Universidad del Valle
Cuadernos de Administración

Journal of Management
Print ISSN: 0120-4645 / E-ISSN: 2256-5078 / Short name: cuad.adm.
Pages: e2111203 / Vol: 38 / Issue: 72 / Jan. - Apr. 2022
Faculty of Administration Sciences / Universidad del Valle / Cali - Colombia

Impact of Open Innovation in Peruvian food firms

Impacto de la innovación abierta en las empresas peruanas de alimentos

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Article of Scientific and Technological Research
Submitted: 25/04/2021
Reviewed: 22/09/2021
Accepted: 30/11/2021
Published: 01/02/2022
Thematic lines: Administration and Organizations
JEL classification: M11, O32, O36
https://doi.org/10.25100/cdea.v38i72.11203

Abstract

Food firms are an important part of Latin American economies, and they face an increasingly competitive context due to their customers' demands. For this reason, the main objective of this study is to empirically verify how inbound open innovation and absorptive capacity have a positive influence on technological innovations in Peruvian food firms. A model was designed that shows the relationship between the constructs, and it is based on a sample of 111 food firms that participated in the third national innovation survey of the manufacturing industry and knowledge-intensive service firms carried out in 2018. The present study contributes to the literature in the following two ways: First, it contributes to the research of the food industry, which is an industry representative of low-tech intensity industries that lack research; second, it aims to deepen the knowledge about the positive influence of open innovation and absorptive capacity on food firms' technological innovation capability. As a result, this study has empirically verified how the implementation of inbound open innovation and absorptive capacity improve the technological innovation capability of Peruvian food firms.

Keywords: Technological innovation; Absorptive capacity; Open innovation; Food firm.

Resumen

Las empresas de alimentos son parte importante de las economías latinoamericanas, las cuales enfrentan un contexto cada vez más competitivo, por las exigencias de sus clientes. Por ello, esta investigación tiene como principal objetivo verificar empíricamente como la innovación abierta de entrada y la capacidad de absorción favorecen el desarrollo de innovaciones tecnológicas en las empresas peruanas de alimentos. Se ha diseñado un modelo que

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evidencia la relación entre los constructos, y contando con una muestra de 111 empresas de alimentos que ha participado en la tercera encuesta nacional de innovación de la industria de manufactura y empresas de servicios intensivas en conocimiento realizadas en el año 2018. El presente estudio contribuye a la literatura de dos maneras: en primer lugar, contribuye a la investigación de la industria de alimentos, que es una industria representativa de las industrias de baja intensidad tecnológica que ha sido poco estudiada; y, en segundo lugar, se quiere profundizar el conocimiento sobre como la innovación abierta de entrada y la capacidad de absorción influyen positivamente sobre la capacidad de innovación tecnológica de las empresas de alimentos. Se logro verificar empíricamente como la aplicación de la innovación abierta de entrada y la capacidad de absorción, mejoran la capacidad de innovación tecnológica de las empresas peruanas de alimentos.

Palabas Clave: Innovación tecnológica; Capacidad de absorción; Innovación abierta; Empresa de alimentos.

1. Introduction

The food industry has drawn the attention of researchers because it is an industry that contributes significantly to the gross domestic product of economies, generates jobs, and increases export levels (Manfio and Lacerda, 2015). In this sense, this study shows how inbound open innovation practices and absorptive capacity improve food firms' technological innovation capability, enabling them to provide guidelines in the academic field, recommendations for managers, and policy design to strengthen the national innovation system.

The literature review shows that the food industry is a representative sector of the low-tech intensity industry, that is, of firms that invest very little in research and development (Ciliberti, Carraresi, and Broering, 2016a). In this context, food firms have been studied from different perspectives. Thus, it has been compared with the pharmaceutical industry, which is an industry that presents a high-tech intensity. Another study found that the food industry is characterized by the acquisition of external technology (Ciliberti, Carraresi, and Broering, 2016b). In addition, some studies show how regional public financing favors the improvement of the food firm´s innovation capability (De Martino and Magnotti, 2018).

In Latin America, researchers have also shown interest in studying food firms. Polo Otero, Ramos Ruiz, Arrieta Barcasnegras, and González Fernández (2017), while analyzing Colombian food and beverage firms, found that research and development activities favor to a greater extent the realization of product innovation rather than process innovation. Likewise, Salgado-Beltrán, Beltrán-Morales, Velarde-Mendivil, and Robles-Baldenegro, (2018) analyzing the behavior of Mexican food consumers, they found that firms must be very innovative, taking into account that innovative customers are an important part of their market.

Additionally, Oliveira, Ruffoni, Maçada, and Padula (2019) conducted research on Brazilian food firms, finding that firms that develop their capacities to absorb external knowledge and improve their innovation capabilities achieve greater efficiency in managing supply chain activities and increasing their sales.

The objectives of this research are described as follows. The first objective is to verify how the application of inbound open innovation helps to improve absorptive capacity. The second objective is to understand how absorptive capacity and inbound open innovation improve the propensity to develop technological innovations. The third objective is to analyze the mediating role of absorptive capacity in the relationship between inbound open innovation and technological innovation in the food industry in an emerging economy.

