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Research article

Assessing Innovative Performance Through Absorptive Capacity by Introducing Organizational Characteristics

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Abstract
Innovation and new knowledge within organizations are essential to stimulate their performance. This study analyzes the degree of influence of identification, assimilation, transformation, and exploitation of external knowledge (absorptive capacity) on product and process innovation in an organization (innovative performance), considering organizational characteristics such as the age of managers, the business sector, and the size of the organization. To this purpose, the study uses multigroup analysis in partial least squares structural equation models on a database of 373 industrial and commercial companies from the Colombian Caribbean coast. Results reveal significant effects between absorptive capacity and innovative performance, thus highlighting the crucial role that age of managers, sector, and size of the organization play on these relationships.

Keywords: innovative performance; absorptive capacity; innovation.

Evaluación del desempeño innovador a través de la capacidad de absorción introduciendo características organizacionales

Resumen
La innovación y los nuevos conocimientos en las organizaciones son fundamentales para estimular su desempeño. Este estudio analiza el grado de influencia de la identificación, asimilación, transformación y explotación del conocimiento externo (capacidad de absorción) en la innovación de productos y procesos de una organización (desempeño innovador), considerando características organizativas como la edad de los directivos, el sector empresarial y el tamaño de la organización. Para esto, el estudio utiliza el análisis multigrupo en modelos de ecuaciones estructurales de mínimos cuadrados parciales en una base de datos de 373 empresas industriales y comerciales de la costa Caribe colombiana. Los resultados revelan efectos significativos entre la capacidad de absorción y el desempeño innovador, mostrando el papel determinante de la edad de los directivos, el sector y el tamaño de la organización en estas relaciones.

Palabras clave: desempeño innovador; capacidad de absorción; innovación.

Avaliação do desempenho inovador por meio da capacidade de absorção com a introdução de características organizacionais

Resumo
A inovação e o novo conhecimento nas organizações são fundamentais para estimular seu desempenho. Este estudo analisa o grau de influência da identificação, assimilação, transformação e exploração do conhecimento externo (capacidade de absorção) na inovação de produtos e processos de uma organização (desempenho inovador), considerando características organizacionais como a idade dos gestores, o setor empresarial e o porte da organização. Para isso, o estudo utiliza a análise multigrupo em modelos de equações estruturais por mínimos quadrados parciais, com base em um banco de dados de 373 empresas industriais e comerciais da costa caribenha colombiana. Os resultados revelam efeitos significativos entre a capacidade de absorção e o desempenho inovador, destacando o papel determinante da idade dos gestores, do setor e do porte organizacional nessas relações.

Palavras-chave: desempenho inovador; capacidade de absorção; inovação.

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1. Introduction

Today's business context is characterized by demanding and informed customers and the constant entry of new competitors (Ortiz et al., 2021). This situation has made innovation a fundamental element within organizations, as it allows the emergence of new products (goods and services) and processes to deal with strong competition in the markets (Hernández-Ramírez et al., 2022). This gives rise to the concept of "innovative performance," which measures the results of this process within an organization (Martínez-Torres & Vega-Jurado, 2022).

The speed at which information circulates plus technological advances are encouraging organizations to make greater use of externally developed knowledge to improve their innovative performance (Flores-Bueno & Jerez, 2023). However, not all organizations absorb new knowledge in the same way; therefore, the concept of "absorptive capacity" (ACAP) refers to the way in which new knowledge is introduced, as well as the nature and dynamics of the processes that are considered determinant variables to promote the organization's innovative performance (Li et al., 2022).

ACAP was introduced by Cohen and Levinthal (1990) as a firm's ability to recognize the value of external knowledge, assimilate it, transform it, and integrate it into the cognitive base for business purposes. Various authors have applied the ACAP concept for different academic purposes (Ben-Menahem et al., 2013); for example, it has been used to determine how the absorption of technologies in companies could impact their financial performance in both national and international markets (Martincevic, 2024). In the hospitality industry, ACAP was applied to demonstrate how it could play an important mediating role in achieving business innovation performance (Sarfraz et al., 2023), as well as to examine how it affects supply chain integration (SCI) and service performance in hotels in Egypt (Espino-Rodríguez & Gebril Taha, 2023).

Given the multidimensional nature of ACAP and the challenge of measuring it with a single variable, Zahra and George (2002) reconceptualized it into two elements: potential absorptive capacity (PACAP) (acquisition and assimilation) and realized absorptive capacity (RACAP) (transformation and exploitation) (Medina et al., 2018). This approach has been used in various studies, for instance to analyze the influence of technological assets on PACAP and RACAP and how they affect organizational variables (García-Sánchez et al., 2018).

As shown, many studies across different countries, sectors, and business sizes have highlighted the importance of organizational capabilities to absorb new knowledge as a determinant of innovative performance (Ko et al., 2022). However, Camisón and Forés (2010) argue that "despite the huge growth in the absorptive capacity literature, certain important gaps still remain" (p.707).

The proposed theoretical and empirical approach of ACAP has been addressed by only a few studies in the Latin American context (Camisón & Forés, 2010), thus creating a research gap. In Colombia, Vega Jurado et al. (2019) analyzed the organizational catalysts of ACAP, highlighting how their analysis contributes to organizational outcomes. The authors demonstrated that PACAP and RACAP can enhance innovative performance. Additionally, they also emphasized the lack of research in this area, thus confirming the existing research gap in Colombia.

In response to this need, this study proposes a theoretical model that examines the effect of PACAP and RACAP on innovative performance by introducing organizational characteristics (age of managers, business sector, and firm size) that are differentiating factors that could influence their effect. Factors such as age, gender, or sector may be key determinants of organizational performance (Bebitoğlu, 2023). It has been recognized that managers' characteristics influence perceptions of innovation (You et al., 2020), particularly in small and medium-sized firms in developing countries (Okrah & Irene, 2023). Furthermore, the age of managers reflects their professional experience; then, it is considered a relevant variable to innovative performance (Protogerou et al, 2017).

The study was conducted in the context of large, medium, and small-sized organizations located along the Colombian Caribbean coast, specifically in the departments of Atlántico, Bolívar, Sucre, Magdalena, Cesar, and Córdoba. It employs Multigroup analysis (MGA) in partial least squares structural equation modeling (PLS-SEM) (Chacón-Henao et al., 2022) to capture the multidimensional nature of the constructs and address measurement biases associated with other indicators (Matthews, 2017; Cheah et al., 2023).

