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Measuring the impact of e-commerce adoption on financial performance: a first- and second-order pls-sem approach in ecuadorian business firms.

ABSTRACT

This study investigates the impact of e-commerce adoption on the financial performance of business firms in Ecuador. A first- and second-order Partial Least Squares Structural Equation Modeling (PLS-SEM) approach was used; survey data from firms in the El Oro province was analyzed; the study assesses the direct relationship between e-commerce adoption and financial performance. The findings indicate that although the direct impact of e-commerce on financial performance was not statistically confirmed, factors that facilitate e-commerce adoption and ICT capabilities are critical for its successful implementation. These results are critical for firms seeking to leverage digital technologies to increase their competitiveness and profitability. The study highlights the complexities of adopting digital strategies and suggests a holistic approach to navigating the digital transformation landscape, providing valuable lessons for both practitioners and academics in the field of business management.

Keywords: e-commerce, financial performance, ICT capabilities, structural equation modeling

Medición del impacto de la adopción del comercio electrónico en el desempeño financiero: un enfoque pls-sem de primer y segundo orden en empresas comerciales ecuatorianas

RESUMEN

Este estudio investiga el impacto de la adopción del comercio electrónico en el desempeño financiero de las empresas comerciales en Ecuador. Se utilizó un enfoque de Modelado de Ecuaciones Estructurales por Mínimos Cuadrados Parciales (PLS-SEM) de primer y segundo orden; se analizó datos de encuestas de empresas en la provincia de El Oro; el estudio evalúa la relación directa entre la adopción del comercio electrónico y el desempeño financiero. Los hallazgos indican que, aunque no se confirmó estadísticamente el impacto directo del comercio electrónico en el desempeño financiero, los factores que facilitan la adopción del comercio electrónico y las capacidades TIC son críticos para su implementación exitosa. Estos resultados son fundamentales para las empresas que buscan aprovechar las tecnologías digitales para aumentar su competitividad y rentabilidad. El estudio destaca las complejidades de adoptar estrategias digitales y sugiere un enfoque holístico para navegar el panorama de la transformación digital, proporcionando lecciones valiosas tanto para profesionales como para académicos en el campo de la gestión empresarial.

Palabras clave: comercio electrónico, desempeño financiero, capacidades TIC, modelamiento de ecuaciones estructurales

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Medindo o impacto da adoção do comércio eletrônico no desempenho financeiro: uma abordagem PLS-SEM de primeira e segunda ordem em empresas comerciais equatorianas

RESUMO

Este estudo investiga o impacto da adoção do comércio eletrônico no desempenho financeiro de empresas comerciais no Equador. Foi utilizada uma abordagem de modelagem de equações estruturais de mínimos quadrados parciais (PLS-SEM) de primeira e segunda ordem; Foram analisados dados de pesquisas realizadas em empresas da província de El Oro; O estudo avalia a relação direta entre a adoção do comércio eletrônico e o desempenho financeiro. Os resultados indicam que, embora o impacto direto do comércio eletrônico no desempenho financeiro não tenha sido confirmado estatisticamente, fatores que facilitam a adoção de recursos de comércio eletrônico e TIC são essenciais para sua implementação bem-sucedida. Esses resultados são essenciais para empresas que buscam alavancar tecnologias digitais para aumentar sua competitividade e lucratividade. O estudo destaca as complexidades da adoção de estratégias digitais e sugere uma abordagem holística para navegar no cenário da transformação digital, fornecendo lições valiosas para profissionais e acadêmicos na área de gestão empresarial.

Palavras-chave: comércio eletrônico, desempenho financeiro, capacidades de TIC, modelagem de equações estruturais.

INTRODUCTION

In the current digital era, the adoption of e-commerce by businesses has emerged as a critical catalyst for business transformation, influencing how organizations approach the globalized market. However, the relationship between the adoption of these digital technologies and the financial performance of companies remains an area of research that requires further exploration. This study seeks to delve into how e-commerce adoption affects profitability and operational efficiency within the context of Ecuadorian companies.

E-commerce adoption is considered not only a technological strategy but also a strategic change that can significantly enhance financial performance. Studies by González and Acosta (2022); Ortega et al. (2020), among others, have provided a framework for understanding the various motivational, experiential, competence, and strategic factors that drive this adoption. Moreover, technical challenges and operational barriers represent crucial elements that companies must overcome to successfully integrate these technologies into their daily operations (Villacres et al., 2020; Espinoza et al., 2021).

This study employs a first and second-order structural equation modeling (PLS-SEM) approach to analyze the structure and relationships between e-commerce adoption and financial performance. By using survey data from commercial companies in the province of El Oro, Ecuador, it aims to validate a conceptual model that not only directly measures these relationships but also considers ICT capabilities as a fundamental pillar in this process. Three main hypotheses are proposed in this study. The first hypothesis (H1) suggests that e-commerce adoption has a significant and positive impact on the financial performance of companies. The second hypothesis (H2) examines how key factors influencing e-commerce adoption—such as motivational factors, experience and competence, strategic planning, support and external resources, and barriers and challenges—affect the overall success of its implementation. The third hypothesis (H3) focuses on the ICT capabilities and their significant and positive relationship with e-commerce adoption. Finally, the fourth hypothesis (H4) examines the impact of company size and the sector to which it belongs on the profitability of firms and on e-commerce adoption.

The conceptual and methodological framework of this study provides a comprehensive base for exploring these dynamics, offering valuable insights into the strategic implementation of e-commerce and its impact on the Ecuadorian business landscape. This approach not only helps identify the direct benefits of these technologies but also highlights the complexities and challenges associated with their adoption, thus providing a holistic view of the phenomenon.

