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Synergy Between Internal Control, Forensic Accounting, And Artificial Intelligence In The Financial System. Optimal Model For Fraud Detection And Financial Information Transparency In The Digital Age

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Abstract
The paradigm of internal control and forensic accounting in private financial institutions, mainly banks and savings and credit cooperatives, which have traditionally carried out their processes manually and on a sample basis, must take on new transformational challenges by incorporating artificial intelligence tools to provide a holistic predictive and reactive system that guarantees the traceability of information and mitigates accounting data bias. This study focuses its efforts on proposing an optimal model of synergy between internal control, forensic accounting, and artificial intelligence to predict and address potential financial fraud. The findings were the result of applying a quantitative methodology with a pragmatic approach, using inferential statistical techniques and instruments under an analytical and descriptive method with the contribution of Chi-Square and Correlation of variables in the SPSS system for hypothesis validation. The study population focused on 422 entities in the Ecuadorian financial system, concluding that financial system organizations must incorporate artificial intelligence into internal control and accounting processes to achieve effectiveness in financial information transparency and have predictive models that guarantee data reliability. The optimal model suggested and recommended by the study is MinimaxET (error minimization and information transparency maximization model).
Keywords: *Internal control, forensic accounting, artificial intelligence, algorithms, fraud, information transparency.*

1. INTRODUCTION

In the current digital and transformational era, financial institutions require a high degree of dynamism to address the complexity of their processes with an emphasis on the accuracy, speed, and timeliness of information, which is achieved through the incorporation of artificial intelligence that enables unprecedented operational efficiency. This research theorizes and guides the praxis of the successful synergy between internal control, forensic accounting, and AI as a model for successful fraud risk management and information transparency in banks and savings and credit cooperatives, allowing for the minimization of bias in accounting data and effective and real accountability.

To argue and substantiate the above premise and establish the conceptual and theoretical foundations of the proposed optimal model, we proceed to a comprehensive review of the evolution of internal control, its relationship with forensic accounting, and the impact of artificial intelligence as a strategic imperative.

2. LITERATURE REVIEW

2.1 Link between Internal Control and Forensic Accounting

One of the main challenges that organizations must face in the 21st century is to have adequate data and digital tools that allow them to control processes, especially those related to accounting and financial data, in order to effectively guarantee the transparency of information and consolidate the sustainability of entities over time. It should be noted that robust internal control is a front-line defense strategy and a

preventive measure against possible fraud. If unusual transactions are detected, forensic accounting should be used to investigate and correct them. With this background, we must begin with an analysis of internal control. Henry Fayol (1916), founder of classical management theory, states in his work entitled Administration industrielle et générale that the five elements of the administrative process are: planning, organizing, directing, coordinating, and controlling, the latter being mentioned as an aspect of transcendental importance in order to ensure that the entire organization in its context complies with the previously stipulated guidelines.

However, with the passage of time and the complexity of human beings, the concept of control has evolved and reached different levels of standardization, becoming a fundamental pillar of strategic and business management, basically for senior management, and especially when the focus on risk is incorporated as a key factor to be considered in order to prevent and deal with adverse situations that endanger the organization.

In this context, in 1992, the Committee of Sponsoring Organizations of the Treadway Commission issued the COSO 1 Integrated Internal Control Framework, whose main objective was to provide a structured and uniform framework that companies could use to ensure the effectiveness of operations, the reliability of financial information, and compliance with laws and regulations. Subsequently, in 2004, improvements were made and COSO II, known as the Enterprise Risk Management (ERM) Integrated Framework, was published. It was designed with the purpose of analyzing uncertainty and determining the probabilities in order to minimize or adequately address the dangers that may arise. Then, in 2013, thanks to a constant reform project by the committee, COSO III, known as the Internal Control-Integrated Framework, was issued. It retains the name COSO I but is an improved version because it integrates each of its five elements, which are: Control environment, risk assessment, control activities, information-communication and monitoring, elements of: Greater emphasis on technology, global relevance, the fight against fraud, and the importance of corporate governance , with the firm objective of ensuring the reliability and transparency of information.