Section 2 outlines the theoretical framework and hypotheses; Section 3 describes the methodology, followed by the presentation of the research results in Section 4; finally, Section 5 discusses the conclusions, limitations, and directions for future research.

2. Theoretical Framework

2.1. Innovative Performance

Innovative performance can be defined as the contribution of product and process innovation to a firm's economic performance (Singh et al., 2022). Enterprises engage in three different types of innovation activities that are considered indicators of innovative performance: patents, R&D investments, and the output of new products and services (whether new to the firm or new to the market) (Chang et al., 2023). However, there are shortcomings and biases associated with using patents as indicators of performance, as not all patents are commercialized and many innovations are not fully attributed to patents (De Vincenzi & da Cunha, 2021). While R&D expenditures are highly correlated with innovative performance, the literature has primarily treated R&D as an input to innovation rather than an output. Therefore, "new products and new services" can reliably measure innovative performance (Krndzija & Pilav-Velic, 2022).

Innovative performance measures an organization's ability to translate ideas and processes into new or improved procedures and products perceived as relevant, useful, and conducive to superior performance (Tavares et al., 2021). It comprises two dimensions (Wilson et al., 2023): product innovation, which refers to the regular introduction of products that are completely new to the market or in the portfolio as well as the success of the organization's new product development strategy compared to competitors (Hurtado-Palomino et al., 2022).

The second dimension of innovative performance corresponds to process innovation, which involves implementing new or significantly improved production processes and regularly introducing new techniques or channels to promote and position products (goods or services) in the market (Rincón et al., 2022). This dimension largely depends on the organization's capabilities, with particular emphasis on ACAP.

2.2. The Organization's ACAP

To maintain an organization's competitive advantage, strategic flexibility, and level of innovation, it is essential to manage and transform its knowledge resources through the development of PACAP and RACAP, as mentioned above (Cuevas-Vargas et al., 2022). PACAP refers to an organization's ability to identify and acquire externally generated knowledge. External interactions with companies, universities, and other external stakeholders make it possible to acquire existing knowledge from the environment and integrate it into the dynamics of knowledge and business innovation (Gonzalez, 2023). These interactions enable problem solving and various learning skills that are visible both inside and outside the organization (Ferreira & Ferreira, 2020).

The first element of PACAP is identification, which involves searching for external information that can impact organizational performance (Leal-Rodríguez et al., 2014). This includes efforts made by members to seek information by leveraging their industry connections like customers, suppliers, competitors, consultants, universities, meetings, and conversations with friends or business partners (Muraliraj et al., 2020).

Once external knowledge has been identified, the second dimension of PACAP is assimilation. This dimension is associated with factors such as the existence of mechanisms to capture external knowledge, its fluidity between different departments, meetings to exchange ideas, problem solving, achievements between organization departments, dissemination and discussion of information acquired from external sources, and its scope to be transformed into knowledge (Nowak, 2020).

The assimilation process stimulates the direct implementation of previously identified external knowledge. Understanding, interpreting, and learning from this new knowledge are necessary to overcome obstacles and continue generating innovation within the organization (Elidjen et al., 2022).

Organizations that systematically invest in assimilating and exploiting new external knowledge are more likely to capitalize on the changing conditions of the competitive environment and generate innovations that meet market demands (Gonzalez, 2024; Li et al., 2022). PACAP promotes the speed, frequency, and magnitude of innovation by stimulating the introduction of products and processes within the organization (Pertiwi et al., 2024).

Accordingly, the first two hypotheses are presented:

H_1: PACAP positively impacts the introduction of new or improved products into the market.

H_2: PACAP positively impacts the introduction of new processes into the organization.

RACAP refers to the development, integration, and refinement of routine capabilities within the organization. It facilitates the integration of existing, newly acquired, and assimilated knowledge, and enables its use and application for the organization's benefit (Müller et al., 2021).

The assimilation process helps the organization understand external knowledge and identify the necessary changes to adopt new functionalities in response to market demands. However, when this knowledge is internalized, it can be transformed into higher-level value within the organization (Morales et al., 2022). Transformation refers to the organization's ability to generate new knowledge from externally acquired knowledge (Miroshnychenko et al., 2021), which is considered essential to implement innovation.

Finally, exploitation reflects an organization's ability to use information and integrate it into its operations. It refers to the ability to convert externally acquired information and knowledge into successful innovations, such as the adoption of new technologies, development of more efficient processes, and adopting mechanisms that facilitate the development of prototypes, new products, or processes (Strøm-Andersen, 2020).

Ortiz et al. (2021) argued that achieving RACAP in the organization is not a goal by itself. It can generate important organizational outcomes, especially those related to innovation and performance. High levels of RACAP provide advantages such as being the first to take action and responding quickly to customer needs (Vega-Jurado et al., 2019), which are essential in today's business environment. Moreover, RACAP can serve as a conduit for knowledge transfer between various organizational units. This knowledge can be instrumental in facilitating an organization's product and process innovation activities, thus contributing to innovative performance (Ferreira & Ferreira, 2020).Accordingly, the last two hypotheses are presented:

H_3: RACAP positively impacts the introduction of new products into the market.

H_4: RACAP positively impacts the introduction of new processes into the organization.

In addition, the magnitude and effect of the relation between ACAP and innovative performance may be stimulated by certain organizational elements, as discussed below.

2.3. Incorporating Organizational Characteristics to Capture the Multidimensional Nature of PACAP and RACAP in Innovative Performance

The effect of PACAP and RACAP on process and product innovation may be influenced by other external factors, such as the characteristics of the organization (Martínez-Torres & Vega-Jurado, 2022). Different authors have highlighted the importance of the age of managers (You et al., 2020), considering it a very relevant factor in innovative performance because it serves as a measure of their experience, and their propensity for innovation (Protogerou et al., 2017). In addition, the sector in which the organization operates can also influence how it innovates (Bebitoğlu, 2023). According to the economic theory, the industrial sector is more competitive because it faces international competition, while the service sector does not, which could make it less innovative. Other factors, such as the size of the organization, can also be determinant in how it innovates, especially in less developed economies (Okrah & Irene, 2023), where small businesses may have limited financial capacity to invest in innovation. It has been shown that larger enterprises make greater efforts to acquire and use external knowledge and that commercial organizations seek external information to a greater extent (Ferreras- et al., 2021).