Financial Performance

Financial performance is essential for the health and sustainability of any company. In the context of e-commerce, it is crucial to understand how the adoption of these technologies affects such performance in order to effectively evaluate the efficacy of digital strategies and make informed decisions (Lützen, 2023). This review focuses on the key financial performance indicators, based on the definitions proposed by Santandreu (2000) and Achim et al. (2022), who identified the following indicators.

Return on Equity (ROE) — This indicator measures a company's ability to generate profits from its shareholders' investments. It is calculated by dividing net income by shareholders' equity. A high ROE indicates that the company is using its resources efficiently to generate significant returns for its owners (Achim et al., 2022; Lisek et al., 2020).

Return on Assets (ROA) — This index measures the efficiency with which a company uses its assets to generate earnings. It is determined by dividing net income by total assets. A

high ROA suggests that the company is effectively managing its assets to produce profits (Achim et al., 2022; Lisek et al., 2020).

Financial Autonomy — This ratio assesses a company's ability to finance its operations using its own resources, thereby reducing dependence on external debt. It is calculated as shareholders' equity divided by total liabilities. High financial autonomy indicates lower vulnerability to economic changes and greater solidity in meeting financial obligations (Achim et al., 2022; Santandreu, 2000).

Leverage — This indicator examines a company's degree of indebtedness by comparing total liabilities to shareholders' equity. High leverage means that a substantial amount of debt is used to finance operations, which can increase the financial risk of the entity (Neacșu & Georgescu, 2024; Santandreu, 2000).

When analyzing the relationship between e-commerce adoption and financial performance, it is vital to use indicators that accurately reflect the various aspects of business success. Metrics such as ROE, ROA, financial autonomy, and financial leverage provide valuable insights into profitability, efficiency, solvency, and financial risk, allowing for a comprehensive assessment of the impact of e-commerce strategies on the overall performance of the company.

E-commerce adoption

In the research conducted by González and Acosta (2022), a comprehensive perspective on the adoption of e-commerce is presented, highlighting the importance of several critical variables that influence this process. First, Motivational Factors emphasize both internal and external drivers that catalyze a company's decision to embark on e-commerce (Mensah & Mwakapesa, 2021; Zhang et al., 2020). This dimension is decisive as it encapsulates the initial predisposition and the strategic need to adopt new technologies to maintain competitiveness in an evolving digital market.

Secondly, the Experience and Competence of an organization in the realm of e-commerce are crucial (Nazir & Khan, 2023). This refers not only to accumulated knowledge and technical skills but also to prior operational experience that can facilitate a smoother transition to e-commerce platforms, thus reducing the learning curve and associated costs.

Strategic Planning plays an essential role in integrating e-commerce within the broader business operations of the organization (Mensah & Mwakapesa, 2021; Sujatha & Karthikeyan, 2021). This process involves defining a clear digital strategy that aligns e-commerce goals with the company's overall objectives, thereby ensuring that resources are effectively allocated and efforts are directed towards measurable outcomes.

On the other hand, Support and External Resources, such as those offered by external market platforms, are fundamental in overcoming initial technical and operational barriers (Maryani et al., 2020). These resources not only provide the necessary tools for execution but also offer ongoing support to solve problems and optimize e-commerce operations (Hidayati et al., 2019).

Finally, it is imperative to consider the Barriers and Challenges that companies face when adopting e-commerce. These challenges can range from technological limitations to organizational resistance to change and concerns about data security and privacy. The identification and proactive management of these obstacles are essential for facilitating a successful and sustainable adoption of e-commerce (Alryalat et al., 2023; Dedi, 2023). Together, these elements constitute a robust framework for understanding and navigating the adoption of e-commerce, emphasizing the need for a holistic strategy that addresses both motivational drivers and practical challenges.

Based on the preceding review of the literature, we can articulate the initial research hypothesis of this study as follows:

H1: *E-Commerce Adoption have a significant and positive impact on financial performance.*

Additionally, considering the reflective nature of the variables used to measure e-commerce adoption, the following hypothesis is also derived:

H2: *The key factors influencing e-commerce adoption—such as motivational factors, experience and competence, strategic planning, support and external resources, and barriers and challenges—have a significant and positive impact on the overall success of e-commerce implementation within firms.*

ICT Capabilities

The variable ICT Capabilities is established as a fundamental pillar for the adoption of e-commerce, incorporating a range of qualitative elements that are essential not only for facilitating such adoption but also for boosting business profitability. Among these critical factors is the expertise of the staff in ICT, which determines a company's ability to implement and effectively manage e-commerce solutions (Lawson et al., 2003; Nazir & Khan, 2023). Continuous training of staff in ICT is another crucial element, ensuring that the team is always up to date with the latest tools and technological practices, which allows for agile adaptation and response to the changing dynamics of the digital market (Ahmed, 2018; Religia et al., 2020; Sze-Wei et al., 2024).

Additionally, the variable includes key operational metrics, such as purchases and sales made through online platforms, as cited in studies by Xing and Bi (2022), respectively. These indicators not only demonstrate the effectiveness of the adopted e-commerce strategies but also provide valuable information about consumer behavior and market penetration. The meticulous integration and analysis of these elements offer a comprehensive understanding of how ICT capabilities can be strategically utilized to optimize business processes and, ultimately, enhance the profitability of the company within the digital realm.

Therefore, the study concludes that the third hypothesis is:

H3: ICT Capabilities have a positive and significant relation with E-Commerce Adoption

Company size and economic sector as control variables

As part of the analysis, this study evaluates the impact of control variables on financial performance. For this purpose, company size is an important variable (Fitraharizki & Rahayu, 2023), defined in accordance with Decision 702 of 2008 by the Andean Community of Nations. Companies are categorized based on the number of employees as follows: small businesses (1-49 workers), medium businesses (50-199 workers), and large businesses (200 or more workers). Economic sector is also considered (Liu, 2023); this variable is identified as the specific segment of the economy in which a company operates, with classifications including manufacturing, services, retail, and technology. Based on these definitions, the following additional hypotheses are proposed:

H4: *Company size and economic sector will significantly affect the financial performance outcomes of firms adopting e-commerce.*

These hypotheses reflect the expected influence of these control variables on the primary relationship being studied, acknowledging that external and organizational factors can alter the dynamics of e-commerce adoption.