As a preamble to the above, it is necessary to highlight the support and argument of the theories of the risk society and internal control. Beck (1986) states:

Risks are not limited to consequences and damages that have already occurred but essentially contain a future component. This lies both in the prolongation into the

future of already visible damage and in a general loss of confidence or the assumption of an "increased risk." Thus, risks are essentially related to foresight, to destruction that has not yet taken place but is imminent, and which, precisely in this sense, is already real today. (p.39)

With regard to internal control, there are some postulates that we can highlight, such as those presented by Pirela (2005).

The theory of internal process control is essentially oriented toward evaluation, a function through which the conditions of utilization of those involved in the context of the strategy are verified. Internal control considers that management is ultimately responsible for carrying out the work and must commit to acting consistently in accordance with all the requirements of the administrative philosophy, based on the consistency of this philosophy. (p. 2).

To speak of forensic accounting is to orient thought and hermeneutics toward the combined skills of investigation, accounting, and auditing to analyze and evaluate financial information in search of evidence that reflects the misuse of funds, fraud, and other activities that negatively affect the organization, as Saccani (2010) points out. forensic accounting "is responsible for detecting signs and uncovering evidence of corporate fraud or acts of corruption in private or public entities." Another postulate is mentioned by Martínez (2017): Forensic accounting is vitally important for resolving possible cases of fraud and is the correct way to prevent or attack the problem even before it happens.

Based on these arguments, all organizations, and particularly financial institutions, must have adequate internal controls in place in a holistic manner to prevent possible errors and fraud that could jeopardize the economic and financial aspects of the entity, as well as to guide improvements that may arise along the way. All of this is complemented by adequate forensic accounting, which allows corrective actions to be taken based on accounting evidence, ensuring transparent information and, above all, supporting the achievement of optimal organizational results.

2.2 Artificial intelligence as a support for internal control and forensic accounting

The digital age has been complemented by a transformational era in which the use of artificial intelligence (AI) tools, models, and instruments has allowed many human activities to be performed in the shortest

possible time and with the least effort, contributing radically to achieving the greatest possible accuracy and minimizing errors. As such, the accounting profession has gradually incorporated a series of systems that have made it possible to automate routine tasks, facilitating their processing.

However, today this discipline, and especially forensic accounting , must consider AI in its actions, especially in organizations with a large number of transactions, which, thanks to this intelligent system designed with the use of algorithms, will allow it to process large volumes of data in seconds so that professionals can examine all the data and not just a sample, as was done in the past. The most important contribution of AI to accounting is the shift from a paradigm where the accountant was the professional responsible for interpreting, recording, and preparing financial statements to a paradigm where the accountant incorporates higher-value tasks into their work, such as strategic financial analysis as a powerful input for senior management decision-making.

The topic of artificial intelligence has been the subject of much research due to its significant impact on the development of competitiveness. However, in the discipline of internal control and forensic accounting, it is a topic that is only just being applied, and efforts must be concentrated on encouraging its use, with the help of knowledge and models that contribute to these sciences for their practical application. Jejeniwa, et al. (2024) highlight in their study the significant contribution of artificial intelligence to accounting practices and the presentation of financial reports but indicate that ethics must always be present in its application.

Odonkor, et al. (2024), in their research, identify the main barriers that organizations face in the accounting area for the use of AI, with the use of qualified personnel, data privacy, and high costs in software or models being the main limitations.

Next, Kureljusic and Karger (2024) point out that the most relevant fields of application in accounting and internal control of AI are: a) bankruptcy prediction, b) financial analysis, and c) fraud and error detection. Shoetan and Familoni (2024) focus on the same line of study, emphasizing that the most relevant contribution of AI in the area of accounting and auditing is to join forces in designing models that help safeguard operations against fraud.

Rangineni and Marupaka (2023) state that, in order to achieve effective application of AI, analytical elements that allow for better interpretation must be incorporated into the models, and accounting and financial experts must have a thorough understanding of how these models work. This result is complemented by the research of Yalamati (2023), which extends its application to the tax area and benefits tax control entities, and that of Moreno, Hernández, et al. (2023), arguing that some international governments, with the help of AI, have implemented systems such as AQM (Aranda Query Manager) for the detection of tax fraud.