According to research, three key organizational characteristics were selected to analyze the effect of PACAP and RACAP on process and product innovation: age of the managers, firm size, and sector. For this purpose, multigroup analysis (MGA) in partial least squares structural equation modeling (PLS-SEM) (Cheah et al., 2023) was used because it enables model comparisons across different subgroups to test hypotheses in various scenarios (Matthews, 2017) and capturing the multidimensional nature of the constructs (Matthews, 2017; Cheah et al., 2023).

3. Methodology

3.1. Data Compilation

Based on a quantitative and analytical approach, this research estimates the causal relations between two variables by providing the values of each relationship (effect), as well as a statistic that expresses the degree of fit of the proposed model, thus confirming its validity (significance). In particular, we aim at finding the effect and significance of the relations between PACAP and RACAP on innovative performance by considering organizational elements. Therefore, companies from the industrial and commercial sector located in the Caribbean coast—comprising the departments of Bolívar, Atlántico, Cesar, Córdoba, Magdalena, and Sucre, which have an estimated universe of 30,000 companies in these sectors—were contacted. The following formula was used to estimate the sample:

$$Sample\ size = \frac{\frac{z^2 * \ p\,(1-p)}{e^2}}{1 + (\frac{z^2 * \ p\,(1-p)}{e^2 N})} \qquad (1)$$

where z is replaced by 1.96, i.e., 95% confidence level, p is the probability of the population (0.5 in finite populations), e is the 5% margin of error, and N is the size of the population; that is, 30,000, thus yielding 380 companies. Furthermore, 500 forms were sent out between November 2021 and July 2022 to adequately cover the sample drawn. Responses were received from 373 companies, resulting in a response rate of 74.6%. The companies were distributed according to the geographical location of the departments, as shown in Table 1.

Table 1. Companies from the Caribbean Coast participating in the study.

Department	Number of Companies	Percentage
Atlántico	147	39.4%
Bolívar	125	33.5%
Sucre	50	13.4%
Magdalena	39	10.4%
Cesar	7	1.8%
Córdoba	5	1.3%
Total	373	100%

Source: own elaboration.

3.2. Analysis Model

The instrument for the analysis was developed based on the study by Vega Jurado et al. (2019) on ACAP and Sok and O'Cass (2011) on innovative performance. Variables that constitute the innovative performance, product innovation, and process innovation for ACAP have been proposed as follows: identification, assimilation, transformation, and exploitation. To verify the effectiveness of the instrument, a pilot test was conducted to demonstrate the managers' understanding of the questions. Finally, the survey was sent to the general manager of each organization through an electronic form.

Data were processed in the SMARTPLS 4 software. Using Partial Least Squares-Structural Equation Modeling (PLS-SEM), the analyses were made in two parts: the measurement model outlining tests to determine the reliability as well as the goodness of fit of the observations obtained, and the structural model evaluating the magnitude of the relations and their significance.

Given that the PLS-SEM was validated for the entire

population, the same model must be validated including the multidimensional analysis (MGA) with organizational characteristics. Table 2 presents the number of observations from participating organizations based on each of these aspects:

Table 2. Observations according to organizational characteristics

Characteristics		Observations
Age	23 - 38 years old	151
	39 - 54 years old	188
	55 or more years old	34
Size	Small	128
	Medium	88
	Large	157
Sector	Industrial	94
	Commercial	279
	Total	373

Source: own elaboration.

Division by firm size was based on the quantity of employees at each organization: small, 20 to 50; medium, 51 to 200; and large, more than 200 employees. Age of the managers was divided into three age groups: 23 to 38, 39 to 54, and older than 55 years. The third analysis group was based on the organization's sector: industrial and commercial.

According to Mathew (2017), multigroup analysis in PLS-SEM is conducted in three steps. In the first step, data groups are created and the categorical variables of interest are identified. In this case, ages of the managers, the size of the company, and the sector of the organization. Then, comparison groups are established appropriately. It is essential that these groups are large enough to ensure the statistical power needed for the subsequent analyses (Mathew, 2017).

The second step is the invariance test, which aims to ensure that the measurements are comparable across the defined groups. To do this, the measurement invariance of composite models (MICOM) is applied, which consists of three stages: the first one is configural invariance, where it is verified that the models have the same structure, meaning that they use the same indicators, the same data treatment, and the same algorithm criteria. The second stage evaluates compositional invariance by comparing the original correlation among composite scores of the groups with the 5% threshold. If this correlation is lower than this quantile, invariance is not established, and the analysis cannot proceed. The third stage checks equality of composition by analyzing whether mean differences between groups fall within the 2.5% and 97.5% limits.

Once an invariance is established, the third step is the analysis and interpretation of results. The PLS algorithm and bootstrapping are executed separately for each group. It allows us to estimate path coefficients and evaluate the statistical significance of the differences between them. With these results, it is possible to interpret the presence or absence of structural variations between groups and draw relevant conclusions for the research.

It is important to note that one of the main advantages of the SEM model is its ability to identify and correct measurement or Type I errors (Wang & Rhemtulla, 2021). By incorporating multiple indicators into each variable, SEM allows the variance of the measurements to be decomposed into adjusted and error components (covariance). This eases a robust assessment of the validity and reliability of the instruments used, minimizing biases and potential distortions within the study (Henseler et al., 2014).

This feature is particularly relevant in the analysis of industrial and commercial companies, where responses can be influenced by the heterogeneity of the organizations, as well as by contextual or sector-specific factors that may introduce bias or distort the collected data. However, the use of SEM models significantly helps minimize these limitations and allows for greater precision in the results.

4. Results

4.1. Validation of the Model

To conduct Multigroup analysis (MGA) in partial least squares structural equation modeling (PLS-SEM), we first established the measurement model to validate the constructs through a confirmatory factor analysis, reliability tests, convergent and discriminant validity, and other suggested analyses (Henseler et al., 2014). Once all the tests were completed, we analyzed the hypotheses proposed for the structural model.

4.1.1. Validation of the PLS-SEM

Based on the measurement model, Table 3 shows that identification (Ide), assimilation (Asi), transformation (Tra), exploitation (Exp), and product innovation (InnProd) constructs included four items or questions, while process innovation (InnProc) comprised three items.