Based on a sample of 111 food firms that participated in the National Survey of Innovation in the Manufacturing Industry and Knowledge-Intensive Service Firms carried out in 2018, an attempt is made to validate a model that answers the questions about how absorptive capacity and inbound open innovation influence technological innovation in food firms in an emerging economy.

This study contributes to the literature in two ways. First, it contributes to the research of the food industry, which is a representative industry of low-tech intensity industry that have been little studied. Moreover, according to Frick, Jantke, and Sauer (2019), the food industry should be studied as an

https://doi.org/10.25100/cdea.v38i72.11203

independent activity rather than as part of the entire manufacturing sector. The second contribution lies in deepening the knowledge on how inbound open innovation and absorptive capacity positively influence food firms' technological innovation capability.

2. Theoretical Framework and Hypothesis

This study is carried out within the dynamic capabilities framework. According to Teece, Pisano, and Shuen (1997, p. 516), they are defined as "the ability of the company to integrate, build, and reconfigure internal and external competencies to face the rapid changes in the environment". One of these dynamic capabilities is absorptive capacity (Zahra and George, 2002), referred to by Cohen and Levinthal (1990, p. 128) as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it".

Likewise, it is framed within the concept of open innovation, which, according to Chesbrough (2006, p. 1), defines open innovation as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively".

On the other hand, Sarkar and Costa (2008) point out that the implementation of the open innovation strategy was aimed at firms with high-tech intensity. But in recent years, it has become evident that the framework is relevant to mature firms and low-tech intensity firms, as food firms have been forced to implement the open innovation strategy due to changes in the preferences of their customers.

The authors aim to demonstrate that the application of these two approaches, open innovation (Bayona-Saez, Cruz-Cázares, García-Marco, and Sánchez García, 2017) and absorptive capacity (Del Carpio Gallegos and Miralles, 2018), improve food firms' technological innovation capability.

2.1. Inbound open innovation and ACAP

The concept of open innovation has attracted the attention of researchers. In this sense, it is convenient to investigate why low-tech firms are interested in putting open innovation into practice, taking into account that low-tech firms are recognized as conservative firms that invest little in research and development but that take advantage of diverse sources of external knowledge (Arcese, Flammini, Lucchetti, and Martucci, 2015).

Thus, concern arises because firms strive to improve their absorptive capacity. In this sense, Spithoven, Clarysse, and Knockaert (2010) pointed out that low-tech intensity firms seek to improve their absorptive capacity to implement inbound open innovation practices. For this reason, when analyzing the Korean manufacturing industry, Kim and Choi (2020) found that a firm´s capability for innovation and development, that is, the implementation of R&D strategies, as well as the resources of firms oriented to this process, helped the firm improve its absorptive capacity.

It is necessary to point out how inbound open innovation and absorptive capacity are linked. Thus, analyzing the inbound open innovation processes, it is appreciated that firms that want to take advantage of external knowledge flows must develop their absorptive capacity. In this way, they will identify the external knowledge that is useful to them and use it to improve their innovation capability, a condition that was empirically verified by Ferreras-Méndez, Newell, Fernández-Mesa, and Alegre (2015) and Aliasghar, Rose, and Chetty (2019).

Therefore, the following hypothesis can be formulated:

Hypothesis 1: Inbound open innovation is related to absorptive capacity in Peruvian food firms.

2.2. ACAP and technological innovation

Much has been investigated about the relationship between absorptive capacity and the development of technological innovation. For example, Piening and Salge (2015) analyzed the information provided by the Communitarian Innovation Survey (CIS-4) from Germany and found that manufacturing firms, including those of food and tobacco, are more likely to develop process innovations

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when they use their absorptive capacity, develop activities related to internal research and development, and acquire external knowledge.

Later, Gkypali, Arvanitis, and Tsekouras (2018), analyzing 300 Greek manufacturing firms, found that absorptive capacity has a strong impact on innovation and plays an important role in the processing of external knowledge. Similarly, Hullova, Simms, Trott, and Laczko (2019), analyzing food and beverage firms in the United Kingdom, concluded that to develop product or process innovations, firms in this area must not only take advantage of internal knowledge but also, through absorptive capacity, make use of external knowledge, acquiring, assimilating and taking advantage of it to improve their innovation capability. On the other hand, it must be considered that both Engelman, Fracasso, Schmidt, and Zen (2017) and Albort-Morant, Henseler, Cepeda-Carrión, and Leal-Rodríguez (2018) proved the positive relationship between absorptive capacity and the development of technological innovation.

Consequently, this study raises the following hypothesis:

Hypothesis 2: Absorptive capacity is related to technological innovation in Peruvian food firms.

2.3. Inbound open innovation and technological innovation

The relationship between open innovation and its influence on technological innovation has been frequently analyzed. Thus, Bianchi, Croce, Dell 'Era, Di Benedetto, and Frattini (2016) analyzed how Spanish firms apply inbound open innovation to improve their innovative performance. In addition, Santoro, Vrontis, and Pastore (2017), studying Italian food and beverage firms, found that market knowledge sources promote incremental innovations, and knowledge sources that come from universities and research centers promote radical innovations.

