit knowledge; however, there is uncertainty as to whether the correct consumer is targeted regarding their needs [59]. Consequently, Kunttu and Neuvo [59] have observed that engaging users and consumers in the academic–industry relationship, for the development of new products, is favorable.

In this sense, the development of new products is critical for the continuous growth and survival of medium-sized firms, requiring interaction with consumers in sales, marketing and design activities, to clearly understand their needs [25]. On the other hand, R&D is perceived to be the main instrument with which to improve the performance of innovation: however, when the threshold of financial openness is low, investment in R&D is negatively affected, and the opposite happens [34]. In studies conducted in developing countries, where the types of innovation that can be produced, their technological intensity and the conditions of demand are scarce [48], it has been shown that there is a significant and positive effect between innovation and a firm's performance [17,54], and that ongoing innovation drives higher profits and improves the firm's performance [60].

Structural factors, such as a firm's size and age, along with its openness to external sources of knowledge, can alter the transfer of technology and knowledge [61]. Time is a barrier for firms that develop innovation. The dynamics of the firm, and its technological influence in work networks, are affected by how long the firm has been established in the market [17,62,63]. Large firms have a greater capacity to innovate, and more benefits when they collaborate, in addition to being able to build relationships of trust between partners. However, there are studies showing that small and medium-sized young firms are more committed to building production networks [25]. It has been observed that learning over time can affect the ability to innovate, as well as the outcomes of innovation—the effect of age as the moderating relationship between collaborative innovation and the development of new products—showing that when firms are younger, they tend to yield better outcomes for the different innovation types [64]. By contrast, in a more recent study, mature firms were more inclined to commit to continuing to innovate [60]. Large firms have more patents for launching new products; however, microfirms have more new product launches per

patent than medium-sized firms [65]. With this background, we propose to analyze the following hypotheses:

Hypothesis 5 (H5). *The effect on economic performance when implementing the types of innovation is greater in older firms.*

Hypothesis 6 (H6). *The effect on economic performance when implementing the types of innovation is greater for medium-sized firms.*

3. Materials and Methods

3.1. Sample and Design

The samples of Ecuador and Peru used for this study were taken from the respective innovation surveys conducted in each of those countries [66,67]: the corresponding datasets were published in 2015 and 2018. In accordance with the technical details from each institution, the forms for the surveys were designed following the guidelines of the Oslo Manual [68]. The procedure for data collection is described in the technical sheets of INEC for Ecuador [69] and INEI for Peru [70].

3.2. Participants

From the interviews conducted, those selected belonged to firms in the manufacturing industry who reported at least 50 employees in their workforce, and who claimed to have developed innovation in products, processes, organization and/or marketing in the periods consulted during the survey.

3.3. Variable Measurement

The size of the firms was categorized, according to the Oslo Manual [16], as medium (51–250 workers) and large (more than 250 employees). The age of the firm's establishment in the market was reported in years, and allowed the companies to be categorized as young (up to 10 years) and old (more than 10 years). The business resources, external factors and types of innovation developed were obtained from the dichotomous variables of the questionnaire related to these topics, and were selected based on the proposal of Heredia Pérez et al. [17].

To measure product innovation, firms in both countries were asked about the introduction of a new or significantly improved good to the market and, for process innovation, about the introduction of a new or significantly improved process. For organizational innovation, companies in Ecuador were asked about organizational practices and, in Peru, about innovation management. In the case of marketing innovation in Ecuador, companies were asked about the introduction of new marketing practices and, for Peru, about the implementation of new marketing activities and brand value [66,67].

Performance was obtained from the percent variance in sales $(v_{t,t-2})$ between the year immediately preceding the year of the survey $t_{(y_t)}$ and the two years prior to this:

$$v_{t,t-2} = \frac{(Y_{t-2})}{\frac{y_t}{y_{t-2}} - 1}$$

3.4. Statistical Analysis

In addition, considering that, with respect to business resources and external factors, the questionnaire used in the innovation survey included several questions about cooperation, sources of information, human resources and R&D, a structure underlying the variables referring to these groups was hypothesized. Once the sample was obtained, a preliminary exploration of the data was performed, to detect extreme values, invalid values and other anomalies [71,72]. Firms with at least 20% blank responses were discarded from the analysis, due to the dependency structure that was hypothesized in the

data [73]; thus, the sample for Ecuador was composed of 472 firms, and that of Peru, of 691 companies. Next, the behavior of the variables by group was reviewed, so that the variables that best fit the cooperation factor or the sources of information were retained through factor analysis [74]. For business resources, human resources and R&D, no factor analysis was performed, but the variables were concatenated to obtain categories that allowed for addressing the hypotheses proposed. Thus, for human resources, the variables were concatenated to obtain two: proportions of university employees and proportions of technical employees in the firm. Similarly, for the R&D resource, the two types of R&D were concatenated (internal and external), so that a variable comprised of two categories was created: (1) the firm did not use any of the types of R&D; and (2) the firm used at least one of the types of R&D.

For the cooperation factors and sources of information, the respective factorial loads were extracted using the maximum likelihood algorithm [75], and the rotation method used was the orthogonal varimax [76–78]. The statistical parameters used to evaluate the factor analysis were as follows: (a) Kaiser–Meyer–Olkin coefficient (KMO) greater than 0.5 [78,79], and Cronbach's α greater than 0.7 [17,75], to confirm the suitability of the sample for factor analysis; (b) explained variance greater than 50% of the total variance [80] and a standardized factorial load not less than 0.4 [81,82], to ensure the cohesion of the groups y; (c) indicators of goodness of fit GFI (Goodness-of-Fit Index) of at least 0.90, AGFI (Adjusted Goodness-of-Fit Index) of at least 0.90, RMSEA (Root Mean Square of Error Approximation) less than 0.10, and a Chi-square value on degrees of freedom not greater than 5 [80].

This step also allowed us to analyze the validity and reliability of the data [17,80]. Additionally, the logistic PCA (logistic principal component analysis) dimension reduction technique [83] was used on the groups confirmed in the previous analysis to obtain the values of the reduced dimension.

