Absorptive capacity and innovation in low-tech companies in emerging economies

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Abstract: Innovation capacity is on the focus of policy makers in emerging economies. Although some studies show the antecedents of innovation capacity for developed economies and high technological industries, scant research outcomes exist for different settings. This study tries to shed some light on the drivers of innovation capacity for low technological companies in emerging economies.

Using the absorptive capacity as a driver of technological and non-technological innovation capacity, this study proposes a SEM model to contribute to the literature of innovation capacity including technological and non-technological innovation, and the relationship between them, in low-techonology industries in an emerging economy. A sample of 706 manufacturing companies from Peru is used.

The academic contribution of this study states that absorptive capacity favors technological and non-technological innovation capacity and that non-technological innovation affects technological one. Accordingly, managerial contribution suggests improving absorptive capacity levels to internal R&D activities but also to organizational and marketing innovation activities.

Keywords: Absorptive capacity; Technological innovation; Non-technological innovation; Low technological intensity; Peru.

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1. Introduction

Innovation helps companies respond to competitive challenges in globalized environments (Hausman, & Johnston, 2014). For this reason, Prajogo & Ahmed (2006, p 504) define the innovation capacity "as the organizational potential to innovate, which is determined by the skills and strengths in R&D and technology". The innovation capacity allows companies to achieve the following results: improve company performance (Jiménez-Jiménez & Sanz-Valle, 2011); (Santos, Basso, Kimura, & Kayo, 2014); generate competitive advantage (Coccia, 2017); increase exports (Love & Roper, 2015); and contribute to growth (George, McGahan, & Prabhu, 2012).

Innovation studies have focused on innovation capacity for technological innovation activities in companies of high technological intensity in developed countries (Wang & Rafiq 2014); (Tzokas, Kim, Akbar, & Al-Dajani, 2015). Although these studies have allowed analyzing the role of innovation in business performance, there are scant research studies in countries of emerging economies that focus in low technological industries (Hervas-Oliver, Albors-Garrigos, de-Miguel & Hidalgo, 2012). Consequently, it is necessary to verify current studies for new environments.

Specifically, Latin America is a region with low levels of research studies (Aguilera, Ciravegna, Cuervo-Cazurra, & Gonzalez-Perez, 2017) on innovation capacity. To allow Latin American companies to face the current challenges of the global economy, more studies are needed to understand the innovation capacity drivers in their settings. That should help in the decision-making process of investing in innovation, contributing to the growth of their economies by creating jobs, generating exports, and better products and services for their consumers (Brenes, Camacho, Ciravegna, & Pichardo, 2016).

Moreover, it can be observed that studies have focused on technological innovation; however, studies on the so-called non-technological innovation (Ali & Park, 2017) and, in particular, the relationship between non-technological innovation and technological innovation have gained increasing interest. (Camisón, C., & Villar-López, 2014). Both from the academic and from the practical points of view, it is interesting to know if there are interdependencies between them, if they have common origins, in short, if what we know about one of them can be applied to the other.

Furthermore, according to the OECD (2011), manufacturing companies can be classified into four categories: high, medium high, médium low and low technological intensity. This study analyzes manufacturing companies of low technological intensity. Low technological intensity companies are characterized by gradual adoption of innovation and a constant improvement of their products according to market demand; they focus on production efficiency, product differentiation and marketing (Von Tunzelmann & Acha, 2005).We find these companies in economic activities, such as food and beverages, textiles, leather and footwear, printing and publishing, chemical products, excluding pharmaceutical products, machinery and electrical appliances, among others.

It is important to point out that there are enough studies to support that absorptive capacity is a dynamic capacity that allows to explain innovation capacity developments, both technological and non-technological (Zahra & George, 2002). In this research work, we intend to go one step further and analyze how non-technological innovation is related to technological innovation. Specifically, we want to see if we can propose that non-technological innovation mediates in the relationship between absorptive capacity and technological innovation.

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This study contributes in several ways in this research stream. First, how Peruvian, an emerging economy, manufacturing low technological intensity companies (Low-Tech) carry out innovations. Second, it proposes an alternative to traditional innovation models that are not able to explain product and process innovations (Trott and Simms, 2017). Third, it also contributes to enrich the literature related to showing the relationships between non-technological innovation and technological innovation (Volberda, Van Den Bosch & Heij, 2013). Finally, it contributes to carry out this research in the context of an emerging economy (Geldes, Felzensztein, & Palacios-Fenech, 2017). Therefore, in an emerging economy and low technological industries settings, their objectives are as follow:

- Show how absorptive capacity helps non-technological innovations and technological innovations.
- Analyze how non-technological innovations impact on technological innovations in low technological intensity companies.
- Determine non-technological innovation as a mediator in the relationship between absorptive capacity and technological innovation.