Conceptual Framework

After conducting an empirical literature review, three hypotheses were identified that include three main constructs and five dimensions. These hypotheses, structurally formulated, led to a conceptual framework for the research. This framework was subsequently examined using survey data to perform statistical measurements of the involved variables (see Figure 1). This methodology allowed for a deeper understanding of the theoretical relationships proposed in the study.

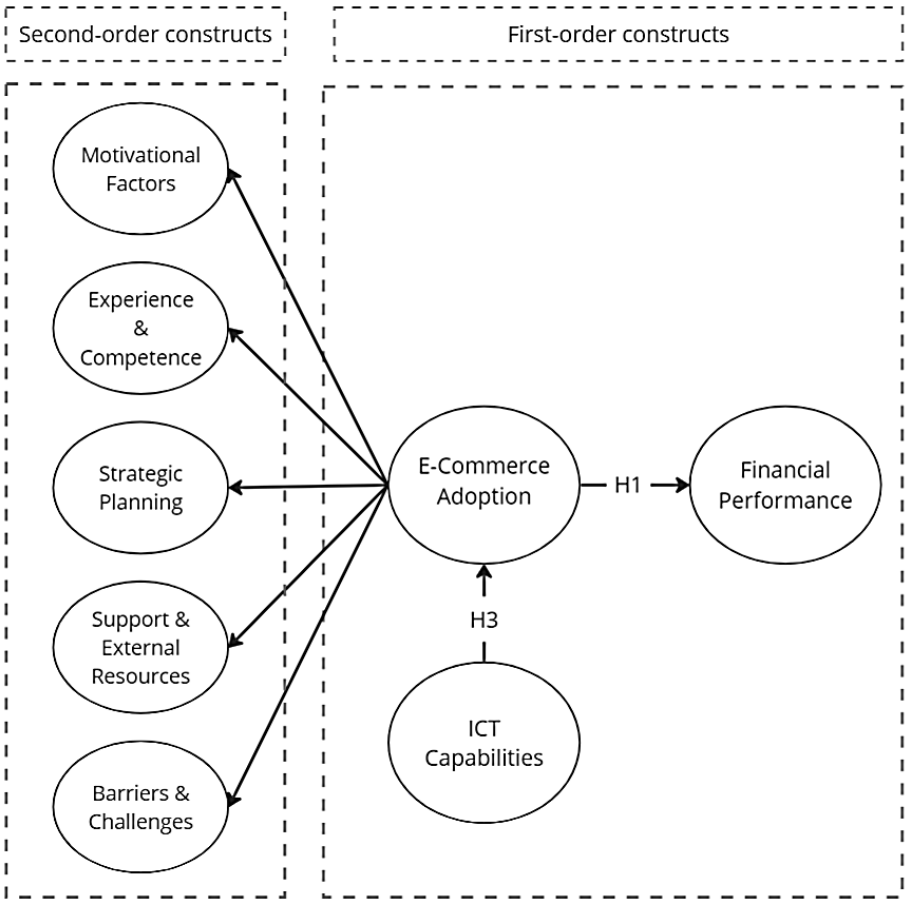

Figure 1. Conceptual Framework

MATERIALS AND METHODS

In social sciences, the most commonly used research methods encompass three paradigms: qualitative, quantitative, and mixed methods. This study was conducted using the Structural Equation Modeling (SEM) technique to substantiate the conceptual framework, an extremely useful tool in both the business realm and social sciences for developing or testing theories (Ghaleb & Yaşlioğlu, 2024). In this instance, a research method with suitable exploratory analysis for a second-order structural equation model was adopted. Furthermore, the framework of the conceptual model was empirically verified using Smart PLS and SPSS to identify empirical data based on the literature review. The sampling procedure implemented in this study involved simple random sampling, which included Ecuadorian companies based in the province of El Oro in Ecuador. Additionally, other aspects of this study were detailed

and executed through a step-by-step data analysis for second-order structural equation modeling.

DATA ANALYSIS

Data analysis is a systematic process, guided by both the method of handling empirical data and the appropriate research design (Sileyew, 2020). In this study, the conceptual model was developed based on a literature review, which established the foundation for hypothesizing relationships between constructs. These hypotheses were crucial for selecting the most suitable analytical methodology for the exploratory analysis, a key component of the widely recognized and utilized quantitative approach for validating theoretical predictions through empirical data (Yong et al., 2021). Consequently, this study employed quantitative analysis using SPSS and SmartPLS software. SPSS is better suited for descriptive analysis, while Smart-PLS is more appropriate for inferential statistics. The research model adopted was reflective rather than formative; a reflective model aims to develop theory rather than to test it (Crocetta et al., 2021). The strategic research design facilitates the derivation of research predictions, whether confirmed or not. Therefore, researchers choose a research design that ensures precise results. This process often involves selecting the philosophy of positivism combined with a deductive approach, which is particularly suitable for developing the conceptual framework through literature review. For data collection, the survey method was selected, using closed-ended questionnaires. Additionally, a mono-method approach with a cross-sectional design was adopted for the study.