In Ecuador, a number of auditing firms have incorporated AI-based models into their processes, as described by Erazo, Castillo, and De la A-Muñoz. Deloitte (Deloitte Touche Tohmatsu Limited, an entity that applies the ARGUS system, whose functionality is to extract accounting information from any electronic file. Price Waterhouse Coopers has partnered with a leading technology company in Silicon Valley, USA, to develop the GL robot, which performs accounting and financial analysis of more than eighteen companies in a thousand seconds.

Based on the aforementioned studies, it can be argued that today organizations, and especially financial institutions (banks and cooperatives), should incorporate artificial intelligence models, systems, and tools into their accounting and auditing activities and processes. These tools enable them to record, process, generate financial reports, detect errors, identify and immediately flag unusual transactions, and predict possible fraud in the shortest possible time, with the greatest ease and a high degree of reliability.

3. METHODOLOGY

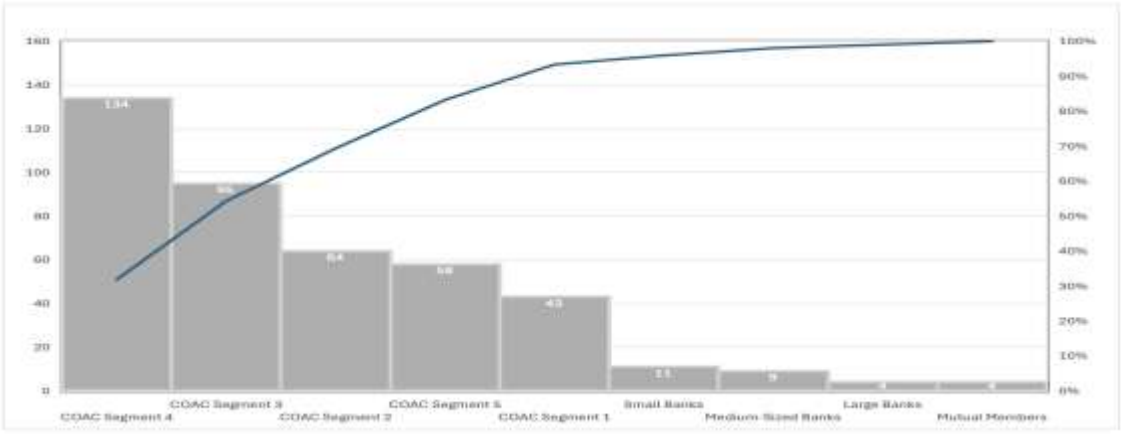
The methodological basis of the research is based on a quantitative approach with a pragmatic perspective and the firm intention of achieving objective findings; the acquisition of measurable data is the fundamental pillar under the use of a non-experimental, descriptive, cross-sectional design. The survey and financial analysis techniques allowed for the collection of primary information and review of accounting data, respectively, with the aim of testing the proposed hypothesis, which is: Artificial intelligence contributes significantly to the effectiveness of internal control and forensic accounting in financial system entities. The reliability of the 15-item survey instrument was previously validated by Cronbach's alpha with a result of 0.92, an excellent rating because, as George and Mayller (2003) indicate, when the validation 0.90 takes that rating.

The entities of the Ecuadorian financial system, comprising private banks and savings and credit cooperatives, are the study population, with a total of 422 entities, generating a sample of 201 elements, whose representativeness and statistical inference are marked by the degree of proportionality and simple random probability sampling with a margin of error of 5%.
The SPSS (Statistical Package for the Social Sciences) system facilitated the execution of variable correlation and Chi-square techniques for hypothesis verification, which is relevant input for the discussion of results and the argumentation of conclusions and contributions to the practice of accounting sciences and internal control.