This study manages to obtain results that allow to affirm that the absorptive capacity is associated to technological and non-technological innovations. As well, identifying the mediator role of non-technological innovation in the relationship between absorptive capacity and technological innovation. These results contribute to the academic literature that emphasizes the role of absorptive capacity and its relation to the innovation developed by low-tech companies in emerging economies. This contribution also has implications for managers who can gain better understanding of the role of absorptive capacity in strengthen their companies' innovation capacity

Next, the structure of the document is detailed: first, the theoretical background and hypothesis; then, the method used to test the hypotheses applying the Partial Least Squares (PLS) technique; and finally, the results, discussion, and conclusions are presented.

2. Theoretical background and hypotheses

Companies that face competitive environments must count on knowledge as one of their most valuable resources (Liao & Wu, 2010). The consolidation of acquired knowledge is determined by the absorptive capacity development (Sun & Anderson, 2010). Cohen & Levinthal (1990) point out that absorptive capacity is the company's ability to recognize the value of new and external information, assimilate it and apply it for commercial purposes and for its critical innovative capabilities. This dynamic capacity allows them a better condition to develop innovations (Andriopoulos & Lewis, 2009).

In previous research, such as that carried out by Schmidt & Rammer (2006), they found that companies that had greater absorptive capacity have had more possibilities to carry out product, process, organizational or marketing innovations. Also, Calero-Medina & Noyons (2008) carried out a mapping of the studies related to absorptive capacity and its linkage with several domains. They found that the relationship between absorptive capacity and organizational innovation is significant. In addition, Chen & Chang (2012) found that, to the extent that the company has a greater degree of absorptive capacity, the greater the degree of organizational innovation.

On the other hand, in the relationship between absorptive capacity and technological innovation, it should be considered that Kostopoulos, Papalexandris, Papachroni, & Ioannou (2011) point out that absorptive capacity directly and indirectly influences innovation. Also, Rangus & Slavec (2017) proposed a model with a sample of 421 manufacturing and service companies, and found that absorptive capacity influences product and process innovations. In addition, Ali & Park (2017) analyzed a sample of 347 Korean industrial companies that had high levels of potential absorptive capacity and found that this leads to high levels of product and process innovations.

Although this theoretical background could be enough for developed economies and high technological companies, we cannot assume that the current background can be applied to an emerging economy and low-technology companies. In order to propose an extension of these studies to an emerging economy, where companies have a specific innovation adoption and the economic growth has a different path, the following hypothesis can be proposed:

Hypothesis 1a: The absorptive capacity helps to improve the development of non-technological innovations of Low-Tech companies in emerging economies.

Hypothesis 1b: The absorptive capacity contributes to improve the development of technological innovations of Low-Tech companies in emerging economies.

The literature review indicates that non-technological innovations and technological innovations have been studied independently and in a related manner. For example, Schmidt & Rammer (2007) analyze the effects of non-technological innovations (organizational and marketing innovations) and compare them with technological innovations, using a German CIS 4 database carried out in 2005. Their results show that technological and non-technological innovations are closely related to one another; thus, it can be said that marketing innovations coincide with innovations in products, or organizational innovations often introduce new process innovations.

Also, Mothe & Uyen Nguyen Thi (2010) studied the importance of marketing innovation, which favors the propensity to innovate. Both marketing and organizational innovation lead to a greater propensity to introduce new or improved products or services.

Furthermore, Battisti & Stoneman (2010) indicated that the wide range of innovations can be summarized in two great categories: the organizational and the technological, both complementary, but not substitutes the one of the others.

Likewise, Camisón & Villar-López (2014) conducted an investigation on innovation and confirmed that organizational innovation favors the development of technological innovations and both allow the company to improve its performance. It should be noted that Min, Ling, & Piew (2015) analyzed how organizational innovation mediates the relationship between absorptive capacity and technological innovation.