In terms of data collection, the research was conducted in two stages. The first involved using a survey technique to measure the dimensions considered within the E-Commerce Adoption construct, utilizing a closed questionnaire with five-point Likert scales. Additionally, the questionnaire included general questions, both dichotomous and nominal, to explore aspects such as the availability of a website, periodic ICT training for staff, the presence of specialized ICT personnel, online sales and purchases, company size, economic sector, and the identification of the RUC (Taxpayer Registration Number). The second stage took place after administering the survey and obtaining the RUC; a secondary data analysis was then conducted, which involved identifying the financial data of the companies through the "Information Portal"[1] of the "Superintendence of Companies, Securities, and Insurance of Ecuador (SCSI)." Using this information, financial indicators relevant to the evaluation of the companies' financial performance were calculated. The respondents targeted were general managers and heads of ICT departments. The distribution of questionnaires took place from January 3 to March 7, 2024. During this period, 400 information requests were sent out, and 137 responses were received. After verifying the information with the Information Portal of the SCSI, the responses were filtered, resulting in a database of 99 fully completed and correctly filled out questionnaires. The sampling process employed a simple random sampling technique.

The data were analyzed using two statistical software programs: SPSS and Smart-PLS. SPSS was used to perform exploratory factor analysis (EFA) on the items. Subsequently, Smart-PLS was used for PLS-SEM analysis. Initially, EFA was applied to ensure that each item's factor loading reached a minimum of 0.50, the threshold value required before proceeding with the structural model. Similarly, PLS-SEM was employed to validate the conceptual model through empirical data analysis. Thus, the following sections present a set of EFA estimates and the validation of structural modeling.

[1] https://appscvsmovil.supercias.gob.ec/PortalInformacion/index.html

RESULTS

Exploratory Factor Analysis (EFA)

To examine the underlying factor structure of the E-Commerce Adoption construct within the SPSS dataset, an Exploratory Factor Analysis (EFA) was conducted using Principal Component Analysis (PCA) for factor extraction. The analysis was complemented by a varimax rotation with Kaiser Normalization to enhance the interpretability of the results. The extracted components each yielded values exceeding the 0.50 mark, fulfilling the criterion for validity where a minimum of 0.50 is necessary (Lloret et al., 2017). The Kaiser-Meyer-Olkin (KMO) measure for assessing sample adequacy registered at 0.907, surpassing the preferred threshold of 0.70. Moreover, Bartlett's Test of Sphericity reached a significance level of 0.000, well below the 0.05 standard. As such, the EFA is statistically substantial, with the factor extraction and rotation methods yielding significant results as depicted in Table 1.

Table 1.
Rotated Component Matrix with KMO & Bartlett's Test and Cronbach's Alpha (α)

Dimension	Items	α	Components [a]			
			1	2	3	4
Motivational Factors (1)	mot2	0.898	0.841			
	mot1		0.829			
	mot3		0.706			
Experience and Competence (2)	exp2	0.911		0.835		
	exp1			0.830		
	exp3			0.692		
Support and External Resources (3)	sop2	0.924			0.779	
	sop3				0.750	
Barriers and Challenges (4)	bar3	0.782				0.901
	bar2					0.659

Note. Extraction method: PCA. Rotation method: Varimax with Kaiser normalization. a. The rotation converged in 6 iterations.

The Cronbach's alpha for each dimension exceeded the threshold of 0.70, set as the minimum to ensure reliability, according to (Bujang et al., 2018). This demonstrates that the scales used in the study are internally consistent and reliable. However, the Strategic Planning dimension did not meet the necessary criteria regarding eigenvalues ≥ 1, and the factor loadings of its items were below 0.50 or overlapped with other dimensions. These results indicate that Strategic Planning did not constitute a coherent and independent factor in the exploratory factor analysis conducted. Consequently, this dimension was excluded from the final model, allowing the four remaining dimensions to advance to subsequent analyses.

Factor Analysis by PLS Algorithm

Utilizing a PLS algorithm within pathway analysis and SEM methodologies, one can establish the path correlation coefficient, offering a measure of the partial correlation present between the endogenous and exogenous variables in the model (Fauzi, 2022). The range of the correlation coefficient is established from -1 to +1, reflecting the strength and direction of the linear relationship that exists between two variables. Regarding significance levels, they are commonly placed at 0.20, although it should be noted that there isn't a mandatory minimum threshold for significance. Within the context of bootstrapping to ascertain the significance of a pathway, it is not unusual to encounter values at or below 0.10 (Wong, 2019). At its core, the PLS algorithm performs a sequence of regressions that are

contingent on weight vectors (Abdi & Williams, 2013). These vectors, when achieving convergence, satisfy certain fixed-point equations, which are intrinsic to the primary techniques of PLS that encompass the subsequent stages outlined (Garrido et al., 2022). Executing the following measurement, the PLS algorithm calculates what is known as the factor loading, a critical parameter (Sarstedt et al., 2017). Hence, the factor loading for each item must reach or surpass a threshold of 0.70 to be considered substantial (Hair et al., 2022). Every measurement surpassing factor loadings of 0.70 suggests that all items were deemed robust enough to be retained within the construct of the measurement model (see Figure 2 for the present study).