4. RESULTS

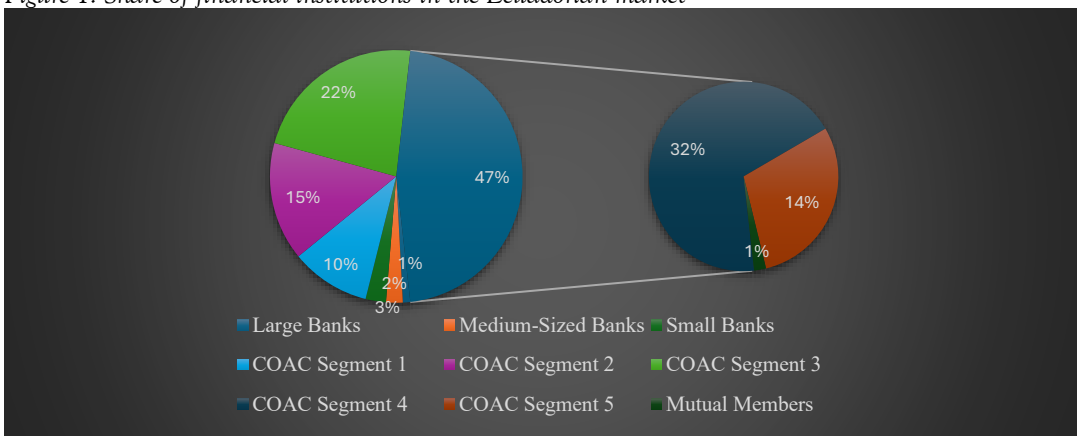
The information for the study's analysis is based on a population of 422 entities in the Ecuadorian financial system in the first quarter of 2025, taken from the newsletter of the control entities, which are the Superintendency of Banks (SBS) and the Superintendency of Popular and Solidarity Economy (SEPS).

Table 1. Number of entities in the Ecuadorian financial system in 2025



Note. SBS and SEPS Ecuador 2025 newsletters

Figure 1. Share of financial institutions in the Ecuadorian market



Note: Based on data from SEPS and SBS 2025

Next, with the support of inferential statistics for finite populations, a sample size of 201 elements was obtained, stratified by type of institution, achieving representativeness of the total population with a significance level of 95% and a constant value of 1.96, based on the postulates and mathematical statement of Cochran (1977).

$$n = \frac{Z^2.N.P.Q}{(N-1)e^2 + Z^2.P.Q}$$

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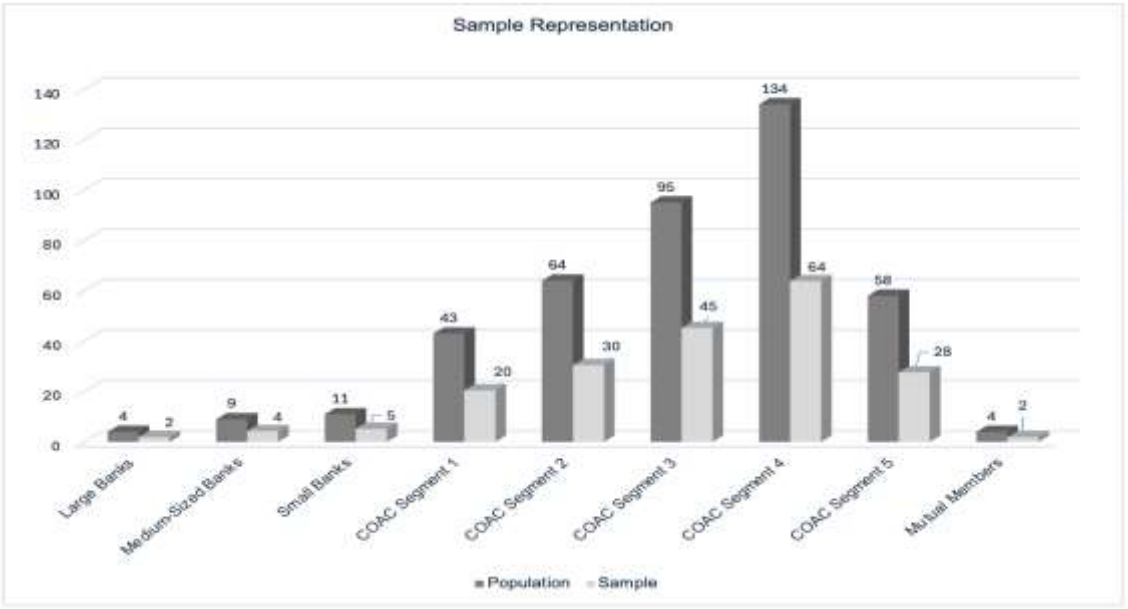
Table 2. Categorized sample of Ecuadorian financial institutions 2025