On the other hand, to differentiate the innovation concepts, Geldes et al. (2017) indicate that innovation, in a company, can be non-technological, such as organizational and marketing innovation; or technological, product and process innovations. The authors propose a model that aims to have a better understanding of how non-technological innovation influences technological innovation.

Therefore, the following hypothesis can be proposed:

Hypothesis 2: Non-technological innovation mediates the relationship between the absorptive capacity and technological innovation of Low-Tech companies in emerging economies.

3. Methods

3.1 Data collection and sample

For the present empirical study, the data collected in the National Survey of Innovation in the Manufacturing Industry 2015 was used, a survey applied to the Peruvian manufacturing companies to obtain information about their innovation processes; carried out in coordination with the Ministry of Economy and Finance (MEF), National Council of Science, Technology and Technological Innovation (Concytec) and the National Institute of Statistics and Informatics (INEI). The design of this survey was developed based on the methodological framework of the "Bogota Manual", which in turn will allow the development of indicators comparable to the results of other Latin American countries. The information collection was during the reference period 2012-2014 and had a representative sample of 1452 companies (INEI questionnaire, 2015), among large, medium and small companies from different regions of the country; however, for the purposes of the study and omitting lost values, 706 manufacturing companies with low technological intensity were considered.

Although the performance of the Peruvian economy in recent decades has been recognized by many authors (Chaston & Scott, 2012), it has also been said that the Peruvian economy has some limitations, "Yet despite this exceptional performance, the country still lags behind other middle-income Latin American economies in terms of per capita income and productivity. The Peruvian economy remains relatively undiversified, largely dependent on natural resources" (Zuniga, 2015, p. 2). Moreover, a characteristic of the Peruvian innovation system is that the Peruvian universities contribute very little to scientific production related to research, development and innovation (Vílchez-Román, 2014). These traits could explain why Peru is ranked 70th in the ranking of the Global Innovation Index 2017 report (Cornell University, INSEAD, and WIPO, 2017).

3.2 The measurement of the variables

The absorptive capacity is measured taking as reference the proposal of Escribano, Fosfuri, & Tribó (2009) and Rammer, Czarnitzki, & Spielkamp (2009). In this regard, there are three variables: (1) expenditures on internal research and technological development activities; (2) training expenses for innovation activities; and (3) if the company has a research and development department. All variables are dichotomous (YES or NO).

Following the Gronum (2012) approach, non-technological innovation has two dimensions: organizational innovation and marketing innovation. Organizational innovation is the sum of the dichotomous answers of three questions, the company carried out the following activities: new business practices, new methods of organizing work and new methods of organizing external relations with other companies or public institutions. In the same way, the marketing innovation shows the result of the sum of the dichotomous answers of four questions: significant changes in the design or packaging of the good or service, new means or techniques of product promotion, new methods for the positioning of the product in the market or sales channels.

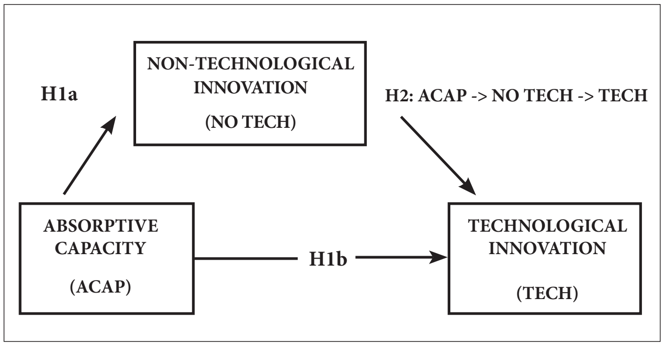
While technological innovation has two dimensions: product innovation and process innovation (Gronum, 2012). Product innovation, the result of the sum of the dichotomous answers of the following questions if the company succeeded in introducing to the market the following: good new, new service, significantly improved and significantly improved service. Process innovation, is the result of the sum of the dichotomous answers to ask if it was possible to introduce the following: new method of production of goods or provision of services; new method of logistics, distribution or dispatch of inputs, goods or service; new activity to support production, such as maintenance or procurement systems, accounting or information technology; methods of production of goods or provision of services significantly improved; logistics method, distribution or dispatch of inputs, goods or services significantly improved; and production support activity, such as significantly improved maintenance or procurement systems, accounting or computing.