With this information, five models were run, four of which were logistic regression models, and one linear regression model. The logistic regression models analyzed the effect of external factors and business resources on the types of innovation [84]: these models considered each type of innovation as a variable dependent on external factors and business resources. The multiple linear regression model was used to estimate the effect of innovation on economic performance, moderating the effect with firm age and firm size, to respond to the proposed hypotheses [85,86]. This indicated that the types of innovation acted as independent variables, and that interaction terms were included, to analyze the moderating effect of the size and age of the firm. The data analysis was performed in R software version 4.1.1 and the RStudio package.

3.5. Validity and Reliability

This study was based on content validity [87,88], as the official sources from which the data were obtained designed the questionnaires by taking into consideration an extensive review of the state of the art in innovation, according to the data sheets reported [66,67]. In addition, the geographic coverage reported by these sources reaches at least 80% of the target population [69,70]. The surveys were based on studies conducted in European countries that apply this type of instrument in that region, which were based on the 2005 Oslo Manual [68].

Additionally, the official sources INEC and INEI performed a validation process on the data collected, to ensure their quality and consistency [69,70]. Likewise, data from innovation surveys from official INEC and INEI sources have been used in several research studies [17,86]. To validate the construct [87,88], the exploratory and confirmatory factor analysis detailed in the previous section [17,80] was performed: this validated the variables that formed the structures of external factors, business resources and types of innovation. The data reliability was checked using the alternate forms reliability method [89], as the questionnaires had been administered periodically in different years to similar populations by the respective official sources in each country [69,70].

4. Results

Of the 472 firms in the sample from Ecuador, there were fewer medium-sized firms (82; 17.4%) than large firms (390; 82.6%)—unlike Peru, where, of the 691 companies in the sample, medium-sized firms represented the highest proportion (436; 63%), and large firms had a smaller number of firms in the sample (255; 37%). Regarding the ages of the firms, 67 (14.2%) Ecuadorian firms were young (up to 10 years in the market), and 405 (85.8%) were old (more than 10 years in the market). Meanwhile, 15.5% (107) of the Peruvian sample were young firms, and 84.5% (584) were old. Table 1 allows us to identify that large Ecuadorian firms were the ones that mostly carried out the different types of innovation, although only in the case of process innovation was this difference statistically significant. Similarly, older Ecuadorian firms were the ones that mostly innovated: however, this difference was statistically significant in the implementation of product innovation and marketing. In the case of Peru, the most innovative firms were medium-sized and old: however, this difference was statistically significant in the implementation of product innovation and marketing.

Table 1. Frequency of the implementation of the types of innovation, by firm size and age, in manufacturing firms in Ecuador and Peru.

Type of Innovation		Products	Processes	Organization	Marketing
Total Ecuador (n = 472)		325; 68.9%	397; 84.1%	196; 41.5%	181; 38.3%
Size	Medium (n = 82; 17.4%)	53; 11.2%	62; 13.1%	33; 7%	32; 6.8%
	Large (n = 390; 82.6%)	272; 57.6%	335; 71%	163; 34.5%	149; 31.6%
	p value	0.427	*0.026*	0.812	0.905
Age	Young (n = 67; 14.2%)	37; 7.8%	57; 12.1%	32; 6.8%	34; 7.2%
	Old (n = 405; 85.8%)	288; 61%	340; 72%	164; 34.7%	147; 31.1%
	p value	*0.012*	0.859	0.284	*0.033*
Total Peru (n = 691)		288; 41.7%	376; 54.4%	663; 95.9%	177; 25.6%
Size	Medium (n = 436; 63.1%	166; 24%	237; 34.3%	414; 59.9%	98; 14.2%
	Large (n = 255; 36.9%	122; 17.7%	139; 20.1%	249; 36%	79; 11.4%
	p value	*0.014*	1	0.099	*0.018*
Age	Young (n = 107; 15.5%)	25; 3.6%	55; 8%	101; 14.6%	24; 3.5%
	Old (n = 584; 84.5%)	263; 38.1%	321; 46.5%	562; 81.3%	153; 22.1%
	p value	*0*	0.507	0.423	0.484

Note: The percentages are calculated based on the total sample size of each country. The *p* values shown correspond to the Chi-square χ^2 independence tests, where the null hypotheses affirm independence between the types of innovation and the size of the firm or age established in the market, correspondingly.

In addition, according to Table 1, in the Ecuador sample, 68.9% (325) of firms reported having implemented product or service innovation during the period covered in the survey; 84.1% (397) indicated having implemented process innovation in their company; 41.5% (196) of firms indicated that they implemented organizational innovation during the period consulted; and 38.3% (181) of firms indicated that they carried out marketing innovation.

For Peru, Table 2 indicates that 41.7% (288) of firms claimed to have carried out innovation of products and services during the period consulted; 54.4% (376) of companies interviewed indicated having implemented process innovation; 95.9% (663) of the firms reported having carried out organizational innovation; and 25.6% (177) of Peruvian companies indicated having implemented marketing innovation. Regarding the bivariate relationship with external factors and business resources, Table 2 indicates that the implementation of product and service innovation in Ecuador was significantly associated with the use of most types of information sources (14 of 20), e.g., various areas and internal departments, databases, customers, competitors, suppliers,

fairs, conferences, magazines, and the internet, among others. Similarly, this type of innovation was associated with cooperation with customers. Additionally, using internal R&D and the hiring of technical personnel or those with a master's degree showed a statistically significant relationship to the implementation of product innovation. On the other hand, the implementation of process innovation in medium or large manufacturing firms in Ecuador showed a statistically significant association with the use of information sources in the area of administration/finance and production. The implementation of organizational innovation was related to the use of consultants as sources of information, of customers and suppliers in the role of collaborators, and external R&D. For the implementation of marketing, innovation was statistically related to the use of the areas of distribution, marketing, customers, R&D departments, exhibitions, fairs and conferences as sources of information, as well as cooperation with customers.