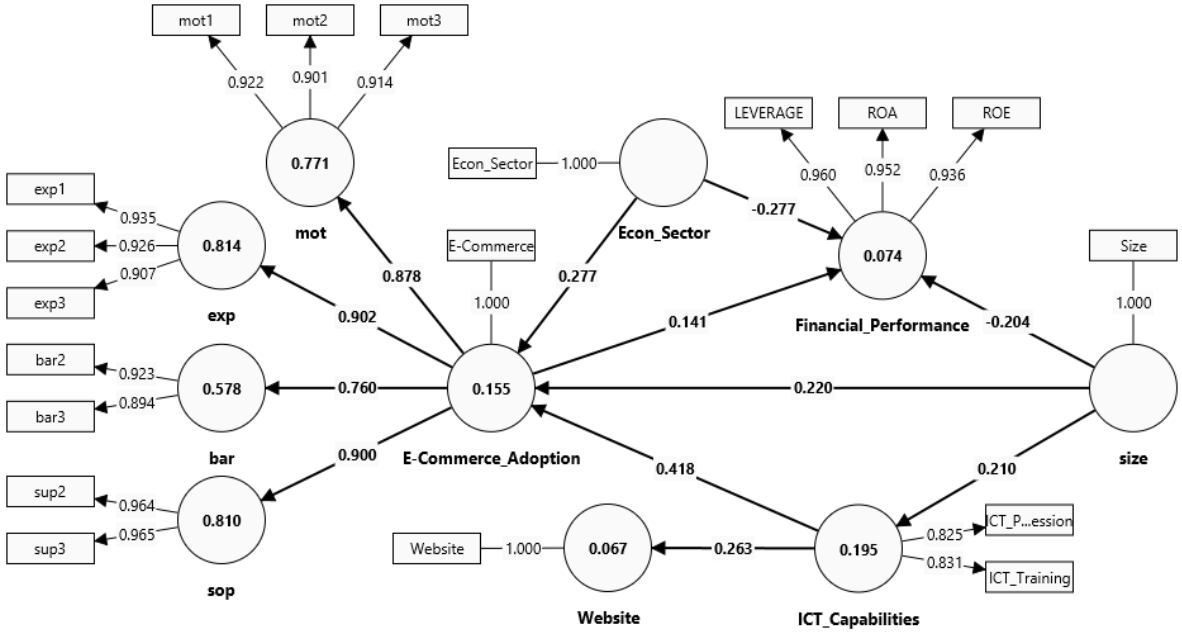

Figure 2. Path coefficients of PLS algorithm.

In the second-order structural model concerning the E-commerce adoption construct, which comprises four dimensions, an exogenous variable significantly impacted the R^2 values. The dimensions of motivational factors, experience and competence, barriers and challenges, and support and external resources recorded achievements of 77.1%, 81.4%, 57.8%, and 81.0%, respectively. Other predictor variables may account for the remaining influences.

The significant correlation coefficient of 0.141 between E-commerce adoption and Financial performance facilitated the use of a precursor subset of the SEM model to initiate the bootstrapping process. On the other hand, regarding the association between ICT capabilities and e-commerce adoption, the most prominent path coefficient is that of ICT capabilities, with a value of 0.418, indicating a correlation of moderate magnitude. Furthermore, between company size and economic sector, with path coefficients of -0.204 and -0.277 respectively, both exhibit significant influence with values greater than 0.20.

Moreover, the construct of the E-commerce adoption with four dimensions has achieved over or equal to 0.20. Therefore, the items of each dimension were statistically measured as second-order dimensions of the e-commerce adoption construct. The coefficient of the path correlation between the exogenous variable of the e-commerce adoption toward the four dimensions showed a strong association between them. The correlation between e-commerce adoption and motivational factors was 0.878 which was the third-highest

association. The dimension of experience and competence and e-commerce adoption was 0.902, which was the highest associations. The third dimension between e-commerce adoption and barriers and challenges was 0.760 which was good at this level. The fourth dimension between e-commerce adoption and support and external resources was 0.900, that showed the second-highest association. Therefore, by the predictor variable of e-commerce measured with all of the dimension items the second-order was confirmed and established the reflective model.

Within the PLS-SEM analysis conducted, it can also be highlighted that the path coefficients also reveal notable relationships involving company size and economic sector as they relate to financial performance. Specifically, the path coefficients of -0.204 for company size and -0.277 for economic sector both demonstrate significant inverse relationships with financial performance. This indicates that these variables are critical factors and that their negative associations warrant further investigation to understand the underlying dynamics at play. These findings suggest that as size and sector characteristics vary, there may be differing impacts on a company's financial health, highlighting the complexity of factors that influence financial outcomes within the model. These insights into size and sector effects are instrumental in forming a holistic view of the antecedents to financial performance and enrich our understanding of the structural relationships in the SEM context.

Construct Reliability and Validity

Just like Cronbach's alpha, composite reliability, also known as construct reliability, is used to assess internal consistency within scale categories (Garson, 2016). Most constructs met or exceeded the required threshold of ≥ 0.70, necessary for the latent variable to be considered reliable in further analyses, where Cronbach's alpha must be at least 0.70 (Hair et al., 2022). However, the 'ICT Capabilities' construct, although it did not reach the desired values in Cronbach's alpha and rho_a, did meet the criteria for Composite Reliability and AVE, which were 0.814 and 0.686 respectively. This justifies its retention in the model as these indices suggest sufficient internal consistency and convergent validity. Since the composite values also exceeded 0.70 for the other constructs, their reliability was confirmed (Chua, 2024). Essentially, the measurement model should focus on measurement indices, such as factor loading ≥ 0.50, AVE ≥ 0.50, CR ≥ 0.70, and Cronbach's alpha ≥ 0.70 (Hair et al., 2022). In this way, the following indices were explored statistically from the survey data (Table 2).

Table 2.
Construct reliability and validity

Construct/ Dimensions	Cronbach´s Alpha	rho_a	Composite Reliability	AVE
Motivational Factors	0.899	0.901	0.937	0.832
Experience and Competence	0.913	0.913	0.945	0.851
Barriers and Challenges	0.789	0.802	0.904	0.825
Support and External Resources	0.925	0.925	0.964	0.930
ICT Capabilities	0.542	0.542	0.814	0.686
Financial Performance	0.946	0.989	0.965	0.902

Convergent and Discriminant Validity

In the same Table 2, convergent validity is calculated using the Average Variance Extracted (AVE). An AVE of ≥ 0.50 indicates that the indicators have been adequately quantified

(Chua, 2024). The AVE for all constructs exceeded 0.50. Subsequently, path coefficient were identified as precursors to conducting further analyses, such as path analysis with bootstrapping. The upcoming discussion on discriminant validity is presented from the perspective of addressing any discriminant issues, explained through various criteria, including the Heterotrait-Monotrait ratio, the Fornell-Larcker criterion, and Cross Loadings, which are detailed below.