Also, the following control variables have been considered: the size of the company, variable measured by the logarithm of the total number of employees, according to Caloghirou, Kastelli, & Tsakanikas (2004) and Schoenmakers & Duysters (2006); professionals and researchers (measured as the ratio between professionals and researchers and the total number of employees), because, according to Tsai (2009), technological innovation is often influenced by the quality of the company's human resources; type of industry, the various environmental dimensions are captured, such as the technological opportunity and the intensity of the competition, according to Tsai (2009), focusing on three types of representative Low-Tech industries, food, clothing and textiles.

3.3 Data Analysis

To analyze the research model in Figure 1, the evaluation of the hypotheses was carried out with the structural equation model (SEM). non-technological innovation

Figure 1: Conceptual model.



3.4 Statistical analysis

SmartPLS 3 estimates the process of the SEM estimation and analysis model, using the PLS technique in two steps, according to Chin, Marcolin, & Newsted (2003). 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 relations between the constructs are obtained, through the path coefficients and the level of significance.

4. Results

Through factor analysis with varimax rotation, we verified the importance of the correlation matrix with Bartlett's contrast. In this case, the correlations taken as a whole are significant at a significance level of 0.05 (Bartlett's sphericity test = 1321.169, gl = 21, $p < .001$). On the other hand, the adequacy measure of the Kaiser-Meyer-Olkin sample is also within the acceptance range (0.809). The factorial solution converges in three factors that explain 71.516% of the variance. The configuration matrix, table 1, offers the saturations of the variables in the factors of the rotated solution. These saturations represent the net contribution of each variable in each factor.

Table 1. Matrix of configuration of the rotated factors.

Name of the factor	Description of the variable	Factor 1	Factor 2	Factor 3
Absorptive capacity (ACAP)	Expenses in internal R&D	0.896		
	Training expenses for innovation activities	0.366		
	R&D Department	0.433		
Non-technological innovation (NO TECH)	**Organization innovation**		0.500	
	Marketing innovation		0.764	
Technological innovation (TECH)	Product innovation			0.460
	Process innovation			0.812

The correlations of the variables of absorptive capacity, non-technological and technology innovation are presented, see annex 7.1. In addition, the graph of the measurement and structural model in annex 7.2.

4.1 Measurement model

The research data is analyzed and presented, using indicators of reliability and convergence. In terms of reliability measured by the Cronbach's Alpha (CA) coefficient, the constructs have a value very close to 0.7. With respect to the Composite Reliability (CR), all the constructs present values greater than 0.7; as well as the Average Variance Extracted (AVE) that is above 0.5. In addition, it can be seen that multicollinearity, Variance Inflation Factor (VIF), is controlled, with values less than 5. Based on the results of the indicators, table 2, it is possible to carry out the structural model. In addition, all the values of are accepted in the endogenous variables, which represents a good effect for the model when considering companies of low technological intensity. Finally, Table 3 reveals that all variables achieve discriminant validity following the criteria of Fornell & Larcker (1981).

Table 2. Indicators of reliability, validity.

Latent variable	CA	CR	AVE	VIF	
Technological innovation	0.696	0.868	0.767		0.433
Non-technological innovation	0.698	0.869	0.768	1.221	0.176
Absorptive capacity	0.609	0.788	0.560	1.369	
Referential values	>0.7	>0.7	>0.5	<5	

CA, Cronbach's Alpha; CR, Composite Reliability; AVE, Average Variance Extracted; VIF, Variance Inflation Factor.

Table 3. Discriminant validity.

	ACAP	Non-technological innovation	Technological innovation
ACAP	**0.748**		
Non-technological innovation	0.419	**0.876**	
Technological innovation	0.484	0.597	**0.876**

Notes: Fornell-Larcker criterion: the diagonal elements (italics) are the square root of the variance shared between the constructs and their measurements (AVE). For discriminant validity, AVE square root (in bold) is greater than the correlations between the other latent variables.

4.2 Structural model

After evaluating the measurement models, we proceed to estimate the structural model. See annex 1.1. Table 4 shows the coefficients and p value of the research model under study. To generate statistical significance in the hypotheses, according to Hair, Sarstedt, Hopkins, & Kuppelwieser (2014), the bootstrapping technique is used, with 1000 re-samples.

Table 4. Results of the structural model.