Table 3 presents the factor loadings, understood as the proportion of variance of a construct explained by their factor or item. Results suggested that the items had a factor loading greater than 0.5, i.e., a high correlation with the first order constructs, as well as a significance at 99%. However, the items "Asi1" and "Exp4" had negative factor loadings and did not reach the significance level but were kept due to their theoretical importance.

Table 3. Validation of constructs

Constructs	Item	Factor Loading
PACAP	Ide1	0.78***
	Ide2	0.77***
	Ide3	0.85***
	Ide4	0.73***
	Asi1	-0.09
	Asi2	0.81***
	Asi3	0.89***
	Asi4	0.84***
	Asi5	0.77***
RACAP	Tra1	0.8***
	Tra2	0.89***
	Tra3	0.86***
	Tra4	0.80***
	Exp1	0.844***
	Exp2	0.832***
	Exp3	0.86***
	Exp4	-0.075
Innovative Product Performance (D.InnProd)	InnProd1	0.74***
	InnProd2	0.67***
	InnProd3	0.85***
	InnProd4	0.76***
Innovative Process Performance (D.InnProc)	InnProc1	0.81***
	InnProc2	0.89***
	InnProc3	0.91***

Notes: Significance 99% ***, 95%**, 90%*.
Source: own elaboration.

Table 4 presents the reliability and validity tests of the construct; values indicated compliance with the indices established in the tests proposed in the model. In addition, multicollinearity tests revealed that none of the items had a variation inflation factor greater than 5, i.e., the items did not present redundancy.

Table 5 presents the discriminant validity of the model proposed by Fornell and Larcker (Fornell & Larcker, 1981). The model allows us to evaluate the correlation of a construct with the items of the other constructs.

A low correlation was observed between PACAP and RACAP constructs and innovative performance constructs, with values lower than 0.7. This result confirms the validity of our model. On the contrary, the discriminant validity between process and product innovation indicated correlation as both belonged to innovative performance. Therefore, in our analysis, one is not causal of the other (García Granero, 2013). The same has been noted with regard to PACAP and RACAP, since both constituted ACAP. Therefore, they do not explain each other.

Table 5. Discriminant validity

	InnProc	Innprod	PACAP	RACAP
InnProc				
Innprod	0.811			
PACAP	0.413	0.444		
RACAP	0.510	0.584	0.781	

Source: own elaboration.

Accordingly, these variables could be part of the same construct, as demonstrated in previous work (Ali et al., 2018). However, recent research has suggested that to better analyze their effects, it is useful to separate them, as in this paper (Nariño et al., 2021).

To analyze the model fit, we used the standardized root mean square residual, which allows us to assess the standardized difference between observed and predicted correlations of the model. A value less than 0.10 indicates an acceptable fit (Henseler et al., 2014)but instead to three problems with Rönkkö and Evermann's study: (a. In this case, the software yielded a value of 0.098, i.e., a reasonable goodness of fit.

Thus, the constructs proposed in the measurement model have acceptable levels of reliability and goodness of fit, thus verifying the validity of the instrument designed for the analysis.

4.1.2. Validation of the MGA in PLS-SEM

Organizational characteristics corresponding to the age of managers, size of the firm, and business sector were incorporated into the model through multigroup analysis in PLS-SEM (Matthews, 2017; Cheah et al., 2023). Results indicate that all invariance tests were successfully passed when considering the sample segmented. Initially, data groups were generated based on these categorical variables, as mentioned above, ensuring that each group had an adequate size to maintain the necessary statistical power in the analysis according to the sample sizes suggested by Matthews (2017), which can be verified in Table 2, and fulfilling the first step of the multigroup analysis.

In the evaluation of invariance, Step 2, it was confirmed that the models showed configural invariance, as the structure of the indicators, the data treatment, and the algorithm criteria were identical across each group, as can be seen in Appendix A. Subsequently, compositional invariance test showed that the original correlation between group's composite scores exceeded the 5% quantile threshold, which allowed for establishing comparability

Table 4. Reliability tests of the analysis model

Constructs	Cronbach's Alpha	Composite Reliability (CR)	Rho_c	Average Variance Extracted (AVE)	Variance Inflation Factor (VIF)
PACAP	0.894	0.858	0.831	0.532	2.718
RACAP	0.738	0.889	0.883	0.521	3.147
D.InnProc	0.745	0.851	0.907	0.765	3.44
D.Innprod	0.858	0.868	0.847	0.582	3.172

Source: own elaboration.

between them. Likewise, the evaluation of composition equality showed that mean differences between groups fell within the confidence interval of 2.5% to 97.5%, thus confirming the equivalence of the measurements, as seen in Appendix A. All the applied tests confirm the possibility of employing multigroup analysis in the study based on the age of the managers, the size of the firm, and the business sector, thus fulfilling Step 3.

4.2. Effect of PACAP and RACAP on Innovative Performance

The results achieved in the structural model provide sufficient empirical evidence to substantiate the direct effects of PACAP and RACAP on the innovative performance of the companies. Table 6 shows that, for the entire sample, data confirmed the positive and significant relation between RACAP and the firm's innovative performance. However, only a positive and significant effect was observed between PACAP and the innovative performance of products.

Thus, H1, H3, and H4 were accepted, and H2 was rejected. This result suggests a significant relation between PACAP and product innovation, and RACAP and product and process innovation. The rejection of H2 indicates that identification and assimilation are not adequate to determine changes in process innovation in industrial and commercial organizations in Colombia's Caribbean coast.

Table 6. Results of the structural model

Relationships	Hypothesis	Effect and Significance
PACAP -> D.Innprod	H_1	0.202***
PACAP -> D.InnProc	H_2	0.048
RACAP -> D.Innprod	H_3	0.385***
RACAP -> D.InnProc	H_4	0.565***

Notes: significance 99% ***, 95%**, 90%*
Source: own elaboration.

Graphically, the structural equation model looks as shown in Figure 1.

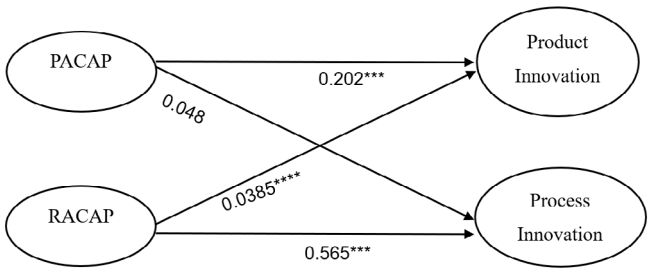

Figure 1. Analysis of PLS for the theoretical model
Source: own elaboration.
Notes: Significance 99% ***, 95%**, 90%*

Contrary to the rejection of H2, H4 was accepted with the highest coefficient, This implies that RACAP had a highly positive effect on process innovation. Therefore, the results suggest that transformation and exploitation are necessary for process innovation in the studied organizations.