The discriminant validity assessed using the HTMT criterion should ideally exhibit values less than 0.85. Nonetheless, in certain research contexts, values below 0.90 are also deemed acceptable, suggesting adequate discriminant validity among the constructs and confirming the absence of discriminant issues. In this study, the HTMT ratios for most constructs fall below the 0.85 threshold. However, there are three exceptions where the values reach up to 0.944. Despite these exceptions, these constructs are retained for further verification against other criteria.

Table 3.
Discriminant validity with HTMT ratio

Construct /Dimension	a	b	c	d	e	f	g	h	i
E-Commerce adoption	-								
Economic sector (a)	0.189								
Financial performance (b)	0.044	0.185							
ICT capabilities (c)	0.373	0.113	0.038						
Website (d)	0.203	0.120	0.119	0.351					
Barriers and Challenges (e)	0.851	0.242	0.057	0.163	0.052				
Experience and Competence (f)	**0.944**	0.202	0.096	0.450	0.191	0.724			
Motivational Factors (g)	**0.925**	0.099	0.051	0.437	0.183	0.711	0.790		
Size (h)	0.218	0.328	0.079	0.599	0.228	0.093	0.258	0.228	
Support and External Resources (i)	**0.936**	0.166	0.032	0.353	0.209	0.772	0.811	0.808	0.189

Using the Fornell-Larcker criterion, which estimates the degree of shared variance among the model's latent variables, it is observed that the square root of the AVE for each variable is greater than its correlations with other variables, thus indicating the absence of discriminant issues. These values are presented on the diagonal of Table 4, highlighted in bold and shaded, except for the binary variables (website, size) and e-commerce adoption, which were measured using an index. This demonstrates that the variables have discriminant validity in all analyzed cases.

Table 4.
Discriminant validity with Fornell-Larcker

Construct /Dimension	a	b	c	d	e	f	g	h	i
E-Commerce adoption (a)	**1.000**								
Financial performance (b)	0.044	**0.950**							
ICT capabilities (c)	0.274	-0.010	**0.828**						
Website (d)	0.203	-0.115	0.258	**1.000**					
Barriers and Challenges (e)	0.760	0.025	0.064	0.044	**0.908**				
Experience and Competence (f)	0.902	0.093	0.316	0.183	0.617	**0.922**			
Motivational Factors (g)	0.878	0.040	0.306	0.174	0.605	0.717	**0.912**		
Size (h)	0.218	-0.083	0.442	0.228	0.087	0.246	0.218	**1.000**	
Support and External Resources (i)	0.900	0.024	0.249	0.201	0.666	0.746	0.739	0.182	**0.964**

Finally, the relationship of cross-loadings among the items was addressed. According to Latan et al. (2023), the items of the main construct should have a factor loading higher than the factor loading correlations of any other correlated construct. In the analysis of the cross-loadings, it was observed that the measures indicated appropriate values for discriminant validity (see Table 5).

Table 5.
Discriminant validity with Cross-loading

Items	1	2	3	4	5	6	7	8	9	10
E-Commerce (1)	**1,000**	0.189	0.044	0.274	0.203	0.760	0.902	0.878	0.218	0.900
Econ_sector (2)	0.189	**1,000**	-0.183	-0.083	0.120	0.221	0.191	0.092	-0.328	0.160
Leverage (3)	0.060	-0.193	**0.960**	-0.005	-0.092	0.046	0.118	0.007	-0.103	0.052
ROA (3)	0.022	-0.172	**0.952**	0,000	-0.141	-0.001	0.061	0.065	-0.086	-0.006
ROE (3)	0.040	-0.149	**0.936**	-0.028	-0.096	0.021	0.076	0.049	-0.031	0.017
ICT professional (4)	0.293	-0.101	-0.028	**0.825**	0.234	0.130	0.335	0.281	0.306	0.269
ICT training (4)	0.162	-0.036	0.012	**0.831**	0.194	-0.023	0.189	0.227	0.425	0.145
Website (5)	0.203	0.120	-0.115	0.258	**1,000**	0.044	0.183	0.174	0.228	0.201
bar2 (6)	0.740	0.268	-0.018	0.070	0.017	**0.923**	0.598	0.606	0.131	0.679
bar3 (6)	0.635	0.123	0.071	0.044	0.067	**0.894**	0.518	0.486	0.019	0.519
exp1 (7)	0.835	0.199	0.099	0.263	0.170	0.573	**0.935**	0.646	0.223	0.670
exp2 (7)	0.812	0.268	0.069	0.292	0.123	0.575	**0.926**	0.600	0.215	0.687
exp3 (7)	0.849	0.067	0.088	0.319	0.213	0.561	**0.907**	0.737	0.243	0.707
mot1 (8)	0.791	0.068	0.044	0.310	0.205	0.540	0.648	**0.922**	0.203	0.659
mot2 (8)	0.771	0.150	0.057	0.198	0.102	0.492	0.624	**0.901**	0.130	0.630
mot3 (8)	0.839	0.039	0.009	0.326	0.167	0.619	0.689	**0.914**	0.259	0.728
Size (9)	0.218	-0.328	-0.083	0.442	0.228	0.087	0.246	0.218	**1,000**	0.182
sup2 (10)	0.858	0.149	0.023	0.246	0.207	0.676	0.700	0.687	0.161	**0.964**
sup3 (10)	0.877	0.160	0.024	0.236	0.182	0.608	0.738	0.737	0.190	**0.965**

Structural Equation Modeling (SEM) Hypotheses Tested via PLS-Bootstrapping

Bootstrapping, a nonparametric approach, is employed to ascertain the statistical robustness of PLS-SEM results, including path coefficients (Hair et al., 2019). In this section, the structural model underwent analysis to derive empirical data outputs via statistical evaluation using Smart PLS and PLS-Bootstrapping (Table 6).