Note: Prepared using a statistical approach for finite populations

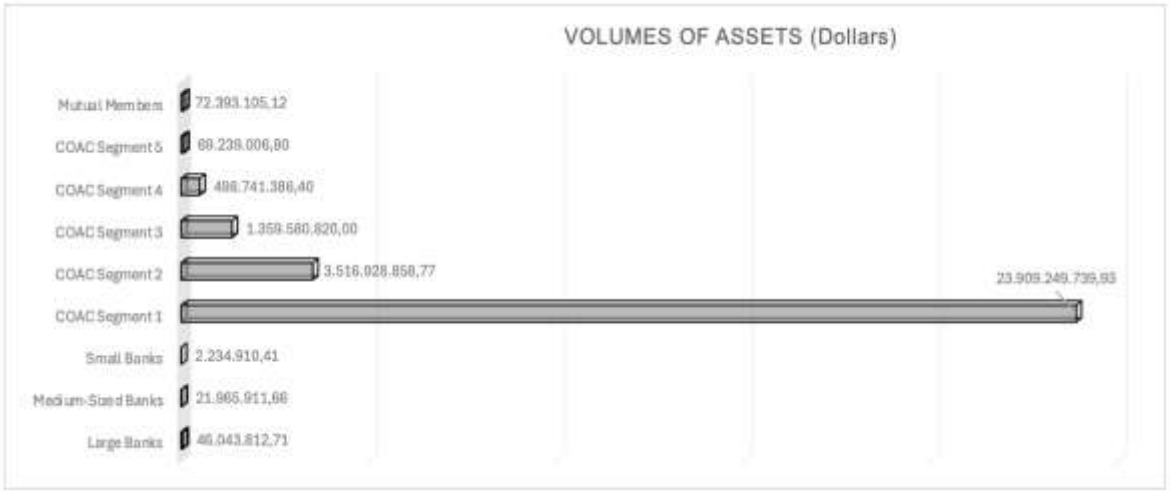
After defining the sample, the information collection instrument was validated using Cronbach's alpha with a level of 0.92 in a pilot test of 20 experts and staff from financial institutions.

Reliability statistics

Cronbach's alpha	N of items
.92	20

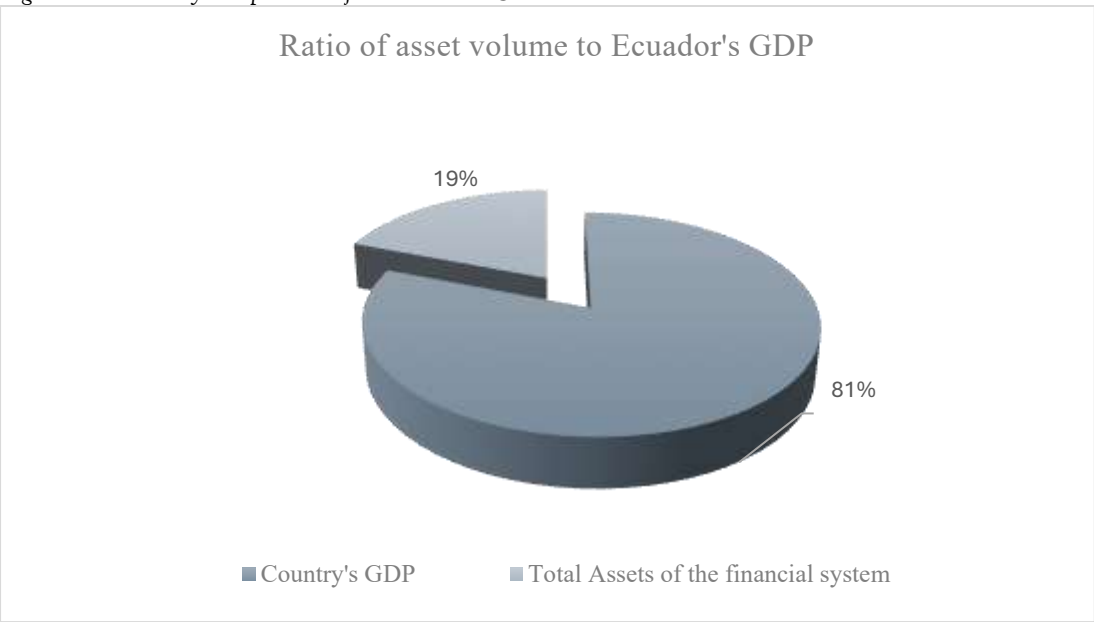
One of the basic reasons for this research is to contribute relevant knowledge to accounting practice in one of the main activities of the global economy, namely the financial system. it is argued that in the case of Ecuador, the volumes of assets in dollars reflected in the financial statements published on the official websites of the supervisory bodies of these entities, as of the first quarter of 2025, represent 19% of the country's gross domestic product (GDP), reinforcing the importance of the applicability of the findings of this study.