Table 2. Frequency of the use of external factors, business resources and implementation of the different types of innovation, and the statistical result of their bivariate relationship in medium or large manufacturing firms in Ecuador.

External Factor/Business Resource	Variable	Product Innovation		Process Innovation		Organizational Innovation		Marketing Innovation	
		Frequency (n = 325)	*p* Value	Frequency (n = 397)	*p* Value	Frequency (n = 196)	*p* Value	Frequency (n = 181)	*p* Value
Information sources	Administration and Finance area	271; 83.4%	0.789	337; 84.9%	*0.017*	168; 85.7%	0.214	157; 86.7%	0.1
	Distribution area	236; 72.6%	*0*	267; 67.3%	0.791	138; 70.4%	0.193	140; 77.3%	0.001
	Marketing area	229; 70.5%	*0*	256; 64.5%	0.38	131; 66.8%	0.242	137; 75.7%	0
	Production area	312; 96%	*0.044*	379; 95.5%	*0.039*	187; 95.4%	0.541	176; 97.2%	0.058
	ICT area	217; 66.8%	0.455	268; 67.5%	0.058	132; 67.3%	0.548	125; 69.1%	0.222
	Scientific databases	137; 42.2%	*0.039*	158; 39.8%	0.321	90; 45.9%	*0.01*	86; 47.5%	*0.002*
	Patent databases	113; 34.8%	*0.01*	127; 32%	0.273	70; 35.7%	0.067	74; 40.9%	*0*
	Customers	296; 91.1%	*0*	345; 86.9%	1	175; 89.3%	0.211	167; 92.3%	*0.014*
	Competitors	228; 70.2%	0.001	259; 65.2%	0.903	131; 66.8%	0.627	124; 68.5%	0.275
	Consultants	168; 51.7%	0.543	207; 52.1%	0.172	113; 57.7%	0.013	102; 56.4%	0.06
	R&D Department	198; 60.9%	*0*	214; 53.9%	0.135	100; 51%	0.635	107; 59.1%	*0.017*
	Exhibitions, Fairsfairs and conferences	228; 70.2%	*0*	255; 64.2%	0.514	134; 68.4%	0.076	128; 70.7%	*0.013*
	Internet	256; 78.8%	*0.002*	301; 75.8%	0.111	155; 79.1%	0.066	139; 76.8%	0.4
	R&D laboratories	110; 33.8%	*0.003*	122; 30.7%	0.271	53; 27%	0.314	65; 35.9%	*0.022*
	Public bodies	72; 22.2%	*0.035*	77; 19.4%	1	34; 17.3%	0.345	42; 23.2%	0.123
	Other firms	128; 39.4%	0.106	154; 38.8%	0.091	80; 40.8%	0.171	84; 46.4%	*0.001*
	Other firms in if the group	115; 35.4%	0.252	133; 33.5%	0.895	75; 38.3%	0.094	65; 35.9%	0.417
	Providers	267; 82.2%	*0.048*	320; 80.6%	0.253	161; 82.1%	0.311	152; 84%	0.086
	Magazines	198; 60.9%	*0.001*	219; 55.2%	0.793	117; 59.7%	0.098	105; 58%	0.282
	Universities	76; 23.4%	0.194	90; 22.7%	0.218	42; 21.4%	1	49; 27.1%	*0.029*

Table 2. *Cont.*

External Factor/Business Resource	Variable	Product Innovation		Process Innovation		Organizational Innovation		Marketing Innovation	
		Frequency (n = 325)	*p* Value	Frequency (n = 397)	*p* Value	Frequency (n = 196)	*p* Value	Frequency (n = 181)	*p* Value
Cooperation	Customers	235; 72.3%	*0*	261; 65.7%	0.597	140; 71.4%	*0.041*	133; 73.5%	*0.013*
	Competitors	80; 24.6%	0.42	94; 23.7%	0.887	50; 25.5%	0.453	52; 28.7%	*0.043*
	Consultants	97; 29.8%	0.445	129; 32.5%	0.105	69; 35.2%	0.122	58; 32%	0.673
	R&D laboratories	70; 21.5%	*0.002*	73; 18.4%	0.508	33; 16.8%	0.713	36; 19.9%	0.383
	Public bodies	19; 5.8%	0.175	18; 4.5%	0.559	12; 6.1%	0.382	13; 7.2%	0.085
	Other firms	47; 14.5%	0.566	56; 14.1%	0.722	28; 14.3%	0.783	33; 18.2%	*0.025*
	Other firms in the group	58; 17.8%	*0.041*	60; 15.1%	0.726	30; 15.3%	1	29; 16%	0.792
	Intellectual Property	23; 7.1%	*0.002*	18; 4.5%	0.543	10; 5.1%	1	11; 6.1%	0.368
	Providers	208; 64%	0.119	252; 63.5%	0.056	132; 67.3%	*0.033*	122; 67.4%	0.059
	Universities	26; 8%	*0.039*	24; 6%	0.595	16; 8.2%	0.18	17; 9.4%	0.059
Human Resources	PhD	35; 10.8%	0.186	39; 9.8%	0.685	24; 12.2%	0.106	18; 9.9%	0.882
	Masters	224; 68.9%	*0.015*	264; 66.5%	0.239	130; 66.3%	0.684	120; 66.3%	0.756
	Specialist	79; 24.3%	0.805	91; 22.9%	0.226	43; 21.9%	0.437	42; 23.2%	0.838
	Level 3	324; 99.7%	1	396; 99.7%	0.295	195; 99.5%	1	179; 98.9%	0.168
	Technician	233; 71.7%	*0*	253; 63.7%	0.109	128; 65.3%	1	116; 64.1%	0.693
	Secondary	319; 98.2%	0.741	388; 97.7%	0.721	192; 98%	1	177; 97.8%	1
	Primary	236; 72.6%	0.447	284; 71.5%	0.884	144; 73.5%	0.395	128; 70.7%	0.844
R&D	Internal	205; 63.1%	*0*	223; 56.2%	0.313	111; 56.6%	0.588	109; 60.2%	0.091
	External	59; 18.2%	0.136	68; 17.1%	0.331	46; 23.5%	*0.001*	39; 21.5%	*0.025*

Note: The absolute frequencies correspond to the number of firms that made use of the respective external factor or business resource, and that implemented the type of innovation detailed in the corresponding column. The percentages correspond to the relative frequency of firms that made use of the respective external factor or to the business resource of the total number of companies that implemented the type of innovation detailed in the corresponding column. The *p* values shown correspond to the Chi-square χ^2 independence tests, where the null hypotheses affirm independence between the external factor/business resource and the types of innovation.