Table 6.
Análisis de la significancia del modelo

	Hypothesis/ Relation constructs	Path coefficients	p-values	Remark
	H1.1. E-Commerce Adoption → Financial Performance	0.141	0.056	Not accepted
	H1.2. Size → Financial Performance	-0.204	0.066	Not accepted
	H1.3. Economic sector → Financial Performance	-0.277	0.008	Accepted
Second-order constructs	H2.1 Barriers and Challenges ← E-Commerce Adoption	0.760	0.000	Accepted
	H2.2. Experience and Competence ← E-Commerce Adoption	0.902	0.000	Accepted
	H2.3. Motivational Factors ← E-Commerce Adoption	0.771	0.000	Accepted
	H2.4. Support and External Resources ← E-commerce	0.810	0.000	Accepted

Adoption			
H3.1. ICT Capabilities → E-Commerce Adoption	0.418	0.045	Accepted
H3.2. Size → E-Commerce Adoption	0.220	0.009	Accepted
H3.3. Economic sector → E-Commerce Adoption	0.277	0.005	Accepted
H4.1. Size → ICT Capabilities	0.210	0.000	Accepted
H4.2. website → ICT Capabilities	0.263	0.006	Accepted

Table 6 reveals that the hypotheses have demonstrated a statistically significant association for most cases, as evidenced by a p-value of ≤0.05. Exceptions to this are the relationships between e-commerce adoption and financial performance, which exhibited a p-value marginally above the threshold, and the relationship between size and financial performance, which posted a p-value of 0.066. Consequently, the null hypotheses for these relationships were rejected, and alternative hypotheses were confirmed for instances where the p-value condition was satisfied.

The theoretical prediction of a relationship between e-commerce adoption and financial performance was not empirically substantiated in hypothesis H1.1, with a p-value of 0.056 slightly exceeding the conventional threshold of 0.05, leading to its non-acceptance. A similar situation was observed for the relationship between company size (size) and financial performance, yielding a p-value of 0.066. However, the relationship between the economic sector and financial performance was statistically significant. Regarding the second hypothesis, all factors considered as reflective constructs of e-commerce adoption—including barriers and challenges, experience and competence, motivational factors, and support and external resources—were found to be statistically significant, with p-values below 0.05. As for the third hypothesis, which examined the links between ICT capabilities and company size concerning e-commerce adoption, p-values below 0.05 were also confirmed, specifically 0.045 for ICT capabilities and 0.009 for company size. For the fourth hypothesis, p-values below the established cut-off were corroborated, notably a p-value of 0.000 for the relationship between company size and ICT capabilities, and 0.006 for the relationship between the website and ICT capabilities. The structural equation model is depicted in Figure 3, including the presentation of the model's R-squared coefficient.

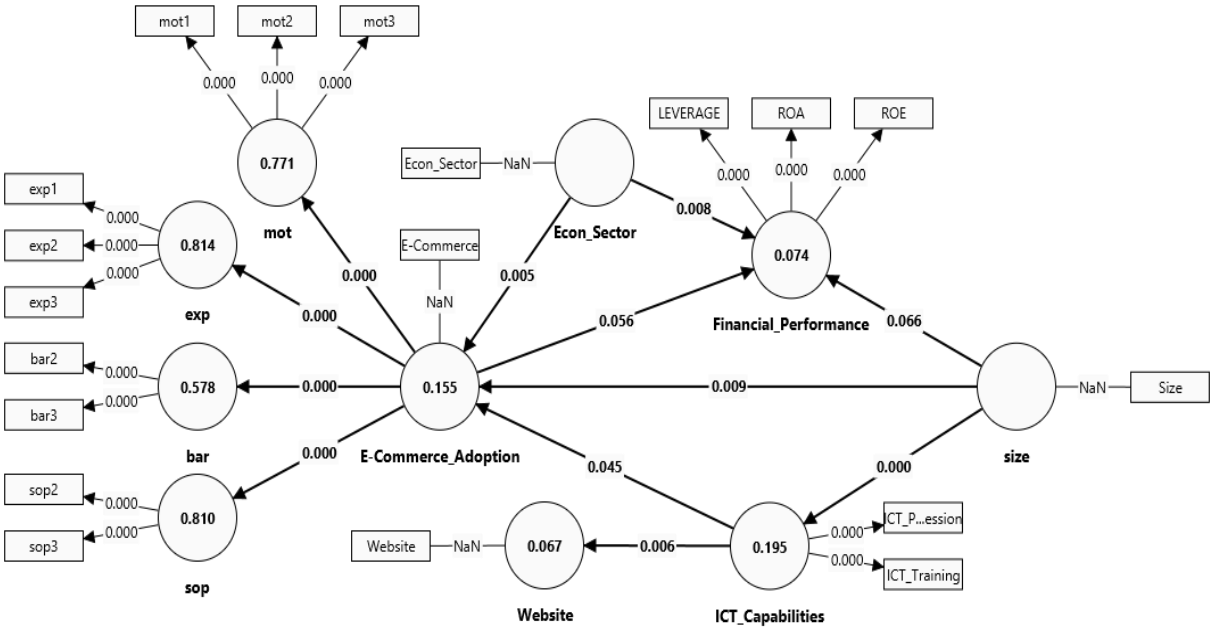

Figure 3. Hypotheses tested via PLS-Bootstrapping

The R-squared value was 0.074, which is nearly 7%, indicating that the endogenous variable of financial performance was modestly influenced by the predictor variables of e-commerce adoption, economic sector, and company size. This outcome is considered modest, and given that the p-value between e-commerce adoption and financial performance is not significant, it can be inferred that the relationship between these variables is marginal within the context of the study. Furthermore, the second-order constructs defining e-commerce adoption were significantly influenced by the measurement variables of each construct, proving to be strong predictors of the measured variables.