Figure 2. Volume of Assets. Statement of Financial Position, Financial Institutions (in dollars)



Note. First quarter of 2025. Ecuador.

Figure 3. Monetary comparison of assets versus GDP Ecuador

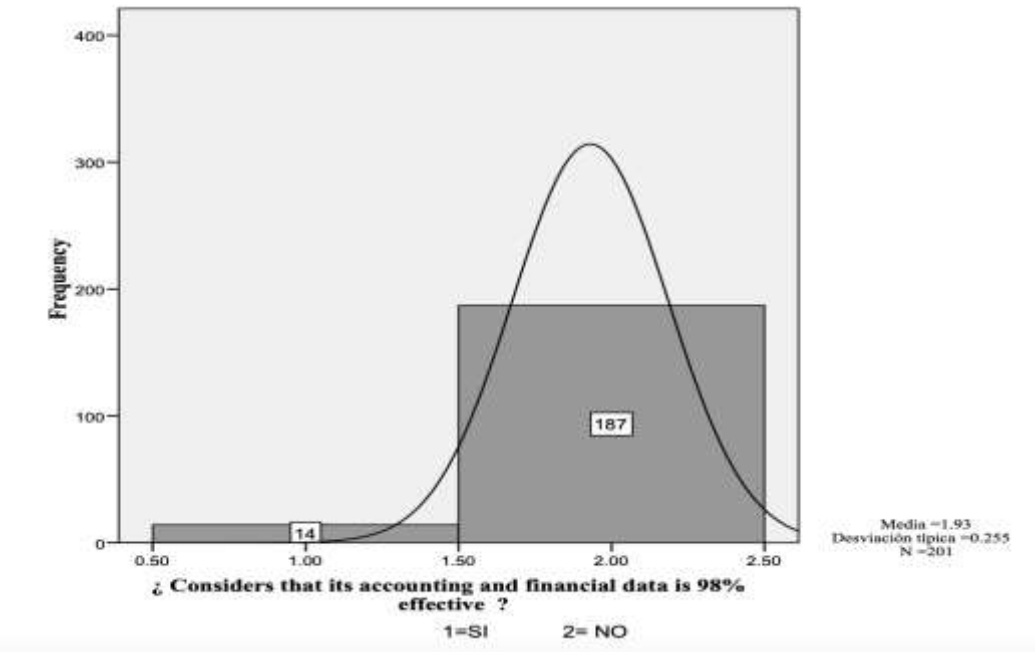


Note. First quarter of 2025. Ecuador.

The key findings of this study are highlighted in the following order:

The majority of financial institutions show deviations from effectiveness in the accounting items of their financial statements, mainly in loan portfolio accounts (code 14 of the Single Accounting Accounts Catalog CIU), loan provisions (code 1499), available funds (code 11), immediate obligations (code 23). This problem is more pronounced in savings and credit cooperatives in segments 2, 3, 4, and 5, while in banks, due to their greater formalization and specialization of their applications and software, the deviation is smaller. In this context, accounting and internal control play an important role in the management of a company, because they must guarantee the reliability of financial information, providing accurate, truthful, and timely accounting records and reports that allow for the proper calculation of financial indicators, which are the input for effective decision-making. Above all, through the transparency of this information, errors, fraud, and possible financial bankruptcies can be avoided.

Figure 4. Effectiveness of accounting data in financial system entities



Note: Entities in the Ecuadorian financial system as of 2025

Another finding is that the critical factors for accounting and internal control to function properly with the support of artificial intelligence in an organization, and especially in a financial institution, are to have high-quality data in both input and output, accessibility to highly qualified software, and, above all, that it be within the financial environment's economic reach, logically with the support of senior management in applying them, with staff trained in the use of these systems and the principle and value of professional ethics prevailing throughout the entity's human talent. With the combination of these elements, deviations or fraud that cause harm to all stakeholders will be avoided.