Regarding the bivariate relationship of the implementation of innovation with external factors and business resources in medium or large firms in Peru, Table 3 indicates that the implementation of product and service innovation was significantly associated with the use of customers, competitors, consultants, exhibitions, fairs, conferences, suppliers and magazines as information sources. However, despite a statistically significant relationship to the types of cooperation, less than 11% of the firms interviewed carried out product innovation or used any type of cooperation. The use of internal R&D and the hiring of secondary or master's degree personnel showed a statistically significant relationship to implementing product innovation. The implementation of process innovation in medium or large manufacturing firms in Peru showed a statistically significant association with the use of customers, competitors, exhibitions, fairs, conferences, suppliers and magazines as information sources, as well as with the hiring of secondary school personnel. Meanwhile, the implementation of organizational innovation did not show a significant statistical association with any external factor or business resource. The application of marketing

innovation was statistically related to the use of customers, competitors, consultants, exhibitions, fairs, conferences, suppliers and magazines as sources of information, as well as to the hiring of personnel with masters and to internal R&D.

Table 3. Frequency of the use of external factors, business resources and implementation of the different types of innovation, and the statistical results of their bivariate relationship in medium or large manufacturing firms in Peru.

External Factor/Business Resource	Variable	Product Innovation		Process Innovation		Organizational Innovation		Marketing Innovation	
		Frequency (n = 288)	*p* Value	Frequency (n = 376)	*p* Value	Frequency (n = 663)	*p* Value	Frequency (n = 177)	*p* Value
Information sources	Patent databases	74; 25.7%	*0*	70; 18.6%	*0.009*	102; 15.4%	0.598	44; 24.9%	*0*
	Customers	233; 80.9%	*0*	270; 71.8%	*0.004*	448; 67.6%	0.306	140; 79.1%	*0*
	Competitors	204; 70.8%	*0*	248; 66%	*0*	397; 59.9%	0.315	124; 70.1%	*0.001*
	Consultants	153; 53.1%	*0*	166; 44.1%	0.002	265; 40%	0.122	95; 53.7%	0
	Exhibitions, fairs and conferences	201; 69.8%	0	243; 64.6%	0	369; 55.7%	0.429	124; 70.1%	0
	Public Bodies	87; 30.2%	0	96; 25.5%	0.048	152; 22.9%	0.65	51; 28.8%	0.03
	Other firms	0; 0%	1	1; 0.3%	1	1; 0.2%	1	0; 0%	1
	Other firms of the group	263; 91.3%	0.073	337; 89.6%	0.469	591; 89.1%	0.122	162; 91.5%	0.218
	Providers	237; 82.3%	0	304; 80.9%	0	486; 73.3%	0.09	140; 79.1%	0.033
	Magazines	191; 66.3%	0	223; 59.3%	0	336; 50.7%	0.256	105; 59.3%	0.007
	Professional and sectoral associations	141; 49%	0	153; 40.7%	0.002	237; 35.7%	0.845	85; 48%	0
	Universities	123; 42.7%	0	125; 33.2%	0.03	201; 30.3%	0.09	74; 41.8%	0.001
Cooperation	Customers	15; 5.2%	0.001	14; 3.7%	0.185	20; 3%	0.626	7; 4%	0.441
	Competitors	2; 0.7%	0.561	3; 0.8%	0.252	3; 0.5%	1	2; 1.1%	0.172
	Consultants	15; 5.2%	0.744	20; 5.3%	0.498	32; 4.8%	1	15; 8.5%	0.011
	R&D laboratories	17; 5.9%	0	12; 3.2%	0.651	20; 3%	0.609	8; 4.5%	0.184
	Government program to promote STI	1; 0.3%	1	2; 0.5%	1	3; 0.5%	1	1; 0.6%	1
	Business associations	3; 1%	0.655	3; 0.8%	1	5; 0.8%	1	1; 0.6%	1
	Other	4; 1.4%	0.406	3; 0.8%	1	6; 0.9%	1	3; 1.7%	0.338
	Providers	29; 10.1%	0.01	31; 8.2%	0.25	49; 7.4%	0.25	17; 9.6%	0.171
	Universities	19; 6.6%	0.022	17; 4.5%	1	31; 4.7%	0.388	11; 6.2%	0.212
	Productive Innovation and Technology Transfer Center (CITE)	4; 1.4%	0.166	3; 0.8%	1	5; 0.8%	1	0; 0%	0.327
	Public research institutes	5; 1.7%	0.134	4; 1.1%	1	7; 1.1%	1	1; 0.6%	0.682
	Technical training institutes	4; 1.4%	0.396	4; 1.1%	0.705	6; 0.9%	1	2; 1.1%	1