Empirical studies have been developed to verify the relationship between open inbound innovation and technological innovations. It is important to point out that some time ago, Sofka and Grimpe (2010), through an empirical study, demonstrated that the specialized search for external knowledge has a positive impact on firm innovative performance. Thus, customers provide knowledge to implement new products, or suppliers provide knowledge to improve processes.

Gómez, Salazar, and Vargas (2016) argued that external knowledge favors the development of technological innovations; more specifically, Lefebvre, De Steur, and Gellynck (2015) studied food firms from 6 European countries and confirmed the same relationship.

Based on the arguments above, the following hypothesis is developed:

Hypothesis 3: Inbound open innovation is related to technological innovation in Peruvian food firms.

2.4. Absorptive capacity as a mediator

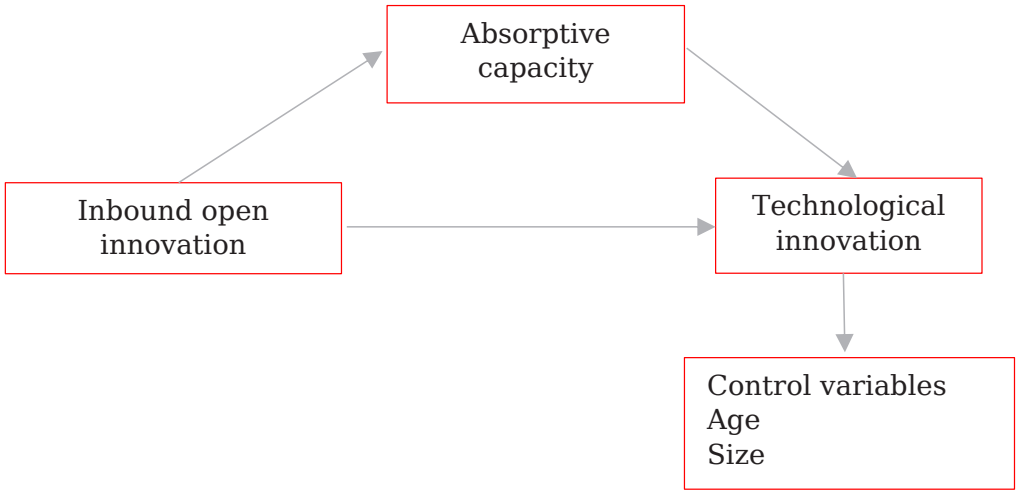
Absorptive capacity has played a role as a mediator in various studies. Thus, Sáenz, Revilla, and Knoppen (2014) indicate that absorptive capacity favors interaction with customers and suppliers, facilitating the exchange of knowledge, which helps to improve a firm´s innovation capability. Moreover, Rahomee and Kumar (2014) assert that many firms acquire and assimilate external knowledge but that they are not able to take advantage of it to develop innovations and that on certain occasions, the size and age of the firm play an important role in development absorptive capacity.

Additionally, Naqshbandi (2016) determines that firms that implement an open innovation strategy from the start, seeking external knowledge from various sources, promote the development of absorptive capacity. This allows firms to assimilate this knowledge and apply it to the development of new innovations. Later, other studies provided more insights into the mediating role of absorptive capacity and its role in the development of innovations.

Additionally, it is necessary to consider the analysis of Moilanen, Østbye, and Woll (2014) and Jeong, Chung, and Roh (2019), who verified the mediating role of absorptive

https://doi.org/10.25100/cdea.v38i72.11203

Figure 1. Conceptual Model



Source: Authors' own elaboration.

capacity in the relationship between sources of external knowledge and technological innovation.

Based on the arguments presented, the following can be formulated:

Hypothesis 4: Absorptive capacity mediates the relationship between inbound open innovation and technological innovation in Peruvian food firms.

3. Methodology

3.1. Data

The study population belongs to the Peruvian food industry, which participated in the 2018 National Survey of Innovation in the Manufacturing Industry and Knowledge-Intensive Services Firms. For the analysis, the information provided for 2018 was taken into consideration. A sample of 111 firms has been considered.

Figure 1 shows the conceptual model of the relationship between open inbound innovation, absorptive capacity and technological innovation.

3.2. Variables

The dependent variable is technological innovation, which consists of innovation in products and processes. Product innovation is a continuous variable, taking place when the firm declared that it had introduced completely new goods or services or with important modifications. Product innovation was formed by a factor analysis of two dichotomous items: (1) New good and (2) Significantly improved good, indicating 1 = if it was entered and 0 = if it was not entered. Innovation in process is also a continuous variable. It happens when the firm indicates that it had introduced some significant modifications in the production, marketing, logistics or distribution process. Innovation was formed through a factor analysis of three dichotomous items: (1) Means: techniques of promotion and/or product positioning, and/or establishment of prices of goods or services, (2) Business Administration and Management: methods of organizing the work, organization of external relations with other firms or public institutions, and (3) R&D processes: creativity or design for the development of products and business processes, indicating 1 = if it was introduced and 0 = if it did not introduce it.