According to Müller et al. (2021) the greater an organization's ability to acquire and use new information, the greater its ability to manage and undertake new innovations. However, initial results suggest that identification and assimilation are not adequate to impact innovation within organization's processes. It is important to draw attention to the literature that discusses the importance of exploitative innovation over exploratory innovation to achieve evolution in the innovative organizational performance (Kranz et al., 2016)

4.3. The Effect of PACAP and RACAP on Innovative Performance, Introducing MGA by Manager's Age

The effect of potential and realized absorptive capacity on innovative performance by product and process analyzed through the MGA PLS-SEM by age can be observed in Table 7.

Table 7. Results of the structural model characterized by age of the manager

Relationships	Hypothesis	Effect and Significance		
		23 - 38	39 – 54	55 o mas
PACAP -> Innprod	H_1	0.465***	0.179**	0.165
PACAP -> InnProc	H_2	0.541*	0.232	0.141
RACAP -> Innprod	H_3	0.325***	0.341**	0.325*
RACAP -> InnProc	H_4	0.138***	0.123**	0.138*

Notes: significance 99% ***, 95%**, 90%*
Source: own elaboration.

Regarding the results of the structural model characterized by the manager's age, all four hypotheses were accepted for ages 23 to 38 years. For ages 39 to 54 years, H1, H3, and H4 were accepted and H2 was rejected. For ages over 55 years, only H3 and H4 were accepted.

These results imply that companies with younger leaders have a greater and more significant relation between PACAP and product and process innovation, thus validating all the proposed hypotheses. For older entrepreneurs, no significant relation was observed between their ability to become innovative in terms of identification and assimilation. The above is consistent with results from previous studies, as Curado et al. (2018) expressed that younger managers tend to be more attentive to external knowledge and innovation than older ones.

Additionally, in younger leaders, the magnitude of the relation between PACAP and product and process innovations tends to be higher than that of RACAP, i.e., younger leaders may develop products and processes in the identification and assimilation phases, suggesting significant implications for positive firm outcomes from an early stage.

4.4 The Effect of PACAP and RACAP on Innovative Performance, Introducing MGA by Firm Size

The effect of potential and realized absorptive capacity on innovative performance by product and process analyzed through the MGA PLS-SEM by firm size can be observed in Table 8.

Table 8. Results of the structural model characterized by firm size

Relationships	Hypothesis	Effect and Significance		
		Small	Medium	Large
PACAP -> Innprod	H_1	0.465***	0.379*	0.565**
PACAP -> InnProc	H_2	0.341*	0.232	0.441
RACAP -> Innprod	H_3	0.125***	0.041*	0.525**
RACAP -> InnProc	H_4	0.238***	0.023*	0.638**

Notes: significance 99% ***, 95%**, 90%*
Source: own elaboration.

In the model differentiated by firm size, all four hypotheses were accepted for small firms. For medium and large firms, H2 was rejected and H1, H3, and H4 were accepted.

The results of the model indicated that, in small firms, all the hypotheses were fulfilled and that H1 and H2 were greater than H3 and H4. This implied that in this firm size, the identification and assimilation of external knowledge was sufficient for process and product innovations.

For medium-sized companies, the relation had a highest value between PACAP and product innovation, suggesting that these organizations should focus on the search for new products and services rather than new processes.

In large organizations, the value of the relation between RACAP and processes and product innovations tends to be higher compared with PACAP. This result suggests that in this type of company, they largely emphasize their innovations in process transformation and exploitation. These findings are consistent with the research of Protogerou et al. (2017), who considered that larger companies can allocate more resources to the transformation and exploitation of new knowledge and its respective result in innovations, with less risk than smaller companies.

4.4 The Effect of PACAP and RACAP on Innovative Performance, Introducing MGA by Business Sector

The effect of potential and realized absorptive capacity on innovative performance by product and process analyzed through the MGA PLS-SEM by business sector can be observed in Table 9.

Table 9. Results of the structural model characterized by business sector

Relationships	Hypothesis	Effect and Significance	
		Industrial	Commercial
PACAP -> Innprod	H_1	0.421**	0.445**
PACAP -> InnProc	H_2	0.312	0.521*
RACAP -> Innprod	H_3	0.131**	0.175**
RACAP -> InnProc	H_4	0.113**	0.218**

Notes: significance 99% ***, 95%**, 90%*
Source: own elaboration.

When dividing the sample between the industrial and commercial sectors, we observed that all four hypotheses were accepted for the commercial sector companies. H1, H3, and H4 were accepted, and H2 was rejected for industrial companies. In the case of the latter, the rejection of H2 indicated that PACAP was not sufficient to achieve process innovations. In commercial companies, PACAP proved to have a significant and much greater effect than RACAP on their innovative performance. In line with the results obtained, Ferreras et al. (2015) argued that the commercial sector has more opportunities to introduce new products and processes than the industrial sector.

The evidence obtained in the analysis indicated that the ACAP model proposed by Cohen & Levinthal (1990) and reconceptualized by Zahra & George (2002) on PACAP and RACAP was applicable in the context of the industrial and commercial organizations of the Colombian Caribbean coast and their innovation management, offering applicable alternatives to stimulate the performance of the organizations analyzed.

The importance of PACAP and RACAP analysis in organizations, acquisition, and exploitation of new knowledge, as well as flexibility and their respective impact on innovation management, is confirmed.

5. Conclusions

For all the companies analyzed, potential absorptive capacity, through its elements of identification and assimilation, had a positive and significant effect on the development of products, but not of processes. Realized absorptive capacity, through its components of transformation and exploitation of external knowledge, had a positive and significant effect on both product and process innovations. Therefore, the first conclusion suggests that to achieve process innovation in a commercial or industrial firm, it is necessary to transform and exploit external knowledge.

Introducing organizational characteristics by multigroup analysis in Partial Least Squares Structural Equation Modeling according to the age of managers, firm size, and sector of the organization, we found that younger managers tend to have a greater ability to identify, assimilate, transform, and exploit external knowledge and that small companies and commercial companies achieve greater and more significant impacts.