Table 3. *Cont.*

External Factor/Business Resource	Variable	Product Innovation		Process Innovation		Organizational Innovation		Marketing Innovation	
		Frequency (n = 288)	*p* Value	Frequency (n = 376)	*p* Value	Frequency (n = 663)	*p* Value	Frequency (n = 177)	*p* Value
Information sources	Patent databases	74; 25.7%	*0*	70; 18.6%	*0.009*	102; 15.4%	0.598	44; 24.9%	*0*
	Parent company or other firm in the group	20; 6.9%	0.08	*23; 6.1%*	*0.229*	*35; 5.3%*	*0.404*	*18; 10.2%*	0.001
	Research, Development, Innovation centers	5; 1.7%	*1*	*9; 2.4%*	*0.407*	*13; 2%*	*0.686*	*4; 2.3%*	*0.747*
Human Resources	PhD	33; 11.5%	*0.159*	*43; 11.4%*	*0.058*	*92; 13.9%*	*0.781*	*27; 15.3%*	*0.54*
	Masters	227; 78.8%	0.015	283; 75.3%	0.434	491; 74.1%	0.814	146; 82.5%	0.002
	Bachelor	286; 99.3%	1	374; 99.5%	0.666	658; 99.2%	1	175; 98.9%	0.604
	Technician	282; 97.9%	0.617	369; 98.1%	0.324	647; 97.6%	1	174; 98.3%	0.581
	Secondary	277; 96.2%	0.02	360; 95.7%	0.013	621; 93.7%	0.409	167; 94.4%	0.617
R&D	Internal	164; 56.9%	0	156; 41.5%	0	233; 35.1%	0	91; 51.4%	0
	External	38; 13.2%	0.001	35; 9.3%	0.326	57; 8.6%	0.152	30; 16.9%	0

Note: The absolute frequencies correspond to the number of firms that made use of the respective external factor or business resource, and that implemented the type of innovation detailed in the corresponding column. The percentages correspond to the relative frequency of firms that made use of the respective external factor or to the business resource of the total number of firms that implemented the type of innovation detailed in the corresponding column. The *p* values shown correspond to the chi-square independence tests, where the null hypotheses affirm independence between the external factor/business resource and the types of innovation.

When performing the factor analysis of the factors external to the firm, 17 and 7 variables of the information source factor were retained in the samples of Ecuador and Peru, respectively, which explained more than 50% of the total variability in both cases. Meanwhile, for the cooperation factor, 3 and 6 variables were maintained in the samples of Ecuador and Peru, respectively, which explained more than 40% of the total variability in both cases. Based on these factors, an analysis of principal logistic components was performed, to obtain the reduced dimension that would be used in the models. The variability explained by the principal component in each country and each external factor ranged between 35% and 55%. A summary of the characteristics of the factors and components is shown in Table 4.

When executing the logistic regression models to explain the probability of performing each of the types of innovation as a function of external factors and business resources, the results in Table 5 show that implementing product innovation for a medium or large manufacturing firm in Ecuador can be explained by the use of information sources and R&D, which show a positive effect on the response variable, and increase the chance of implementing this type of innovation by 4% and 241%, respectively, when making use of them. On the other hand, using cooperation for the implementation of product innovation in Ecuador shows a statistically significant positive effect at 10%.

Table 4. Results of the factor analysis and analysis of the main logistic components of the external factors, cooperation and sources of information of medium or large manufacturing firms in Ecuador and Peru.

			Factor Analysis							Principal Component Analysis	
Factor/Resource	**Country**	**Variable**	**Load**	**Cronbach's α**	**% Var. Explained**	**χ^2/d.f.**	**GFI**	**AGFI**	**RMSEA**	**Load**	**Number of Components (% Var. Explained)**
Information sources	Ecuador	Administration and Finance Area	0.66	0.95	53%	5	0.85	0.80	0.09	0.23	1 (36%)
		Distribution Area	0.7							0.21	
		Marketing Area	0.6							0.15	
		ICT Area	0.68							0.21	
		Scientific databases	0.81							0.29	
		Patent databases	0.85							0.31	
		Customers	0.66							0.25	
		Competitors	0.74							0.23	
		Consultants	0.69							0.18	
		Exhibitions, fairs and conferences	0.71							0.22	
		Internet	0.76							0.28	
		R&D Labs	0.74							0.23	
		Public Bodies	0.79							0.28	
		Other firms	0.68							0.19	
		Providers	0.69							0.24	
		Magazines	0.78							0.27	
		Universities	0.81							0.3	
	Peru	Customers	0.58	0.92	61%	15	0.92	0.83	0.14	0.24	1 (47%)
		Competitors	0.59							0.24	
		Consultants	0.77							0.30	
		Exhibitions, fairs and conferences	0.86							0.44	
		Public Bodies	0.77							0.39	
		Magazines	0.9							0.46	
		Professional and sectoral associations	0.92							0.46	
Cooperation	Ecuador	Customers	0.66	0.71	46%	27.8	1	1	0	0.66	1 (55%)
		Competitors	0.64							0.64	
		Providers	0.4							0.4	
	Peru	Customers	0.82	0.82	43%	3.7	0.98	0.96	0.06	0.32	1 (38%)
		Consultants	0.49							0.34	
		Labs I + D	0.63							0.26	
		Providers	0.78							0.68	
		Universities	0.57							0.32	
		Parent company or other firm in the group	0.59							0.39	

Table 5. Logistic regression models of the types of innovation as a function of external factors and business resources in medium or large manufacturing firms in Ecuador and Peru.