Hypothesis	Endogenous variable	Direct effect	Indirect effect	p-Value
	NO TECH (= 0.176)			
H1a	ACAP -> NO TECH	0.467 ***		0.001
	TECH (=0.433)			
H1b	ACAP -> TECH	0.316 ***		0.001
	NO TECH -> TECH	0.475 ***		0.001
H2	ACAP -> NO TECH -> TECH		0.222 ***	0.001

The direct effects are positive and significant. As well as the existence of an indirect effect of the absorptive capacity in technological innovation through non-technological innovation. The empirical results support the acceptance of the hypotheses.

4.3 Analysis of mediation

When analyzing non-technological innovation, certain steps are evaluated to confirm if it is a mediating variable and the type of effect. According to Hair et al. (2014), mediation represents a situation in which a mediating variable to some extent absorbs the effect of an exogenous construct (with independent variables) in an endogenous construct (with the dependent variable) in the PLS path model. The evaluation of variance accounted for (VAF) determines to what extent the mediation process explains the variance of the dependent variable. The rule is, 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, & Sarstedt, 2016); and a VAF above 80 percent indicates full mediation. The VAF is the ratio between the indirect effect (0.467 * 0.475 = 0.222) and the total effect (0.538); obtaining 41%. Therefore, a partial mediation of non-technological innovation is presented.

4.4 Control variables

Table 5 shows the coefficients, standard deviation and p value of the control variables.

Table 5. Control variables.

Control variables	Coefficient	Standard deviation	P-Value
Size of the company	0.000	0.032	0.998
Professionals and researchers	-0.003	0.024	0.905
Food companies	-0.091	0.035	0.009
Garment companies	-0.067	0.033	0.043
Textile companies	-0.037	0.028	0.18

It can be seen that the control variables related to whether the Low-Tech company belongs to the food and clothing industries are statistically significant, small in size and negative. While the control variables such as: size of the company, professionals and researchers, and companies in the textile industry are not statistically significant, that is, they do not influence technological innovations.

5. Discussion

In the first place, the results show that the H1a hypothesis is accepted, the absorptive capacity contributes to improve the development of the non-technological innovations in Low-Tech companies in Peru, which is consistent with the Chen & Chang study (2012) for developed econmies.

Second, the structural equation model tells us that the H1b hypothesis is accepted, that is, that the absorptive capacity helps to improve the development of technological innovations in Low-Tech companies. This result coincides with the results of the studies carried out by Rangus & Slavec (2017) and Ali & Park (2017) that indicate that the higher the level of absorptive capacity, the higher the level of product or process innovation that are detected.

Third, the mediation analysis shows that hypothesis 2 must be accepted, that is, non-technological innovation has a partial mediating role in the relationship between absorptive capacity and technological innovation. This result coincides with that obtained by Min et al. (2015), highlighting that our study contributes by including marketing innovation as a dimension of non-technological innovation

In relation to the academic implications, we present the contributions of the present study, such as: enrich the literature of non-technological innovation with a new paradigm of innovation (Volberda et al., 2013); corroborate that absorptive capacity explains the development of innovation, not only in companies with high technological intensity, but also in companies with low technological intensity; and in a special way it contributes to the innovation studies carried out in an emerging economy, such as the Peruvian economy.

Regarding the practical implications, it can be pointed out that the Low-tech company managers of the companies in emerging economies must promote the increase of the levels of absorptive capacity to favor the development of non-technological and technological innovations. Meanwhile, policymakers should encourage companies with low technological intensity, because these companies contribute to economic growth, create new jobs, and generate exports.

6. Conclusion, limitations, and future investigations

Based on a sample of 706 manufacturing companies in Peru belonging to the category of companies of low technological intensity, and through the implementation of a model of structural equations of partial least squares that have allowed to evaluate the hypothesis, the results indicate that improving absorptive capacity level favors the development of technological and non-technological innovations, and the realization of non-technological innovations play a partial mediating role in the relationship between absorptive capacity and technological innovations.

However, there are some limitations, the cross-sectional nature of this study limits to generalize the causality between the constructs. A second limitation is the way in which absorptive capacity has been measured; the approach of Jiménez-Barrionuevo, García-Morales, & Molina (2011) can be used in future research.

While it is suggested that future research be carried out in emerging economies, focusing on companies of low technological intensity, considering different industries, for example: food, beverage and soft drink industries, clothing industries, in order to identify patterns of behavior in carrying out activities that lead to innovation development. Or, it would also be very valuable to carry out comparative studies among Latin American countries, which help governments to improve the policies promoting innovations developments.