On the other hand, the independent variables are inbound open innovation and absorptive capacity. For inbound open innovation, the measurement used by Gentile-Lüdecke, de Oliveira, and Paul (2020) was taken as a reference, who considered the degree of importance (1 = none, 2 = low, 3 = medium, 4 = high) from the following sources

https://doi.org/10.25100/cdea.v38i72.11203

of external knowledge: (1) consultants, commercial laboratories and private R&D institutes, (2) universities and other higher education centers, (3) governmental and public research institutes, (4) conferences, fairs, exhibitions and similar, (5) scientific journals and trade/technical publications and (6) professional and industry associations, (7) clients, (8) competitors, and (9) suppliers. In absorptive capacity (ACAP), there are the following items: (1) internal research and development (R&D) development (ACAP 1), (2) training for innovation activities (ACAP 2) and (3) presentation of a research and/or development and/or innovation department (ACAP 3), according to Escribano, Fosfuri, and Tribó (2009) and Rammer, Czarnitzki, and Spielkamp (2009). These items are dichotomous, indicating 1 = if it was implemented and 0 = if it was not implemented.

In the control variables, we have the size and age of the firm. Firm size and firm age can influence the realization of technological innovation. The firm size (expressed in logarithm) is measured by the number of employees, and the firm age is the number of years (expressed in logarithm) from its foundation to 2021. In both cases, the above is followed by Park and Kim (2015).

3.3. Analysis method

SmartPLS 3 was applied to estimate and analyze our model using the two-step PLS technique, described by Vinzi, Chin, Henseler, and Wang (2010). First, the measurement model is estimated when the relationship between the indicators and the latent construct is determined. Second, the estimation of the structural model is carried out, in which the relationships between the constructs are obtained by means of the path coefficients and the level of significance. The application of the partial structural equations is justified, as indicated by Hair, Risher, Sarstedt, and Ringle (2019), for two reasons: 1) Because the information comes from a secondary database, and 2) it does not have an effect if the normality test is not met.

4. Results and discussion

The results below are presented in six stages: 1) the descriptive statistics, 2) the results of the factor analysis, 3) the results of the measurement model, 4) the results of the structural model, 5) the control variables and 6) the mediation model.

4.1. Descriptive statistics

Table 1 shows descriptive statistics of the firms included in the sample. The firms were classified according to seniority or age and by size.

Table 1. Number of firms according to their technological intensity

Age firm	
Young (<28 years old)	79
Middle (28 to 45 years old)	18
Old (> 45 years old)	14
Total	111
Size firm	
Small (50 employees)	21
Middle (51 a 250 employees)	38
Large (≥251 employees)	52
Total	111

Source: INEI. Own elaboration.

4.2. Factor analysis

For the analysis of the two independent variables (absorptive capacity and open inbound innovation), SPSS software was used. We applied exploratory factor analysis (EFA) to determine which items measure each factor, as described by Boateng, Neilands, Frongillo, Melgar-Quiñonez, and Young (2018), with an adequate factor load greater than 0.4, and with certain statistical criteria, such as the Kaiser–Meyer–Olkin (KMO) sampling adequacy and the Bartlett sphericity value. Obtaining the factorial structure makes for an easier and more meaningful interpretation (Rossoni, Engelbert, and Bellegard, 2016). The results are shown in Table 2. According to Beavers, Lounsbury, Richards, Huck, Skolits, and Esquivel (2013), to verify reliability and validity, the percentage of the total variance explained is 77.83%, 69.91% and 50.23% for technological innovation, absorptive capacity and open inbound innovation, respectively.

https://doi.org/10.25100/cdea.v38i72.11203

Table 2. Factorial loads of the variables

Variable	Indicator	Factorial loads	Goodness of it
Technological innovation	Product	0.882	KMO: 0.500 Barlett: 40.2 (p=0.001)
	Process	0.882	
Absoprtive capacity	ACAP1	0.926	KMO: 0.588 Barlett: 136.9 (p=0.001)
	ACAP2	0.665	
	ACAP3	0.893	
Inbound open innovation	Consultants	0.759	KMO: 0.824 Barlett: 495.7 (p=0.001)
	Universities	0.812	
	Institutes	0.706	
	Conferences	0.758	
	Journals	0.831	
	Associations	0.756	
	Clients	0.596	
	Competitor	0.561	
	Suppliers	0.530	

Source: Authors' own elaboration (Software IBM SPSS Statistics).

Table 3. Reliability and validity indicators

Latent variable	CA	CR	AVE	VIF	Coefficient of determination
Technological innovation	0.715	0.874	0.776		0.476
ACAP	0.775	0.872	0.699	1.365	0.176
Inbound open innovation	0.872	0.898	0.501	1.221	
Reference values	>0.7	>0.7	>0.5	<5	

CA, Cronbach's alpha; CR, composite reliability; AVE, average variance extracted; VIF, Variance inflation factor

Source: Authors' own elaboration (Software IBM SPSS Statistics).