This adds a layer of depth to the analysis because the initial model did not find sufficient evidence to support all the hypotheses. However, by delving deeper into the arguments for why these relationships did not have significant relationships, we explored the possibility that, under certain circumstances, the model did find sufficient evidence, thereby leaving a precedent for future work to attempt to delve deeper and test the models. However, it would be interesting to comprehensively analyze how other elements influence absorptive capacity and innovative performance.

Future lines of research can take advantage of some of the gaps found in the literature to further deepen the mentioned topic. Considering that the results suggested that potential absorptive capacity and realized absorptive capacity act as an organizational antecedent that stimulates innovation within the organization, it would be interesting to analyze other similar antecedents such as socialization capabilities, decentralization of decision making, and formalization of processes that affect potential absorptive capacity and realized absorptive capacity in the organization. In addition, the existence of conflicts within the organization and especially at the time of acquiring and exploiting external knowledge could be an obstacle to innovation management. Therefore, it could be an area of research for future lines in the field.

Conflict of interest

The authors declare no conflict of interest.

References

Ali, M., Ali, I., Al-Maimani, K. A., & Park, K. (2018). The effect of organizational structure on absorptive capacity in single and dual learning modes. *Journal of Innovation & Knowledge*, *3*(3), 108–114. https://doi.org/10.1016/j.jik.2017.03.007

Bebitoğlu, M. E. (2023). The Effect of Work Engagement on Perceived Business Performance: Comparisons between Manufacturing and Service Sectors. *Trakya University Journal of Social Science*, *25*(1), 261–282. https://doi.org/10.26468/trakyasobed.1106039

Ben-Menahem, S. M., Kwee, Z., Volberda, H. W., & Van Den Bosch, F. A. J. (2013). Strategic renewal over time: The enabling role of potential absorptive capacity in aligning internal and external rates of change. *Long Range Planning*, *46*(3), 216–235. https://doi.org/10.1016/j.lrp.2012.09.012

Camisón, C., & Forés, B. (2010). Knowledge absorptive capacity: New insights for its conceptualization and measurement. *Journal of Business Research*, *63*(7), 707–715. https://doi.org/10.1016/j.jbusres.2009.04.022

Chacón-Henao, J., López-Zapata, E., & Arias-Pérez, J. (2022). Liderazgo compartido en equipos directivos y desempeño organizacional: el rol mediador del capital social. *Estudios Gerenciales*, *38*(162), 32–44. https://doi.org/10.18046/j.estger.2022.162.4524

Chang, Y. Y., Wannamakok, W., & Lin, Y. H. (2023). Work conformity as a double-edged sword: Disentangling intra-firm social dynamics and employees' innovative performance in technology-intensive firms. *Asia Pacific Management Review*, *28*(4), 439–448. https://doi.org/10.1016/j.apmrv.2023.01.003

Cheah, J. H., Amaro, S., & Roldán, J. L. (2023). Multigroup analysis of more than two groups in PLS-SEM: A review, illustration, and recommendations. *Journal of Business Research*, *156*, 113539. https://doi.org/10.1016/j.jbusres.2022.113539

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity : A New Perspective on and Innovation Learning. *Administrative Science Quarterly*, *35*(1), 128–152. https://doi.org/10.2307/2393553

Cuevas-Vargas, H., Cortés-Palacios, H. A., Leana-Morales, C., & Huerta-Mascotte, E. (2022). Absorptive Capacity and Its Dual Effect on Technological Innovation: A Structural Equations Model Approach. *Sustainability (Switzerland)*, *14*(19), 1–18. https://doi.org/10.3390/su141912740

Curado, C., Muñoz-Pascual, L., & Galende, J. (2018). Antecedents to innovation performance in SMEs: A mixed methods approach. *Journal of Business Research*, *89*(June 2017), 206–215. https://doi.org/10.1016/j.jbusres.2017.12.056

De Vincenzi, T. B., & da Cunha, J. C. (2021). Open innovation and performance in the service sector. *Innovation and Management Review*, *18*(4), 382–399. https://doi.org/10.1108/INMR-01-2020-0004

Elidjen, E., Pertiwi, A., Mursitama, T. N., & Beng, J. T. (2022). How potential and realized absorptive capacity increased ability to innovate: the moderating role of structural ambidexterity. *VINE Journal of Information and Knowledge Management Systems*, *084*. https://doi.org/10.1108/VJIKMS-12-2021-0298

Espino-Rodríguez, T. F., & Gebril Taha, M. (2023). Absorptive Capacity and Supply Chain Integration and Their Impact on Hotel Service Performance. *Administrative Sciences*, *13*(12). https://doi.org/10.3390/admsci13120247

Ferreira, G. C., & Ferreira, J. M. (2020). Generational Diversity as a Moderator for the Relationship Between Absorptive Capacity and Innovation Performance at Family Firms. *Studies on Entrepreneurship, Structural Change and Industrial Dynamics*, 85–111. https://doi.org/10.1007/978-3-030-15526-1_6

Ferreras-m, L., Olmos-pe, J., & Alegre, J. (2021). *Technovation Entrepreneurial orientation and new product development performance in SMEs : The mediating role of business model innovation*. *108*(April). https://doi.org/10.1016/j.technovation.2021.102325

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

Flores-Bueno, D., & Jerez, O. (2023). Incubadoras de negocios, desempeño y eficacia: una revisión sistemática. *Estudios Gerenciales*, *39*, 93–109. https://doi.org/10.18046/j.estger.2023.166.5312

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3151312

García-Sánchez, E., García-Morales, V. J., & Martín-Rojas, R. (2018). Influence of technological assets on organizational performance through absorptive capacity, organizational innovation and internal labour flexibility. *Sustainability (Switzerland)*, *10*(3). https://doi.org/10.3390/su10030770

García Granero, A. (2013). Determinants and effects of external knowledge search: focusing on organizational formal structure [Tesis de Doctorado, University of Valencia]. Repositori d'Objectes Digitals per a l'Ensenyament la Recerca i la Cultura University of Valencia. http://hdl.handle.net/10261/132693

Gonzalez, R. V. D. (2024). The impact of potential and realized absorptive capacity on open innovation: the moderating role of knowledge-oriented leadership. *Journal of Knowledge Management*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/JKM-11-2023-1102