Country	Type of Innovation	Covariate	β_i	Standard Error	$e^{\beta i}$ (95% CI)
Ecuador	Products	Intercept	0.231 ****	0.202	1.26 [0.85, 1.87]
		Cooperation	0.044 *	0.024	1.04 [1, 1.10]
		Information sources	0.039 ***	0.013	1.04 [1.01, 1.07]
		Professional human resources	0.168	0.623	1.18 [0.36, 4.15]
		R&D (Yes)	0.879 ****	0.211	2.41 [1.59, 3.65]
	Processes	Intercept	1.459 ****	0.247	4.30 [2.68, 7.07]
		Cooperation	−0.006	0.029	0.99 [0.94, 1.05]
		Information sources	0.022	0.016	1.02 [0.99, 1.05]
		Professional human resources	−0.165	0.743	0.85 [0.21, 3.97]
		R&D (Yes)	0.376	0.259	1.46 [0.87, 2.42]
	Organization	Intercept	−0.628 ***	0.198	0.53 [0.36, 0.78]
		Cooperation	0.038 *	0.022	1.04 [1, 1.09]
		Information sources	0.013	0.012	1.01 [0.99, 1.04]
		Professional human resources	0.37	0.562	1.45 [0.48, 4.36]
		R&D (Yes)	0.30	0.201	1.35 [0.91, 2.01]
	Marketing	Intercept	−0.848 ****	0.207	0.43 [0.28, 0.64]
		Cooperation	0.05 **	0.023	1.05 [1.01, 1.10]
		Information sources	0.033 ***	0.012	1.03 [1.01, 1.06]
		Professional human resources	0.409	0.578	1.51 [0.48, 4.66]
		R&D (Yes)	0.355 *	0.208	1.43 [0.95, 2.15]
Peru	Products	Intercept	−0.277	0.382	0.76 [0.36, 1.62]
		Cooperation	0.022	0.041	1.02 [0.94, 1.11]
		Information sources	0.067 ****	0.013	1.07 [1.04, 1.10]
		Professional human resources	−2.012 ****	0.444	0.13 [0.05, 0.31]
		R&D (Yes)	1.705 ****	0.197	5.50 [3.76, 8.14]
	Processes	Intercept	0.41	0.348	1.51 [0.77, 3.03]
		Cooperation	0	0.037	1 [0.93, 1.08]
		Information sources	0.044 ****	0.013	1.05 [1.02, 1.07]
		Professional human resources	−1.76 ****	0.378	0.17 [0.08, 0.36]
		R&D (Yes)	0.698 ****	0.186	2.01 [1.40, 2.91]
	Organization	Intercept	5.84 **	2.8	344 [9.47, Inf]
		Cooperation	0.348	0.305	1.42 [0.96, 3.78]
		Information sources	−0.008	0.029	0.99 [0.94, 1.05]
		Professional human resources	−0.12	0.897	0.89 [0.17, 6.18]
		R&D (Yes)	17.6	1110	Inf
	Marketing	Intercept	−1.188 ****	0.351	0.31 [0.15, 0.61]
		Cooperation	0.042	0.037	1.04 [0.97, 1.12]
		Information sources	0.042 ***	0.014	1.04 [1.02, 1.07]
		Professional human resources	0.574	0.393	1.77 [0.81, 3.81]
		R&D (Yes)	0.804 ****	0.196	2.23 [1.52, 3.28]

Note: Significant estimators are highlighted according to the magnitude of their *p*-value, i.e.,: 0 '****' 0.001 '***' 0.01 '**' 0.05 '*' 0.1. Non-highlighted values were not significant at 5% or 10%.

For Peruvian firms, the information sources and the use of R&D were the explanatory variables that had a significant positive effect on the implementation of product innovation, which increased the chance of implementing this type of innovation in the firm by 7% and

550%, respectively. Meanwhile, the hiring of professional personnel (or of those with a university degree) showed a significantly negative effect on the response variable, and decreased the possibility of implementing product innovation by 87%. These results led to H1a and H1d being rejected in both countries, as cooperation and hiring professional personnel were not significant variables for the implementation of product innovation. Meanwhile, H1b was accepted in both countries, as the sources of information showed a significant effect on the implementation of this type of innovation.

The application of process innovation in Ecuador did not obtain statistically significant explanatory factors in the logistic regression model, while for Peru, the use of information and R&D sources showed a significantly positive effect on the implementation of process innovation in the firm, increasing the chance of doing so by 5% and 200%, respectively. Meanwhile, the hiring of professional staff (or those with a university degree) showed a significantly negative effect, which decreased the possibility of implementing process innovation in Peruvian firms by 83%. These results allowed us to reject H2a in both economies, but not so with H2b, which is accepted in Peru. On the other hand, the implementation of organizational innovation in Ecuador and Peru did not show a statistically significant relationship to any external factor or business resource. In light of these results, the claims of H3c and H3d were rejected. Cooperation and information sources were shown to have a significantly positive effect on implementing marketing innovation in medium or large manufacturing firms in Ecuador, so much so that their widespread use by a company increased the chance of implementing marketing innovation in that company by 5% and 3%, respectively. For Peruvian firms, the sources of information and the use of R&D showed a significantly positive effect, in that, after being used by a company, they increased the chance of implementing marketing innovation in that company by 4% and 223%, respectively. These results allowed us to reject H4c for Ecuador, but to accept it for Peru, while H4a was accepted for Ecuador but not for Peru. In addition, H4d was rejected for both countries.

On the other hand, for the Ecuadorian firms interviewed, the economic performance that was measured in terms of the relative variance in sales with respect to the two previous years indicated an average value of 16% $\pm$ 37% standard error, in a range of -100% to 175%. Meanwhile, for Peru, the variance in sales reported by the firms interviewed was in the range of -94.3% and 199%, with an average value of 12% $\pm$ 35% standard error. The size of the firm did not show a statistically significant effect on performance in the firms of either country (p value for the mean difference by size in Ecuador equal to 0.995, and in Peru equal to 0.228): Ecuadorian medium-sized firms presented an average 16% $\pm$ 40% percent variance in sales of 16% $\pm$ 40%; Ecuadorian large firms presented a 16% $\pm$ 37% average percent variance in sales; for medium-sized Peruvian firms, the average reported performance was 11% $\pm$ 33%; for large Peruvian firms, it was 14% $\pm$ 38%.

Regarding the ages of firms, in Ecuador there were no significant differences between young and old companies (p value of the mean difference test, 0.909), as the former presented an average performance of 17% $\pm$ 44%, and the old ones, 16% $\pm$ 36%. This was not the case with Peruvian firms, where significant variance in sales performance (p value of the mean difference test, 0.005) was observed, in favor of young firms. In this sense, young Peruvian firms (up to 10 years old in the market) showed an average increase in sales in the last two years of 22% $\pm$ 41%, while the old ones (more than 10 years in the market) reported an average increase in sales of 11% $\pm$ 33%.