4.3. Measurement model

The research data are analyzed and presented using internal consistency reliability indicators such as Cronbach's alpha (CA) and the composite reliability index (CR), whose values must be greater than 0.7; convergent validity, through the average variance extracted (AVE), whose value must be greater than 0.5; the analysis of multicollinearity measured by the variance inflation factor (VIF), whose values must be less than 5; and the determination coefficient (R^2).

Table 3 shows the values of the indicators of reliability, convergent validity, multicollinearity analysis, and the determination coefficient for the research model. According to Vinzi *et al,* (2010) when the approach of partial least square equations is applied, the composite reliability index is more reliable than Cronbach's alpha. Regarding convergent validity, the indicators comply with the established values. In relation to the multicollinearity analysis, it is true for all the variables that the inflation factor of the variance does not exceed the value of 5. Meanwhile, the determination coefficient is 0.476, which shows a moderate relationship between the dependent and independent variables.

In relation to discriminant validity the Fornell and Larcker (1981) criterion is used, which establishes that the square root of the extracted variance (AVE) (shown in the diagonals and in bold in Table 4) must be greater than the correlations between the latent variables. In the present study, it can be

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Table 4. Discriminant validity			
Latent Variables	**Technological innovation**	**Absorptive capacity**	**Inbound open innovation**
Technological innovation	0.881		
Absorptive capacity	0.625	0.836	
Inbound open innovation	0.501	0.419	0.708
Source: Software Smart PLS 3.			

Table 5. Results of the structural model of product innovation		
Hypothesis	**Coefficient**	**Pvalue**
ACAP->TI	0.500***	0.001
IOI->ACAP	0.434***	0.001
IOI->TI	0.296***	0.001
Note: ACAP: absorptive capacity; IOI: inbound open innovation; TI: technological innovation. Note: *p<=0.1; **p<=0.05; ***p<=0.001.		
Source: Software Smart PLS 3.		

Table 6. Coefficients of the control variables		
Variable de control	**Coefficient**	**P-value**
Age	0.121	0.082*
Size	-0.100	0.276
Source: Software Smart PLS 3. Note: *p<=0.1; **p<=0.05; ***p<=0.001		

seen that the model meets the discriminant validity.

4.4. Structural model

After evaluating the measurement model, we proceeded to estimate the structural model for this study. Table 5 shows the coefficient values and the p values of the model. To generate statistical significance in the hypotheses, according to Benitez, Henseler, Castillo & Schuberth (2020), the bootstrapping technique is used, with 2000 resamples.

Table 5 shows the results of the structural model. As seen in the relationships, the coefficients are positive and statistically significant.

The model also complies with the goodness of fit (GoF) index (Tenenhaus, Esposito Vinzi, Chatelin, and Lauro, 2005). This index varies between values of 0 and 1. Although there is no minimum threshold, a value greater than 0.36 is recommended (Wetzels, Odekerken-Schröder, and Van Oppen 2009). The GoF index reaches a value of 0.49 for the model, which is higher than the minimum recommended to guarantee the quality of the fit of the model under study.

4.5. Control variables

Table 6 shows the coefficients of the control variables. The model shows that firm age is statistically significant. This means that a mature firm accumulates more knowledge and is in a position to develop technological innovations. At the same time, firm size is not statistically significant.

4.6. Mediation model

When analyzing absorptive capacity, certain steps are evaluated to confirm whether it is a mediating variable and the type of effect. According to Hair Jr, Sarstedt, Hopkins, and Kuppelwieser (2014) and

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Table 7. Mediation results

Relation	Indirect effect	Direct effect	Total effect	VAF (%)
IOI>ACAP>TI	0.208	0.293	0.501	41.52

Note: IOI: inbound open innovation; ACAP: absorptive capacity; TI: technological innovation.

Source: Software Smart PLS 3.

Carrión, Nitzl, and Roldán (2017), mediation represents a situation in which a mediating variable to some extent absorbs the effect of an exogenous construct (with independent variables) on an endogenous construct (with the dependent variable) in the PLS path model. The evaluation of explained variance (VAF) determines to what extent the mediation process explains the variance of the dependent variable. The rule is that if the VAF is less than 20 percent, one must conclude that there is no mediation; a situation in which the VAF is greater than 20 percent and less than 80 percent could be characterized as a typical partial mediation (Hair Jr, Hult, Ringle, and Sarstedt, 2016); and a VAF above 80 percent indicates complete mediation. The VAF is the ratio between the indirect effect and the total effect, obtaining 41.52% for the relationship of absorptive capacity between inbound open innovation and technological innovation (Table 7). Therefore, absorptive capacity is a partial mediator in the relationship between inbound open innovation and technological innovation.

5. Discussion

Applying the approach of dynamic capabilities, which firms develop to adapt to changes in the environment, it has been possible to empirically verify how the application of inbound open innovation and the development of absorptive capacity improve food firms' technological innovation capability.