Gonzalez, R. V. D. (2023). Potential And Realized Absorptive Capacity: An Analysis In Project Teams. *RAE: Revista de Administração de Empresas*, *63*(6), 1–21. https://doi.org/10.1590/S0034-759020230605x

Henseler, J., Dijkstra, T. K., Sarstedt, M., Ringle, C. M., Diamantopoulos, A., Straub, D. W., Ketchen, D. J., Hair, J. F., Hult, G. T. M., & Calantone, R. J. (2014). Common Beliefs and Reality About PLS: Comments on Rönkkö and Evermann (2013). *Organizational Research Methods*, *17*(2), 182–209. https://doi.org/10.1177/1094428114526928

Hernández-Ramírez, M., Mora-Esquivel, R., & Leiva, J. C. (2022). Entrepreneurial orientation and innovation performance in MSMEs. The moderating role of strategic orientation. *Estudios Gerenciales*, *38*(162), 95–108. https://doi.org/10.18046/j.estger.2022.162.4519

Hurtado-Palomino, A., De la Gala-Velásquez, B., & Ccorisapra-Quintana, J. (2022). The interactive effect of innovation capability and potential absorptive capacity on innovation performance. *Journal of Innovation and Knowledge*, *7*(4). https://doi.org/10.1016/j.jik.2022.100259

Ko, A., Mitev, A., Kovács, T., Fehér, P., & Szabó, Z. (2022). Digital Agility, Digital Competitiveness, and Innovative Performance of SMEs. *Journal of Competitiveness*, *14*(4), 78–96. https://doi.org/10.7441/joc.2022.04.05

Kranz, J. J., Hanelt, A., & Kolbe, L. M. (2016). Understanding the influence of absorptive capacity and ambidexterity on the process of business model change – the case of on-premise and cloud-computing software. *Information Systems Journal*, *26*(5), 477–517. https://doi.org/10.1111/isj.12102

Krndzija, L., & Pilav-Velic, A. (2022). Innovative behavior of Small and Medium Enterprises: A comprehensive bibliometric analysis. *International Journal of Industrial Engineering and Management*, *13*(3), 158–171. https://doi.org/10.24867/IJIEM-2022-3-309

Leal-Rodríguez, A. L., Ariza-Montes, J. A., Roldán, J. L., & Leal-Millán, A. G. (2014). Absorptive capacity, innovation and cultural barriers: A conditional mediation model. *Journal of Business Research*, *67*(5), 763–768. https://doi.org/10.1016/j.jbusres.2013.11.041

Li, B., Lei, Y., Hu, M., & Li, W. (2022). The Impact of Policy Orientation on Green Innovative Performance: The Role of Green Innovative Capacity and Absorptive Capacity. *Frontiers in Environmental Science*, *10*(June), 1–10. https://doi.org/10.3389/fenvs.2022.842133

Martincevic, I. (2024). Enhancing Financial Performance through Absorptive Capacity: Evidence from Croatian Export Companies in Domestic and International Markets. *Business Systems Research*, *14*(2), 214–238. https://doi.org/10.2478/bsrj-2023-0020

Martínez-Torres, J. C., & Vega-Jurado, J. (2022). The impact of intermediaries agents on the process of cooperation to innovate: The moderating role of company size. *Estudios Gerenciales*, *38*(162), 2–16. https://doi.org/10.18046/j.estger.2022.162.4502

Matthews, L. (2017). Applying Multigroup Analysis in PLS-SEM: A Step-by-Step Process. In: Latan, H., Noonan, R. (eds) Partial Least Squares Path Modeling, 219-243. Springer, Cham. https://doi.org/10.1007/978-3-319-64069-3_10

Medina, M. N., Ramachandran, I., & Daspit, J. J. (2018). Collaboration or Clash? Mapping the Effects of Top Management Team Conflict on Firm Absorptive Capacity. *International Journal of Innovation Management*, *1950023*, 1–29. https://doi.org/10.1142/S1363919619500233

Miroshnychenko, I., Strobl, A., Matzler, K., & De Massis, A. (2021). Absorptive capacity, strategic flexibility, and business model innovation: Empirical evidence from Italian SMEs. *Journal of Business Research*, *130*(February 2019), 670–682. https://doi.org/10.1016/j.jbusres.2020.02.015

Morales, G. L. O., Aguilar, J. C. R., & Morales, K. Y. L. (2022). Culture as an obstacle for entrepreneurship. *Journal of Innovation and Entrepreneurship*, *11*(1). https://doi.org/10.1186/s13731-022-00230-7

Müller, J. M., Buliga, O., & Voigt, K. I. (2021). The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models - A comparison between SMEs and large enterprises. *European Management Journal*, *39*(3), 333–343. https://doi.org/10.1016/j.emj.2020.01.002

Muraliraj, J., Kuppusamy, S., Zailani, S., & Santha, C. (2020). Lean, Six Sigma and its influence on potential and realized absorptive capacity. *International Journal of Lean Six Sigma*, *11*(1), 84–124. https://doi.org/10.1108/IJLSS-03-2018-0020

Nariño, A. H., Cossío, N. S., Castro, G. R., & Castro, A. H. (2021). Developing an improvement strategy in health research innovation and quality based on technology watch adoption: a cuban case study. *International Journal of Innovation*, *9*(1), 11–44. https://doi.org/10.5585/iji.v9i1.18103

Nowak, R. (2020). The Effects of Cognitive Diversity and Cohesiveness on Absorptive Capacity. *International Journal of Innovation Management*, *24*(2), 1–23. https://doi.org/10.1142/S136391962050019X

Okrah, J., & Irene, B. (2023). The effect of top managers' years of experience on innovation. *International Journal of Innovation Studies*, *7*(3), 208–217. https://doi.org/10.1016/j.ijis.2023.03.004

Ortiz, B., Donate, M. J., & Guadamillas, F. (2021). Intra-Organizational Social Capital and Product Innovation: The Mediating Role of Realized Absorptive Capacity. *Frontiers in Psychology*, *11*(January). https://doi.org/10.3389/fpsyg.2020.624189

Pertiwi, A., Mursitama, T. N., Beng, J. T., & Elidjen. (2024). The Under-Developed Social Integration Mechanism as Moderating Factor of Two-Dimensional Absorptive Capacity Relationship: Systematic Literature Review. *SAGE Open*, *14*(2), 1–16. https://doi.org/10.1177/21582440231203904