7. Bibliography

Ali, M., & Park, K. (2017). The mediating role of an innovative culture in the relationship between absorptive capacity and technical and non-technical innovation. Journal of Business Research, 1669-1675. doi: 10.1016/j.jbusres.2015.10.036

Aguilera, R. V., Ciravegna, L., Cuervo-Cazurra, A., & Gonzalez-Perez, M. A. (2017). Multilatinas and the internationalization of Latin American firms. Journal of World Business. doi: 10.1016/j.jwb.2017.05.006

Andriopoulos, C., & Lewis, M. W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. Organization Science, 696-717. doi: 10.1287/orsc.1080.0406

Battisti, G., & Stoneman, P. (2010). How innovative are UK firms? Evidence from the fourth UK community innovation survey on synergies between technological and organizational innovations. British Journal of Management, 187-206. doi: 10.1111/j.1467-8551.2009.00629.x

Brenes, E. R., Camacho, A. R., Ciravegna, L., & Pichardo, C. A. (2016). Strategy and innovation in emerging economies after the end of the commodity boom—Insights from Latin America. Journal of Business Research, 69(10), 4363-4367. doi: 10.1016/j.jbusres.2016.03.059

Calero-Medina, C., & Noyons, E. C. (2008). Combining mapping and citation network analysis for a better understanding of the scientific development: The case of the absorptive capacity field. Journal of Informetrics, 272-279. doi: 10.1016/j.joi.2008.09.005

Caloghirou, Y., Kastelli, I., & Tsakanikas, A. (2004). Internal capability and external knowledge sources: complements or substitutes for innovative performance? Technovation, 29–39. doi: 10.1016/s0166-4972(02)00051-2

Camisón, C., & Villar-López, A. (2014). Organizational innovation as an enabler of technological innovation capabilities and firm performance. Journal of Business Research, 2891-2902. doi: 10.1016/j.jbusres.2012.06.004

Chen, S. T., & Chang, B. G. (2012). The effects of absorptive capacity and decision speed on organizational innovation: a study of organizational structure as an antecedent variable. Contemporary Management Research, 27. doi: 10.7903/cmr.7996

Chin, W., Marcolin, B., & Newsted, P. (2003). A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-mail Emotion/Adoption Study. Information Systems Research, 189-217. doi: 10.1287/isre.14.2.189.16018

Coccia, M. (2017). Sources of technological innovation: Radical and incremental innovation problem-driven to support competitive advantage of firms. Technology Analysis & Strategic Management, 29(9), 1048-1061. doi: 10.1080/09537325.2016.1268682

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. Administrative science quarterly, 128-152. doi: 10.2307/2393553

Cornell University, INSEAD, and WIPO (2017): The Global Innovation Index 2017: Innovation Feeding the World, Ithaca, Fontainebleau, and Geneva. ISSN 2263-3693. ISBN 979-10-95870-04-3

Cuestionario INEI. (2015). Perú: Encuesta Nacional de Innovación en la Industria Manufacturera, 2015. Obtenido del Instituto Nacional de Estadística e Informática.http://iinei.inei.gob.pe/iinei/srienaho/descarga/DocumentosZIP/2015-105/02_Cuestionario.zip

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

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, 106-121. doi: 10.1108/ebr-10-2013-0128

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of marketing research, 382-388. doi: 10.2307/3150980

Geldes, C., Felzensztein, C., & Palacios-Fenech, J. (2017). Technological and non-technological innovations, performance and propensity to innovate across industries: The case of an emerging economy. Industrial Marketing Management, 55-66. doi: 10.1016/j.indmarman.2016.10.010

George, G., McGahan, A. M., & Prabhu, J. (2012). Innovation for inclusive growth: Towards a theoretical framework and a research agenda. Journal of management studies, 49(4), 661-683. doi: 10.1111/j.1467-6486.2012.01048.x

Gronum, S. V. (2012). The role of networks in small and medium-sized enterprise innovation and firm performance. Journal of Small Business Management, 257-282. doi: 10.1111/j.1540-627x.2012.00353.x

Hair Jr, J., Hult, T., Ringle, C., & Sarstedt, M. (2016). A primer on partial least squares structural equation modeling (PLS-SEM). Los Ángeles: Sage Publications. ISBN: 9781452217444