After analyzing the performance by type of innovation in Table 6, we concluded that in Ecuador, the variance in sales was independent of the type of innovation that was carried out, even when the interaction between firm size and firm age was analyzed. For Peru, the variance in sales was statistically greater when organizational innovation was implemented, i.e., the firms that innovated organizationally achieved an average increase in sales of 13% $\pm$ 35%, while those that did not implement this type of innovation reported an average increase in sales of 2% $\pm$ 27%. There was a significant difference in the performance for this type of innovation when considering a firm's age, as the younger firms had a higher average increase in sales than the older ones that also innovated. Similarly, young firms that implemented product and process innovation showed a significantly greater increase in sales than older firms that had also implemented these types of innovation. These results allowed H5 to be rejected

for both countries, as in Ecuador there was no significant difference in economic performance due to establishment, while for Peru it was evident that economic performance was lower for the older firms. Likewise, H6 was rejected, due to the lack of statistical evidence on the differences in economic performance between medium and large firms for both countries.

Table 6. Percent variance in sales performance in the last two years by type of innovation, firm size and firm age, reported by medium or large manufacturing firms in Ecuador and Peru.

Variable	Values	Types of Innovation							
		Ecuador				Peru			
		Products	Processes	Organization	Marketing	Products	Processes	Organization	Marketing
% Variance in sales	Innovated	0.18 ± 0.33	0.16 ± 0.38	0.17 ± 0.34	0.18 ± 0.35	0.11 ± 0.32	0.11 ± 0.32	0.13 ± 0.35	0.12 ± 0.33
	Did not innovate	0.13 ± 0.45	0.16 ± 0.32	0.16 ± 0.39	0.15 ± 0.39	0.13 ± 0.37	0.14 ± 0.38	0.02 ± 0.27	0.13 ± 0.35
	p value	0.137	0.518	0.345	0.187	0.803	0.830	*0.032*	0.577
Size	Median	0.14 ± 0.32	0.16 ± 0.43	0.15 ± 0.37	0.17 ± 0.36	0.08 ± 0.27	0.11 ± 0.32	0.12 ± 0.33	0.11 ± 0.32
	Large	0.18 ± 0.34	0.16 ± 0.37	0.17 ± 0.34	0.18 ± 0.35	0.15 ± 0.37	0.11 ± 0.32	0.15 ± 0.38	0.13 ± 0.35
	p value	0.345	0.925	0.719	0.872	0.071	0.967	0.321	0.692
Age	Young	0.15 ± 0.38	0.16 ± 0.47	0.18 ± 0.44	0.16 ± 0.46	0.24 ± 0.31	0.21 ± 0.33	0.24 ± 0.41	0.2 ± 0.38
	Old	0.18 ± 0.33	0.16 ± 0.37	0.17 ± 0.32	0.19 ± 0.32	0.1 ± 0.31	0.09 ± 0.31	0.11 ± 0.33	0.11 ± 0.33
	p value	0.602	0.991	0.84	0.719	*0.041*	*0.018*	*0.003*	0.258

When analyzing the linear relationship between performance and types of innovation, with the interaction of firm age and firm size, Table 7 shows that for Ecuador, there was no significant linear relationship between the variance in sales and the types of innovation, firm age, or firm size. Meanwhile, firm performance in Peru could be explained linearly through the implementation of organizational innovation, which showed a positive effect on the variance in sales. Thus, organizational innovation increased the percent variance in sales by approximately 32%. In addition, large firms that implemented product innovation showed a significantly positive increase of 10% in economic performance.

Table 7. Percent variance in sales performance in the last two years, depending on the type of innovation, firm size and firm age, reported by medium or large manufacturing firms in Ecuador and Peru.

Variable	Ecuador		Peru	
	Coef. (SE)	*p* Value	Coef. (SE)	*p* Value
Intercept	0.325 (0.168)	*0.054*	−0.076 (0.152)	0.619
Product innovation	−0.137 (0.116)	0.239	0.009 (0.085)	0.918
Process innovation	−0.084 (0.15)	0.575	−0.031 (0.074)	0.67
Organizational innovation	−0.012 (0.119)	0.918	0.324 (0.157)	*0.039*
Marketing innovation	−0.008 (0.121)	0.947	−0.019 (0.081)	0.82
Product innovation in an old firm	0.086 (0.108)	0.425	−0.061 (0.091)	0.504
Process innovation in an old firm	0.044 (0.145)	0.76	0.034 (0.079)	0.662
Organizational innovation in an old firm	−0.041 (0.105)	0.694	−0.251 (0.167)	0.133
Marketing innovation in an old firm	0.057 (0.108)	0.596	0.026 (0.088)	0.77
Product innovation in a large firm	0.134 (0.101)	0.187	0.098 (0.059)	*0.094*
Process innovation in a large firm	0.056 (0.121)	0.643	−0.07 (0.056)	0.216
Organizational innovation in a large firm	0.068 (0.1)	0.5	−0.116 (0.165)	0.482
Marketing innovation in a large firm	−0.02 (0.103)	0.847	−0.028 (0.064)	0.656
Old firm	−0.102 (0.157)	0.516	0.113 (0.162)	0.488
Large firm	−0.149 (0.141)	0.29	0.157 (0.163)	0.336

5. Discussion and Conclusions

This section discusses the relationship between the research questions, the theoretical–conceptual model and its hypotheses and the results obtained. According to Expósito et al. [20], firms mainly apply organizational innovation. These results were confirmed in the present study, as 95.9% of firms in the Peruvian sample reported having implemented this type of innovation. For Ecuador, the most frequent type of innovation was that of processes (84.1%). In the case of Peru, although firms presented a high rate of organizational innovation, the results of this study did not show a significant association with any external factor or business resource. Meanwhile, for Ecuador, process innovation showed a statistically significant association with information sources from the areas of production and of administration and finance.

In Ecuador, the majority of large firms applied innovation; in Peru, they were medium-sized: however, in both cases, the firms that mostly implemented innovation had been established for more than 10 years in the market: these results were in contrast to the conclusion of Heredia, which indicated that large firms invested more resources in innovation [17], but they supported the statement of Angelidou et al. [7], who observed that the flexibility to innovate increases with a firm's age. On the other hand, when analyzing the multivariate influence of human resources with university degrees in both emerging economies, the results did not show a statistically significant association. However, on a bivariate basis, the hiring of personnel with a master's degree was statistically associated with the implementation of product innovation in both countries: specifically for Peru, it was also associated with carrying out marketing innovation. This point is relevant, as the absorption of individual knowledge is related to the firm's innovation strategy [90].