Table 3. Substantial factors for AI adoption in FCCI

Frequency			Percentage	Valid percentage	Cumulative percentage
Valid	Highly trained personnel				
		22	10.9	10.9	10.9
	Staff ethics	22	10.9	10.9	21.9
	Senior management decision	26	12.9	12.9	34.8
	Quality of information	103	51.2	51.2	86.1
	Accessibility to highly skilled systems	28	13.9	13.9	100.0
	Total	201	100.0	100.0	

Note: AI. Artificial Intelligence, FCCI Finance, Accounting, and Internal Control.

5. DISCUSSION

This discussion focuses on analyzing and interpreting, from a technical and statistical perspective, the combination of findings in light of the main objective of the research, which is to propose an optimal theoretical model that allows for transparency of financial information and prevents fraud through the integrated application of artificial intelligence in internal control and forensic accounting. The hypothesis was verified with a Spearman's Rho of 0.870 using the variable correlation method and with a Pearson's Chi-square of 52.5 and Sig. of 0.000.

Table 4. Chi-square test hypothesis

Do you consider your accounting and financial data to be 98% effective?				Does the financial institution use any AI-based models to generate automatic reports of irregularities that require investigation by forensic accounting?
Spearman's rho	Do you consider your accounting and financial data to be 98% effective?	Correlation coefficient	1.000	.870
		Sig. (two-tailed)	.	,002
		N	201	201
	Does the financial institution use any AI-based	Correlation coefficient	.870	1.000

	models to generate automatic reports of irregularities that require investigation by forensic accounting?	Sig. (two-tailed)		
			,0.02	.
		N		
			201	201

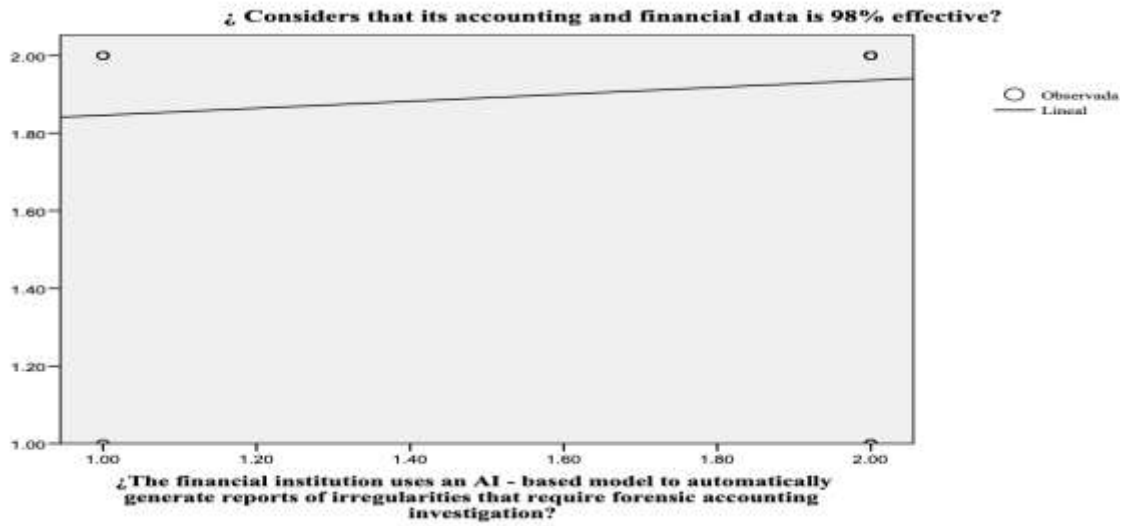
Table 5. Hypothesis test. Variable correlation

	Value	gl	Asymptotic significance (two-tailed)	Exact significance (two-tailed)	Exact significance (one-tailed)
Pearson's chi-square	52.520(a)	1	.00218		
Continuity adjustment(a)					
	.449	1	.00503		
Reasonableness ratio	1.184	1	.00277		
Fisher's exact statistic					
				,000	.000
Linear association per linear	1,513	1	.00219		
N of valid cases	201				

Calculated only for a 2x2 table

Another argumentative element that supports this study is that the application of Linear Regression shows that there is a directly linear and proportional trend in the sense that entities that use artificial intelligence-based models in their accounting and financial systems will guarantee highly transparent information.