Hausman, A., & Johnston, W. J. (2014). The role of innovation in driving the economy: Lessons from the global financial crisis. Journal of Business Research, 67(1), 2720-2726. doi: 10.1016/j.jbusres.2013.03.021

Hervas-Oliver, J. L., Albors-Garrigos, J., de-Miguel, B., & Hidalgo, A. (2012). The role of a firm's absorptive capacity and the technology transfer process in clusters: How effective are technology centres in low-tech clusters?. Entrepreneurship & Regional Development, 24(7-8), 523-559. doi: 10.1080/08985626.2012.710256

Jiménez-Barrionuevo, M. M., García-Morales, V. J., & Molina, L. M. (2011). Validation of an instrument to measure absorptive capacity. Technovation, 31(5):190-202. doi: 10.1016/j.technovation.2010.12.002

Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. Journal of business research, 64(4), 408-417. doi: 10.1016/j.jbusres.2010.09.010

Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. Journal of Business Research, 64(12), 1335-1343. doi: 10.1016/j.jbusres.2010.12.005

Liao, S. H., & Wu, C. C. (2010). System perspective of knowledge management, organizational learning, and organizational innovation. Expert systems with Applications, 37(2), 1096-1103. doi: 10.1016/j.eswa.2009.06.109

Love, J. H., & Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. International Small Business Journal, 33(1), 28-48. doi: 10.1177/0266242614550190

Min, W. Z., Ling, K. C., & Piew, T. H. (2015). The Effects of Technological Innovation, Organizational Innovation and Absorptive Capacity on Product Innovation: A Structural Equation Modeling Approach. . Asian Social Science, 199. doi: 10.5539/ass.v12n1p199

Mothe, C., & Uyen Nguyen Thi, T. (2010). The link between non-technological innovations and technological innovation. European Journal of Innovation Management, 313-332. doi: 10.1108/14601061011060148

OECD (2011), OECD Science, Technology and Industry Scoreboard 2011, OECD Publishing, Paris. doi: 10.1787/sti_scoreboard-2011-14-en

Prajogo, D. I., & Ahmed, P. K. (2006). Relationships between innovation stimulus, innovation capacity, and innovation performance. R&D Management, 36(5), 499-515. doi: 10.1111/j.1467-9310.2006.00450.x

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

Rangus, K., & Slavec, A. (2017). The interplay of decentralization, employee involvement and absorptive capacity on firms' innovation and business performance. Technological Forecasting and Social Change. doi: 10.1016/j.techfore.2016.12.017

Santos, D. F. L., Basso, L. F. C., Kimura, H., & Kayo, E. K. (2014). Innovation efforts and performances of Brazilian firms. Journal of Business Research, 67(4), 527-535. doi: 10.1016/j.jbusres.2013.11.009

Schmidt, T., & Rammer, C. (2006). The determinants and effects of technological and non technological innovations–Evidence from the German CIS IV. Zentrum für Europäische Wirtschaftsforschung (ZEW), Mannheim.

Schmidt, T., & Rammer, C. (2007). Non-technological and technological innovation: strange bedfellows?. Centre for European Economic Research Discussion, 1-50. doi: 10.2139/ssrn.1010301

Schoenmakers, W., & Duysters, G. (2006). Learning in strategic technology alliances. Technology Analysis & Strategic Management, 245–264. doi: 10.1080/09537320600624162

Sun, P.-T., & Anderson, M. (2010). An examination of the relationship between absorptive capacity and organizational learning, and a proposed integration. International Journal of Management Review, 130-150. doi: 10.1111/j.1468-2370.2008.00256.x

Trott, P., & Simms, C. (2017). An examination of product innovation in low-and medium-technology industries: Cases from the UK packaged food sector. Research Policy, 46(3), 605-623. doi: 10.1016/j.respol.2017.01.007

Tsai, K. H. (2009). Collaborative networks and product innovation performance: Toward a contingency perspective. Research policy, 38(5), 765-778. doi: 10.1016/j.respol.2008.12.012

Tzokas, N., Kim, Y. A., Akbar, H., & Al-Dajani, H. (2015). Absorptive capacity and performance: The role of customer relationship and technological capabilities in high-tech SMEs. Industrial Marketing Management, 47, 134-142. doi: 10.1016/j.indmarman.2015.02.033

Volberda, H. W., Van Den Bosch, F. A., & Heij, C. V. (2013). Management innovation: Management as fertile ground for innovation. European Management Review, 10(1), 1-15. doi: 10.1111/emre.12007