The results obtained make it possible to affirm that the application of inbound open innovation, where the firm seeks to have access to various sources of external knowledge, positively influences the firm´s absorptive capacity. These results coincide with those obtained by Ferreras-Méndez *et al.* (2015) and Aliasghar *et al.* (2019). Furthermore, the results show that absorptive capacity has a positive influence on technological innovation. These results are in line with those obtained by Engelman *et al.* (2017), who verified that absorptive capacity favors the development of product innovation, and with those obtained by Albort-Morant *et al.* (2018), who empirically verified that absorptive capacity positively influences the development of product and process innovations.

Additionally, it was verified that inbound open innovation favors the development of technological innovations, as confirmed by Lefebvre *et al.* (2015) and Gómez *et al.* (2016). On the other hand, the mediating role of absorptive capacity in the relationship between inbound open innovation and technological innovation was verified by Moilanen *et al.* (2014), who obtained a similar result.

6. Conclusions

The present investigation set three objectives: The first objective was to empirically verify that the inbound open innovation is positively related to absorptive capacity. This relationship was observed in manufacturing firms in developed economies. A similar behavior shown by food firms in an emerging economy.

The second objective was to check how the interaction between inbound open innovation and absorptive capacity improves firms' technological innovation capability. Food firms interact with suppliers, customers, competitors, universities, and consultants to obtain external knowledge, and then these firms apply their absorptive capacity develop product and process innovations.

The third objective was to verify the mediating role of absorptive capacity in the relationship between inbound open

https://doi.org/10.25100/cdea.v38i72.11203

innovation and technological innovation in firms. Having access to sources of external knowledge is not enough to promote technological innovations. It is necessary to have the absorptive capacity to process and assimilate knowledge and apply it in the realization of product and process innovations.

This study contributes to the literature on innovation in food firms in an emerging economy, confirming that the implementation of inbound open innovation improves food firms' absorptive capacity and the development of technological innovations. Moreover, it has contributed to having a better understanding of the innovation processes in low-tech intensity firms in an emerging economy.

This study also provides practical implications. For example, it has been found that food firms turn more to institutional knowledge sources (universities, research institutes, associations) than to market sources (customers, suppliers and competitors). On

the other hand, although it is true that food firms invest little in research and development due to their low-tech intensity, it has been proven that this type of investment can improve their absorptive capacity, favoring the development of technological innovations. Additionally, it should be recommended to policy-makers from emerging economies, who should promote incentives to low-tech intensity firms, and especially to food firms, to develop the absorptive capacity of firms and the application of the inbound open innovation strategy to develop technological innovations. This will lead to the development of competitive advantages, which will allow food firms to survive in an increasingly demanding environment.

This study has the following limitations: It is by nature cross-sectional, and it is therefore difficult to make generalizations. Because of this, it is recommended to carry out longitudinal studies to verify the relationship between the different constructs. In addition, this study has been carried out with data from firms in Peru. Thus, it is suggested that comparative studies be carried out with data from other Latin American countries. It is also recommended to consider other variables, in addition to inbound open innovation and absorptive capacity, such as machinery acquisition or the realization of nontechnological innovations.

7. Conflict of interest

The authors declare no conflict of interest.

8. Source of Financing

This research received a grant from Universidad ESAN.

9. References

Albort-Morant, G., Henseler, J., Cepeda-Carrión, G., & Leal-Rodríguez, A. L. (2018). Potential and realized absorptive capacity as complementary drivers of green product and process innovation performance. *Sustainability*, *10*(2), 381. http://dx.doi.org/doi:10.3390/su10020381

Aliasghar, O., Rose, E. L., & Chetty, S. (2019). Where to search for process innovations? The mediating role of absorptive capacity and its impact on process innovation. *Industrial Marketing Management*, *82*, 199-212. http://dx.doi.org/10.1016/j.indmarman.2019.01.014

Arcese, G., Flammini, S., Lucchetti, M. C., & Martucci, O. (2015). Evidence and experience of open sustainability innovation practices in the food sector. *Sustainability*, *7*(7), 8067-8090. http://dx.doi:10.3390/su7078067

Bayona-Saez, C., Cruz-Cázares, C., García-Marco, T., & Sánchez García, M. (2017), "Open innovation in the food and beverage industry", *Management Decision*, *55*(3), 526-546. http://dx.doi.org/10.1108/MD-04-2016-0213

Beavers, A. S., Lounsbury, J. W., Richards, J. K., Huck, S. W., Skolits, G. J., & Esquivel, S. L. (2013). Practical considerations for using exploratory factor analysis in educational research. *Practical Assessment, Research, and Evaluation, 18*(1), 6. https://doi.org/10.7275/qv2q-rk76

Benitez, J., Henseler, J., Castillo, A., & Schuberth, F. (2020). How to perform and report an impactful analysis using partial least squares: Guidelines for confirmatory and explanatory IS research. *Information & Management*, *57*(2), 103168. https://doi.org/10.1016/j.im.2019.05.003

https://doi.org/10.25100/cdea.v38i72.11203

Bianchi, M., Croce, A., Dell'Era, C., Di Benedetto, C. A., & Frattini, F. (2016). Organizing for inbound open innovation: how external consultants and a dedicated R & D unit influence product innovation performance. *Journal of Product Innovation Management, 33*(4), 492-510. http://dx.doi.org/10.1111/jpim.12302