Figure 5. Linear relationship between AI and accounting processes



Note. Primary information. 2025

6. THEORETICAL AND PRACTICAL CONTRIBUTION

The research ultimately contributes to the theoretical corpus by arguing that artificial intelligence (AI) in the new digital and transformational era invites public accounting professionals and auditors to shift from a paradigm of manual and complex processes to a paradigm of a feasible and agile methodological reality that allows for 100% verification of transactions in a fast, timely, and real-time manner.

The results contribute to the praxis that in the immediate future requires professionals to be highly trained in new trends in artificial intelligence and that immediate training and adaptation should not be seen as a limitation but rather as a challenge to incorporate this new way of thinking and applicability of science.

An optimal theoretical model of predictive synergy is proposed that redefines the relationship between internal control as a preventive function, forensic accounting as a reactive function, and artificial intelligence as a strategic pillar. This trilogy holistically contributes to the gap in fraud prevention with the intervention of algorithms in its systems that determine critical high-risk points in accounting data and minimize financial information biases.

The theoretical model known as the MinimaxET Model (model for minimizing errors and maximizing transparency in information) includes the following statement:

$$Modelo\ MinimaxET = \Sigma\ (CI + CF + IA)$$

IC. Internal Control
FA. Forensic Accounting
AI. Artificial Intelligence

Key factors to apply to the model.

F1. High quality and accuracy of the information recorded and entered.
F2. AI accounting system based on control and predictive algorithms.
F3. Training of the personnel involved
F4. Professional ethics and lines of supervision.
F5. Attitude of adaptation to the new digital and transformational era

7. CONCLUSIONS

COSO II (ERM), COSO III (Internal Control-Integrated Framework) internal control, and forensic accounting assisted by artificial intelligence (AI) allow organizations, and especially financial institutions in the current digital age, to safeguard the integrity of financial information and minimize-mitigate operational and ethical risks thanks to the adoption of algorithm-based models and systems that enable real-time identification of the main vectors of error and deviation, ensuring the reliability of accounting and financial data suitable for management decision-making.

The public accounting professions must transcend being mere record keepers, preparers, and presenters of financial information to scientific accountants who, with advanced data analytics, provide ethical and transparent financial information to all stakeholders. In particular, forensic accountants must shift their focus from being mere document detectives to high-level technological accountants in order to assertively detect vulnerability to scenarios of economic danger.

In the financial system, where trust is a fundamental pillar of corporate image, the transparency in financial information offered by artificial intelligence for fraud identification and transaction security is one of the strategies that provides a competitive advantage and ensures the sustainability of the organization over time.

Holistic integration into a model that combines a preventive approach achieved through effective internal control the reactive approach of forensic accounting, which investigates past fraud, and the strategic incorporation of artificial intelligence into accounting and financial systems, provides banking institutions and cooperatives with a powerful synergy tool that allows them to analyze and control all transactions in the shortest possible time, detect anomalies, and deal with fraudulent actions immediately, ensuring a high level of transparency in information.

The MinimaxET Model (a model for minimizing errors and maximizing transparency in information) combines internal control, forensic accounting, and artificial intelligence as a high-scale catalyst to prevent and address fraud in a timely manner and achieve high standards of transparency in financial information, but logically with the prior support of good quality data, accounting models and systems, and internal control with AI, trained personnel, large-scale ethics of those involved, and an attitude toward change.

A series of fraud detection and analytics systems are suggested, used worldwide such as SAS (Solutions for Fraud and Security Intelligence), which uses predictive models and links on its platform to identify patterns of fraud, money laundering, and inconsistencies in accounting and financial reports. Another recommended system is FICO Enterprise Security Solutions, which uses behavioral analytics to create real-time risk profiles. Another system is Integrated GRC Solutions, which allows financial institutions to map financial risks with COSO-based internal controls and, above all, monitor transactions in real time through a continuous risk control panel. However, organizations must analyze and adapt their AI systems and models to their accounting processes according to their institutional needs and requirements.

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