DISCUSSIONS AND CONCLUSION

This study has examined the adoption of e-commerce and its impact on the financial performance of companies in Ecuador, employing a first and second-order Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. The results highlight the significant influence of e-commerce adoption on profitability and operational efficiency, underscoring the crucial role of ICT capabilities, motivational factors, experience and competence, strategic planning, and external support in this process.

The main hypothesis (H1), which proposed a significant and positive impact of e-commerce adoption on financial performance, was not statistically confirmed. This suggests that the relationship between these variables may be more complex and influenced by additional factors not fully captured in this study. Previous research indicates that while high levels of e-commerce adoption can positively impact profitability, there are also cases where the implementation of e-commerce does not significantly affect income growth (Chávez el al., 2020). Moreover, it has been found that e-commerce adoption can have a negative and insignificant effect on the value of the company under certain circumstances (Lorca et al., 2019). Factors such as gender, education, income, digital skills, age, and household composition influence e-commerce adoption. Some demographic groups show a positive relationship with e-commerce adoption, while others exhibit negative effects (Kaunda, 2015). Therefore, the relationship between profitability and e-commerce adoption is not universally positive or negative but depends on various contextual elements and individual characteristics of the cases analyzed.

Furthermore, the results on the statistical significance of e-commerce adoption on profitability have shown considerable variability. While studies like that of Azkhiya and Hendratno (2020) found no significant differences in profitability metrics before and after the implementation of e-commerce, other studies, have observed that high levels of e-commerce adoption can lead to an immediate increase in company profitability (Lorca et al., 2019; Maghfiroh & Biduri, 2022).

However, the hypotheses related to the determinants of e-commerce adoption (H2) and ICT capabilities (H3) were confirmed, indicating that these elements are essential for success in implementing e-commerce. E-commerce adoption in small and medium-sized companies (SMEs) is influenced by various motivational factors, barriers, ICT experience, support, and external resources. In Latin America, it has been determined that personal motivational factors significantly influence e-commerce adoption (Bailey et al., 2022). The barriers affecting e-commerce adoption in SMEs include organizational, technological, and environmental factors (Shahadat et al., 2023). Additionally, organizational support and technological competence significantly affect performance improvement in e-commerce adoption by SMEs (Febria & Suwarni, 2022). Factors such as top management support, learning orientation, computer readiness, and costs play a crucial role in influencing e-commerce adoption in Indian SMEs (Sánchez et al., 2021). These observations highlight the

multifaceted nature of e-commerce adoption and the importance of addressing various factors to facilitate its implementation in SMEs.

Implications

This study on e-commerce adoption and its impact on the financial performance of companies in Ecuador offers significant theoretical and managerial implications, essential for academics and professionals in the digital economy sphere.

Theoretical Implications

From a theoretical perspective, this analysis broadens the understanding of how the integration of digital technologies can transform businesses. Although the direct adoption of e-commerce did not show a significant impact on financial performance, factors such as ICT capabilities, change management, and structural support emerge as crucial elements for success. This finding suggests that e-commerce adoption should be seen not only as a technological transition but also as an organizational and strategic transformation. Therefore, future research could further explore how various ICT capabilities and change management strategies specifically influence the financial and operational outcomes of companies. Moreover, the study emphasizes the importance of considering contextual and sectoral variables when examining the effects of e-commerce, which could enrich the literature on technological adaptations in emerging markets and developing economies. Differences in technological infrastructure, organizational culture, and government policies are examples of how the context can influence the effectiveness of e-commerce adoption.

Managerial Implications

Regarding managerial implications, the study's findings are vitally important for business leaders looking to integrate e-commerce into their operations. Firstly, prioritizing ICT capabilities is fundamental. Managers should consider strategic investments not only in advanced technologies but also in staff training, ensuring that employees are well-equipped to handle and optimize digital tools. Additionally, developing an organizational culture that promotes innovation and adaptability is essential. This culture should value experimentation and flexibility, allowing companies to quickly adapt to changes in the digital market environment. Implementing a holistic approach in the e-commerce strategy, which includes both the merchant's and the consumer's perspectives, is also crucial for maximizing the effectiveness of e-commerce initiatives.

Customizing strategies according to the specific needs of the sector and target market can help companies enhance their competitiveness in e-commerce. Furthermore, continuous evaluation and revision of e-commerce strategies are necessary to effectively respond to dynamic technological and market developments. Consequently, managers must be prepared to proactively manage the operational and technical challenges associated with e-commerce, implementing robust technical support and crisis management systems. This will not only minimize operational disruptions but also improve organizational resilience.

Limitations and future scope

Although meticulously designed and rigorously documented, this paper is not without limitations. Firstly, the results exclusively stem from companies within the commerce sector in El Oro province, Ecuador. This geographic and sectoral focus may limit the extrapolation of the findings to other regions and economic sectors. This situation underscores the need for future research that encompasses more varied areas and different sectors to extend the validity of the results to other contexts within Ecuador and internationally. Secondly, while the research captures the perspective of merchants, it omits the viewpoint of consumers, which could enrich the understanding of the impact of e-commerce on market behavior. Given that PLS-SEM is a novel and easy-to-implement technique, the study could be

expanded to incorporate both perspectives, which would allow for a more precise identification of the critical factors for successful e-commerce adoption.

Additionally, this study opens the door to future research that could explore the impact of e-commerce adoption on other aspects of business performance, such as customer satisfaction, retention, and market expansion. It would also be revealing to analyze how variations in the economic and cultural environment of different regions within Ecuador affect the adoption and benefits of e-commerce. Moreover, integrating further financial and operational indicators would provide a more comprehensive understanding of the impact of e-commerce. Increasing the sample size and improving survey response rates in future research could enhance the robustness and relevance of the results obtained. These adjustments would not only improve methodological solidity but also enhance the practical relevance of the research for stakeholders and policymakers interested in the dynamics of e-commerce.

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