Von Tunzelmann, N., & Acha, V. (2005). Innovation in "low-tech" industries. In The Oxford handbook of innovation. doi: 10.1093/oxfordhb/9780199286805.003.0015

Wang, C. L., & Rafiq, M. (2014). Ambidextrous organizational culture, contextual ambidexterity and new product innovation: a comparative study of UK and Chinese high-tech firms. British Journal of Management, 25(1), 58-76. doi: 10.1111/j.1467-8551.2012.00832.x

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

8. Annexes

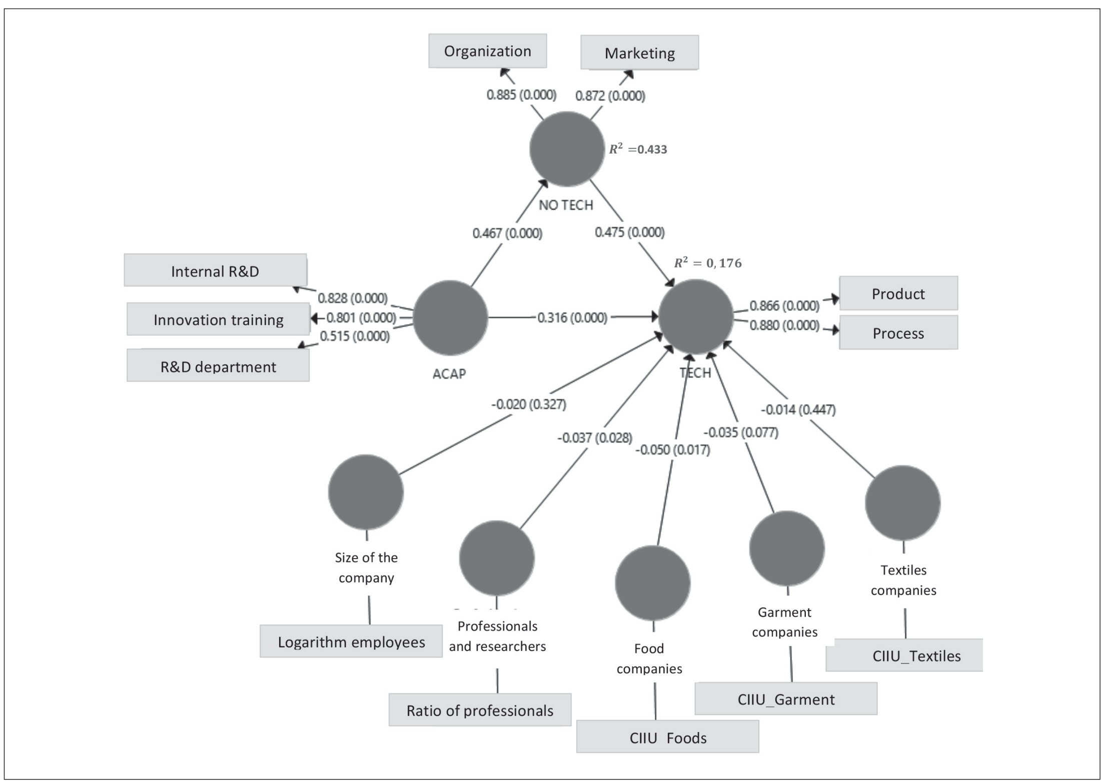
8.1 Correlation matrix

Table 6. Descriptive statistics and correlation of all companies with low technological intensity.

Variables	Mean	Standard desviation	Internal R&D expenses	Innovation training expenses	R&D Department	Organization innovation	Marketing innovation	Product innovation	Process innovation
Internal R&D expenses	0.23	0.421	1						
Innovation training expenses	0.22	0.417	0.426	1					
R&D Department	0.22	0.416	0.421	0.179	1				
Organization innovation	0.64	0.924	0.310	0.326	0.145	1			
Marketing innovation	0.84	1.206	0.345	0.270	0.191	0.537	1		
Product innovation	0.65	0.852	0.436	0.315	0.230	0.397	0.457	1	
Process innovation	1.01	1.452	0.338	0.348	0.166	0.528	0.448	0.534	1

8.2 Structural model

Figure 2. Graphical representation of the PATH diagram for the structural model of manufacturing companies with low technological intensity.



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