The results of this study showed that the use of R&D, whether internal or external, had a positive effect on implementing product in Ecuador, and product, process, or marketing innovation in Peru. The use of R&D resources in marketing innovation confirms the conclusions of Heredia Pérez et al. [17] in Chile and Peru, for results from previous years. These results are relevant because, according to Hammar and Belarbi [34], R&D is perceived as the main instrument to improve innovation performance.

When comparing the results of the econometric models of Ecuador and Peru, it is not possible to establish if product, process, organizational and marketing innovation interact with each other, a situation common to emerging economies, and the opposite of that in developed economies [64], which could be analyzed in future research. In addition, in the logistic models, the positive influence of the external factor of information sources on the innovation of products, processes and marketing in both countries was observed, while generally, the external factor cooperation showed a significant effect only on the implementation of marketing innovation in Ecuadorian firms.

However, at the bivariate level, cooperation with customers, competitors and suppliers had a statistically significant and positive association with the implementation of product, organizational and marketing innovation in firms in Ecuador, which coincides with Moura et al. [45], who indicated that these types of collaborations make firms more likely to innovate. In addition, our results indicate that the theory of university–business cooperation for innovation did not occur in Ecuador, although large firms are the most likely to develop this cooperation [86]. In the case of Peru, the little influence, or lack of influence, of cooperation on implementing innovation was consistent with the conclusions of the study by Heredia Pérez et al. [17] in this country.

Additionally, the results of this study indicate that neither the types of innovation, firm age, nor firm size influence the variance in sales as an indicator of the economic performance of Ecuadorian firms. For Peru, organizational innovation and the implementation of product innovation by large firms showed a positive influence on the measure taken in this study as the indicator for the economic performance of firms, yielding an increase in sales of more than 30% in two years. These results confirm that innovation increases profits and improves the performance of firms [60], and they contribute, therefore, to the conclusions of Heredia-Pérez et al. [17], which showed that nontechnological innovations

(organization and marketing) had a greater impact on performance than technological innovations (product and processes).

Likewise, the fact that the interaction between implementing product innovation and firm size was significant, at 10%, in the modeling of the performance of Peruvian firms supports the suggestion by Nathan and Rosso [65], that large firms tend to introduce more new products to the market, which in turn equates to higher performance.

Regarding the effect of the age of firms on sales performance, our results showed that young Peruvian firms increased their sales, within 2 years, to a significantly higher level than that of firms that had been in the market more than 10 years, when they carried out product, processes and organizational innovation: this can be explained by the conclusions of Angelidou et al. [7], who indicated that younger firms are more willing to acquire new technologies and characteristics that enable changing the routines of new product development, although older firms have more resources and skills available. These results also support the conclusions of the study by Heredia Pérez et al. [17] conducted in Peru, which showed that, as firms age, there is a significantly negative effect on their financial performance; however, these results are contradictory to the association between a firm's age and its implementation of innovation. We suspect that there is a gap containing additional factors that have not been studied but that influence performance. The effects of a firm's age appear in various environments; however, it is necessary to investigate those factors that weaken these effects. This study, like the study by Angelidou et al. [7], motivates us to continue exploring the factors that influence the development of new innovations as a function of a firm's age.

Practical Implications

In the studies carried out in countries with emerging economies, it has been observed that firms are continually faced with the development of internal capacities, and with the search for resources that enable development of the types of innovations that lead to improvements in manufacturing, and that achieve the financial performance expected [17]. In addition, the use of external factors, such as cooperation and information sources, triggers product and marketing innovation. Manufacturing firms that have used R&D resources in combination with cooperation and sources, have developed product, process and marketing innovations. These results have theoretical relevance, and a practical perspective that allows entrepreneurs or administrative leaders to seek internal resources and to develop specific strategic capabilities that enable the development of innovations in dynamic and complex contexts such as emerging economies.

In this study, the age of the firm had no influence on the model, nor did it negatively influence performance. These contradictions are reflected in different studies contained in the academic literature. The study by Angelidou et al. [7] indicates that this conflict can be attributed to the systematic differences that firms show regarding their performance. Thus, the influence of age over innovation has been proved negative when the firm's performance is better than its competitors' under uncertain conditions, as the firm's flexibility to innovate decreases; however, when the firm experiences lower performance than its competitors, the influence of the firm's age can be favorable. According to these findings, we suggest continuing to explore the influence of a firm's age in its management of resources to innovate, and their respective performances. Emerging economies are characterized by unstable policies, legal frameworks and market structures, and these become challenges for the implementation of business strategies [32,91]. The study results are found in the cultural profile of the region, mentioned by Tekic and Tekic [28], which indicates that the effects of the culture of the region on the national innovation system have these characteristics.

6. Limitations and Future Research

The results of this study contribute to the continuing research on firms in emerging economies, to gain further detail in the management and outcomes of this type of organization when implementing innovation processes: however, this research is limited

by the outdated databases of firms, with respect to this topic; consequently, this study encourages governments and institutions responsible for promoting R&D&I activities in emerging economies to keep the information produced by firms on this subject up to date. Another limitation of this study is that it did not consider micro or small firms. In addition, this research focused on the manufacturing industry. We recommend that future studies include other sectors, use longitudinal research methodologies and apply the experimental design technique to determine what external factors and business resources are necessary or relevant in the development of innovation in firms in emerging economies. In addition, this study confirms the proposals of other works that encourage research on how the size of a firm and its age (length of time established in the market) can influence innovation and thus improve its economic performance. We suggest analyzing the effects of the behavior of these variables in high-risk or uncertain environments on the development of innovation. In addition, we recommend comparing innovation in emerging countries to industrialized countries.

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