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Frontiers in public health,6*, 149. https://doi.org/10.3389/fpubh.2018.00149

Carrión, G. C., Nitzl, C., & Roldán, J. L. (2017). Mediation analyses in partial least squares structural equation modeling: Guidelines and empirical examples. *In Partial least squares path modeling* (pp. 173-195). Springer, Cham. https://doi.org/10.1007/978-3-319-64069-3_8

Chesbrough, H. W. (2006). The era of open innovation. *Managing innovation and change, 127*(3), 34-41. http://sloanreview.mit.edu/wp-content/uploads/2011/06/INS0111-Top-Ten-Innovation.pdf#page=37

Ciliberti, S., Carraresi, L., & Broering, S. (2016a). External knowledge sources as drivers for cross-industry innovation in the Italian food sector: does company size matter? *International Food and Agribusiness Management Review*, *19*(3), 77-98. https://doi.org/10.22004/ag.econ.244687

Ciliberti, S., Carraresi, L. and Bröring, S. (2016b), "Drivers of innovation in Italy: food versus pharmaceutical industry", *British Food Journal*, *118*(6), 1292-1316. https://doi.org/10.1108/BFJ-10-2015-0405

Cohen, W. M. & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128-152. https://doi.org/10.2307/2393553

Del Carpio Gallegos, J. F. & Miralles Torner, F. (2018). Absorptive capacity and innovation in low-tech companies in emerging economies. *Journal of technology management & innovation, 13*(2), 3-11. http://dx.doi.org/10.4067/S0718-27242018000200003

De Martino, M. & Magnotti, F. (2018), "The innovation capacity of small food firms in Italy", *European Journal of Innovation Management*, *21*(3), 362-383. https://doi.org/10.1108/EJIM-04-2017-0041

Engelman, R. M., Fracasso, E. M., Schmidt, S., & Zen, A. C. (2017). Intellectual capital, absorptive capacity and product innovation. *Management Decision*, *55*(3), 474-490. https://doi.org/10.1108/MD-05-2016-0315

Escribano, A., Fosfuri, A., & Tribó, J. A. (2009). Managing external knowledge flows: The moderating role of absorptive capacity. *Research policy*, *38*(1), 96-105. https://doi.org/10.1016/j.respol.2008.10.022

Fornell, C. & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of marketing research*, *18*(1), 382-388. http://www.jstor.org/stable/3151312

Ferreras-Méndez, J. L., Newell, S., Fernández-Mesa, A., & Alegre, J. (2015). Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity. *Industrial Marketing Management*, *47,* 86-97. https://doi.org/10.1016/j.indmarman.2015.02.038

Frick, F., Jantke, C., & Sauer, J. (2019). Innovation and productivity in the food vs. the high-tech manufacturing sector. *Economics of Innovation and New Technology*, *28*(7), 674-694. https://doi.org/10.1080/10438599.2018.1557405

Gentile-Lüdecke, S., de Oliveira, R. T., & Paul, J. (2020). Does organizational structure facilitate inbound and outbound open innovation in SMEs? *Small Business Economics, 55*(4), 1091-1112. https://doi.org/10.1007/s11187-019-00175-4

Gkypali, A., Arvanitis, S., & Tsekouras, K. (2018). Absorptive capacity, exporting activities, innovation openness and innovation performance: A SEM approach towards a unifying framework. *Technological Forecasting and Social Change, 132,* 143-155. https://doi.org/10.1016/j.techfore.2018.01.025

Gómez, J., Salazar, I., & Vargas, P. (2016). Sources of information as determinants of product and process innovation. *PloS one*, *11*(4), e0152743. https://doi.org/10.1371/journal.pone.0152743

Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM) An emerging tool in business research. *European Business Review*, *26*(2), 106-121. https://doi.org/10.1108/EBR-10-2013-0128

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM).* Sage Publications.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2-24. https://doi.org/10.1108/EBR-11-2018-0203

Hullova, D., Simms, C. D., Trott, P., & Laczko,

https://doi.org/10.25100/cdea.v38i72.11203

P. (2019). Critical for effective management of complementarity between product and process innovation: Cases from the food and drink industry. *Research Policy*, *48*(1), 339-354. https://doi.org/10.1016/j.respol.2018.09.001

Jeong, S. W., Chung, J. E., & Roh, J. S. (2019). Impact of external knowledge inflow on product and process innovation of Korean SMEs: Absorptive Capacity as a Mediator. *Clothing and Textiles Research Journal*, *37*(4), 219-234. https://doi.org/10.1177/0887302X19860913

Kim, J. & Choi, S. O. (2020). A Comparative Analysis of Corporate R&D Capability and Innovation: Focused on the Korean Manufacturing Industry. *Journal of Open Innovation: Technology, Market, and Complexity*, *6*(4), 100. https://doi.org/10.3390/joitmc6040100

Lefebvre, V. M., De Steur, H., & Gellynck, X. (2015). External sources for innovation in food SMEs. *British Food Journal*, *117*(1), pp. 412-430. https://doi.org/10.1108/BFJ-09-2013-0276