Protogerou, A., Caloghirou, Y., & Vonortas, N. S. (2017). Determinants of young firms' innovative performance: Empirical evidence from Europe. *Research Policy*, *46*(7), 1312–1326. https://doi.org/10.1016/j.respol.2017.05.011

Rincón, M. L. C., Vidal, J. A., García, C. V., Díaz, M. L. A., Ortiz, M. F., & Castro, R. P. (2022). Open innovation and superior performance in SMEs: The mediating role of marketing capabilities and innovation. *Direccion y Organizacion*, *7*(77), 5–21. https://doi.org/10.37610/dyo.v77i0.620

Sarfraz, M., Khawaja, K. F., Khalil, M., & Han, H. (2023). Knowledge-based HRM and business process innovation in the hospitality industry. *Humanities and Social Sciences Communications*, *10*(1). https://doi.org/10.1057/s41599-023-02140-9

Singh, S. K., Del Giudice, M., Tarba, S. Y., & De Bernardi, P. (2022). Top Management Team Shared Leadership, Market-Oriented Culture, Innovation Capability, and Firm Performance. *IEEE Transactions on Engineering Management*, *69*(6), 2544 – 2554. https://doi.org/10.1109/TEM.2019.2946608

Sok, P., & O'Cass, A. (2011). Achieving superior innovation-based performance outcomes in SMEs through innovation resource-capability complementarity. *Industrial Marketing Management*, *40*(8), 1285–1293. https://doi.org/10.1016/j.indmarman.2011.10.007

Strøm-Andersen, N. (2020). Innovation and by-product valorization: A comparative analysis of the absorptive capacity of food processing firms. *Journal of Cleaner Production*, *253*(1), 119943.

Tavares, M. S. D. A., Gohr, C. F., Morioka, S., & da Cunha, T. R. (2021). Systematic literature review on innovation capabilities in clusters. *Innovation and Management Review*, *18*(2), 192–220. https://doi.org/10.1108/INMR-12-2019-0153

Vega-Jurado, J., Schmutzler, J., & Manjarrés-Henríquez, L. Vega-Cárcamo, J. (2019). Orchestrating absorptive capacity: organizational catalysts of TMT's influence. *Management Research*, *17*(4), 426–444. https://doi.org/https://doi.org/10.1108/MRJIAM-12-2018-0892

Wilson, G. A., Case, T., Dobni, C. B., & Liguori, E. (2023). The limitations of open innovation: an examination of innovation orientation, open innovation and performance in North America. *Management Decision*, *ahead-of-p*(ahead-of-print). https://doi.org/10.1108/MD-10-2022-1337

You, Y., Srinivasan, S., Pauwels, K., & Joshi, A. (2020). How CEO/CMO characteristics affect innovation and stock returns: findings and future directions. *Journal of the Academy of Marketing Science*, *48*(6), 1229–1253. https://doi.org/10.1007/s11747-020-00732-4

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

APENDIX A.

A.1. Constructs correlation

Table A.1.1 MICOM results report- total population

	Original correlation	Correlation permutation mean	5.00%	Permutation p-values
PACAP	0.998	0.996	0.987	0.852
RACAP	0.997	0.995	0.974	0.842
D.InnProc	0.999	0.997	0.965	0.698
D.Innprod	0.997	0.995	0.972	0.673

A.2. Age of the manager

Table A.2.1 MICOM results report-part 1

	Mean original difference (23 - 38 years old. 39 - 54 years old 55 or more years old)	Mean permutation mean difference (23 - 38 years old. 39 - 54 years old. 55 or more years old)	2.50%	97.5%	Permutation p-values
PACAP	-0.213	0.011	-0.245	0.267	0.651
RACAP	-0.214	0.014	-0.223	0.25	0.654
D.InnProc	0.985	-0.005	-0.278	0.247	0.752
D.Innprod	0.993	-0.007	-0.283	0.274	0.621

Table A.2.2 MICOM results report-part 2

	Variance original difference (23 - 38 years old. 39 - 54 years old 55 or more years old)	Variance permutation mean difference (23 - 38 years old. 39 - 54 years old. 55 or more years old)	2.50%	97.5%	Permutation p-values
PACAP	0.205	0.013	-0.345	0.359	0.623
RACAP	0.203	0.021	-0.323	0.348	0.614
D.InnProc	-0.018	0.004	-0.578	0.513	0.584
D.Innprod	-0.015	0.003	-0.583	0.617	0.592

A.3. Size of the firm

Table A.3.1 MICOM results report-part 1

	Mean original difference (Small-Medium-Large)	Mean permutation mean difference (Small-Medium-Large)	2.50%	97.5%	Permutation p-values
PACAP	-0.183	0.021	-0.232	0.267	0.651
RACAP	-0.194	0.019	-0.223	0.24	0.632
D.InnProc	0.895	-0.007	-0.287	0.198	0.785
D.Innprod	0.983	-0.005	-0.226	0.237	0.725

Table A.3.2 MICOM results report-part 2

	Variance original difference (Small-Medium-Large)	Variance permutation mean difference (Small-Medium-Large)	2.50%	97.5%	Permutation p-values
PACAP	0.247	0.012	-0.354	0.398	0.618
RACAP	0.209	0.019	-0.332	0.383	0.624
D.InnProc	-0.015	0.007	-0.587	0.521	0.536
D.Innprod	-0.014	0.009	-0.583	0.673	0.532

A.4. Sector

Table A.4.1. MICOM results report-part 1

	Mean original difference (Industrial-Commercial)	Mean permutation mean difference (Industrial-Commercial)	2.50%	97.5%	Permutation p-values
PACAP	-0.225	0.020	-0.341	0.261	0.554
RACAP	-0.184	0.021	-0.235	0.28	0.533
D.InnProc	0.985	-0.008	-0.248	0.195	0.685
D.Innprod	0.874	-0.003	-0.232	0.212	0.621

Table A.4.2 MICOM results report-part 2

	Variance original difference (Industrial-Commercial)	Variance permutation mean difference (Industrial-Commercial)	2.50%	97.5%	Permutation p-values
PACAP	0.215	0.011	-0.352	0.399	0.618
RACAP	0.204	0.017	-0.331	0.382	0.624
D.InnProc	-0.012	0.009	-0.585	0.523	0.536
D.Innprod	-0.013	0.003	-0.581	0.674	0.532