Manfio, N. M. & Lacerda, D. P. (2015). Definition of scope in new product development projects for the food industry: a proposed method. *Gestão & Produção*, *23,* 18-36. https://doi.org/10.1590/0104-530X1009-13

Moilanen, M., Østbye, S., & Woll, K. (2014). Non-R&D SMEs: external knowledge, absorptive capacity and product innovation. *Small Business Economics*, *43*(2), 447-462. https://doi.org/10.1007/s11187-014-9545-9

Naqshbandi, M. M. (2016). Managerial ties and open innovation: examining the role of absorptive capacity. *Management Decision*, *54*(9), 2256-2276. https://doi.org/10.1108/MD-03-2016-0161

Oliveira, C. A. O., Ruffoni, E. P., Maçada, A. C. G., & Padula, Â. D. (2019). Innovation capabilities in the food processing industry in Brazil. *British Food Journal, 121*(11), 2901-2918. https://doi.org/10.1108/BFJ-10-2018-0647

Park, J. & Kim, S. (2015). The differentiating effects of workforce aging on exploitative and exploratory innovation: The moderating role of workforce diversity. *Asia Pacific Journal of Management*, *32*(2), 481-503. https://doi.org/10.1007/s10490-014-9407-7

Piening, E. P. & Salge, T. O. (2015). Understanding the antecedents, contingencies, and performance implications of process innovation: A dynamic capabilities perspective. *Journal of Product Innovation Management, 32*(1), 80-97. https://doi.org/10.1111/jpim.12225

Polo Otero, J. L., Ramos Ruiz, J. L., Arrieta Barcasnegras, A., y González Fernández, A. (2017). Relación entre I+ D, actividades innovadoras y resultados empresariales: un análisis para el sector de alimentos y bebidas en Colombia. *Dimensión Empresarial*, *15*(1), 175-197. https://doi.org/10.15665/rde.v15i1.1246

Rahomee, A. Q. & Kumar, D. (2014). The Mediating Role of Absorptive Capacity in Its Effect on Organizational Support Factors and Technological Innovation. *Information Management and Business Review*, *6*(1), 25-41. https://doi.org/10.22610/imbr.v6i1.1098

Rammer, C., Czarnitzki, D., & Spielkamp, A. (2009). Innovation success of non-R&D-performers: substituting technology by management in SMEs. *Small Business Economics*, *33*(1), 35-58. https://doi.org/10.1007/s11187-009-9185-7

Rossoni, L., Engelbert, R., & Bellegard, N. L. (2016). Normal science and its tools: Reviewing the effects of exploratory factor analysis in management. *Revista de Administração*, *51,* 198-211. https://doi.org/10.5700/rausp1234

Sáenz, M. J., Revilla, E., & Knoppen, D. (2014). Absorptive capacity in buyer–supplier relationships: empirical evidence of its mediating role. *Journal of Supply Chain Management, 50*(2), 18-40. https://doi.org/10.1111/jscm.12020

Salgado-Beltrán, L., Beltrán-Morales, L. F., Velarde-Mendivil, A. T., & Robles-Baldenegro, M. E. (2018). Attitudes and sensory perceptions of food consumers towards technological innovation in Mexico: A case-study on rice-based dessert. *Sustainability*, *10*(1) 175. https://doi.org/10.3390/su10010175

Santoro, G., Vrontis, D., & Pastore, A. (2017). External knowledge sourcing and new product development. *British Food Journal*, *119*(11), 2373-2387. https://doi.org/10.1108/BFJ-02-2017-0120

Sarkar, S. & Costa, A. I. (2008). Dynamics of open innovation in the food industry. *Trends in Food Science & Technology*, *19*(11), 574-580. https://doi.org/10.1016/j.tifs.2008.09.006

Spithoven, A., Clarysse, B., & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation, 30*(2), 130-141. https://doi.org/10.1016/j.technovation.2009.08.004

Sofka, W. & Grimpe, C. (2010). Specialized search and innovation performance–evidence across Europe.*R&DManagement,40*(3),310-323.https://doi.org/10.1111/j.1467-9310.2010.00592.x

https://doi.org/10.25100/cdea.v38i72.11203

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Tenenhaus, M., Vinzi, V. E., Chatelin, Y. M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics & Data Analysis*, *48*(1), 159-205. https://doi.org/10.1016/j.csda.2004.03.005

Vinzi, V. E., Chin, W. W., Henseler, J., & Wang, H. (2010). *Handbook of partial least squares* (Vol. 201).Springer.

Wetzels, M., Odekerken-Schröder, G., & Van Oppen, C. (2009). Using PLS Path Modeling for Assessing Hierarchical Construct Models: Guidelines and Empirical Illustration. USA: *MIS Quarterly*, *33*(1), 177-195. https://doi.org/10.2307/20650284

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185-203. https://doi.org/10.5465/amr.2002.6587995

How to cite this paper?

Del Carpio Gallegos, J. F. & Mikhieieva, O. (2022). Impact of Open Innovation in Peruvian food firms. *Cuadernos de Administración, 38*(72), e2111203. https://doi.org/10.25100/cdea.v38i72.11203