

THEORETICAL FOUNDATION OF FINANCIAL LIABILITIES AUDIT QUALITY VIA A MATHEMATICAL MODEL APPLIED TO RISK ASSESSMENT AND SPECIFIC AUDIT PROCEDURES

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Abstract: *The assessment of risks related to financial liabilities in the audit of financial statements is still facing more often with problems related to subjectivity, lack of quantitative benchmarks and pressure on auditors. Without a unified methodological framework, professional decisions become difficult to document and compare, which affects the transparency and quality of the audit process. In this context, the present research aims to develop and validate a mathematical model that transforms key concepts such as the level of risk, the intensity of the procedures applied and the quality of the auditor's decisions into measurable and quantifiable variables.*

The study was carried out in three stages: theoretical analysis of risks and ethical dilemmas, construction of a well-structured mathematical model, and development of a scaled form for risk and procedure assessment. The proposed model provides a logical, coherent and reproducible framework for substantiating auditor's decisions, contributing to the standardization of professional reasoning and strengthening ethics in financial debt auditing. The empirical validation of the model through application in practical cases will be the subject of future research, aimed at testing the consistency of the functional relationships and calibrating the scores in real audit contexts.

Keywords: *financial debt audit, risk assessment, mathematical model, audit quality, professional decision, financial transparency*

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1. Introduction

In the current context of financial statement auditing, the assessment of the risks associated with financial liabilities faces multiple challenges that affect the consistency and quality of the auditors' decision-making process. The increasing complexity of credit and loan contracts, the pressures in the client-auditor relationship and the lack of well-defined quantitative benchmarks on the severity of risks contribute to a climate of uncertainty and subjectivity in the audit assessment of these liabilities. Moreover, the absence of a uniform methodological framework for quantifying risks and the effectiveness of the procedures applied by the auditor leads to divergent interpretations, ethical tensions and difficulties in the traceability of professional decisions. In this reality, the theoretical identification of risks is no longer sufficient - it is necessary to develop applicable, quantifiable and reproducible tools that support auditors in objectively substantiating their opinions and increase the transparency of the decision-making process.

With these premises in mind, the choice of the topic is motivated by the need to transform a conceptual approach into an applied tool that responds to the current needs of the accounting profession and users of financial information. The development of a mathematical model thus becomes not only a natural continuation of earlier theoretical research on optimizing decision making and managing ethical dilemmas, but also a practical response to the problems encountered in financial

debt auditing.

The overall aim of the research is to develop and validate a mathematical model applicable in financial debt auditing, capable of transforming conceptual elements such as risk severity, intensity of procedures applied and quality of professional decisions into measurable variables. The proposed model will enable logical analysis, support the auditor's conclusions and increase transparency in financial auditing.

In order to achieve this goal, the research aims to achieve the following **objectives**:

- ✓ theoretical and normative analysis of the risks associated with financial liabilities and the ethical dilemmas influencing auditor's decisions;
- ✓ identification and classification of the relevant variables for the model (risks, procedures, outcomes);
- ✓ formulation of the functional relationships between variables in the form of a mathematical model;
- ✓ development of an assessment tool applicable in audit engagements (scaled grid form).

The research was structured in three stages:

Stage I: Theoretical and documentary foundation by reviewing the literature, auditing standards and accounting regulations on financial liabilities;

Stage II: Construction of the mathematical model by defining the variables, formulating the functional relationships and developing the model;

Stage III: Development of the applied tool by realizing the assessment grids, scaling the scores and constructing the working form.

2. Basic content

There are numerous works in the literature devoted to external auditing as a whole, but they deal with risk and professional decision issues in a general way, without paying detailed attention to financial debt auditing as a distinct segment.

Therefore, Tanasă and Nuță (2020) demonstrate that audit risk estimation can be deepened by using probabilistic models based on confidence functions, which allow the auditor to quantify professional judgment in a formalized and reproducible way. This approach provides an alternative analytical framework to that provided by traditional standards, with the potential to improve the quality of documentation and the relevance of audit conclusions.

Some studies (Kyriakou, 2024) approach audit quality from the perspective of external pressures, such as non-audit service provision or financial crises, demonstrating that it can be negatively affected under conditions of high systemic risk. The present research proposes an alternative, internal and formalized, internal approach to the influence of specific risks and applied procedures on audit quality.

Other research (Botez, 2015), confirms that the conceptual transformation of risks into measurable variables allows the auditor not only to identify them, but also to logically relate them to the procedures applied, thus enhancing the substantiation of the professional decision. In this way, the developed mathematical model becomes an essential tool in optimizing audit planning and enhancing audit quality.

In the view of some Romanian researchers, risk assessment in financial auditing requires a rigorous and objective approach, and the integration of statistical methods and technology-assisted tools is a viable solution for reducing subjectivity and increasing the reliability of auditor's decisions. The proposed model provides an applicable mathematical framework that supports the professional substantiation of the audit opinion, while preserving the essential role of human reasoning in the interpretation of results (Zaiceanu et al., 2015).

In the context of economic uncertainties and the growing need for credible financial information, research (Robu et al., 2012) demonstrates that statistical analysis applied to relevant economic and financial indicators can significantly contribute to the assessment of going concern and the

classification of entities according to the risk of bankruptcy. The proposed mathematical model, based on rigorous multivariate analysis methods, provides a practical tool for anticipating financial vulnerabilities in the corporate environment.

Șoimu (2024) proposes an advanced integrative-type model for the optimization and continuous supervision of the quality management system in financial auditing, built in accordance with the requirements of international quality control standards. Although the model is not limited to a singular thematic segment, its architecture allows for methodological adaptation to the specific risks of financial debt auditing, providing a logical and operational framework for identifying, quantifying and addressing quality deficiencies in the auditor's decision making.

A qualitative study conducted in France reveals that decision-making in the face of ethical dilemmas is not a solitary process, but based on strategic professional consultations between audit partners. The choice of consultees reflects the subjective perception of ethical risk, which highlights the importance of collective reasoning in managing moral uncertainty (Hazgui and Brivot, 2020).

Recent research on decision modeling in auditing has highlighted the need to develop applicable analytical frameworks and tools to support professional reasoning under uncertainty. Among the major directions being addressed are logistic regression models (Johnstone, 2000), used in estimating the likelihood of events such as client acceptance or issuance of a modified opinion.

In this context, the model proposed in the present research is positioned as an applied contribution, aimed at formalizing the relationships between identified risks, the procedures actually applied and audit quality. In contrast to advanced statistical or algorithmic models, the chosen approach combines the simplicity of a deterministic function with the practical applicability of a scaled worksheet, which directly reflects the professional judgment and traceability of the financial auditor's decisions.

Therefore, the previous phase of the research [?] aimed at optimizing auditors' decision making in the context of financial debt risks, highlighting the tensions between the technical requirements of auditing and the ethical dilemmas that auditors face in practice.

This research continues in this direction by developing an applied mathematical model to formalize the decision-making process in a coherent, quantifiable and reproducible framework. In order to build this model, a number of risks specific to the audit of financial liabilities have been identified, correlated with the usual procedures applied by the auditor in practice. These elements were translated into observable variables, which serve as pillars of the mathematical model.

Thus, risks have been coded as variables X, procedures as variables Z, and expected outcomes are represented by output variables Y. This structure ($X \rightarrow Z \rightarrow Y$) allows tracing the logical flow from cause (risk) to action (procedure) to effect (audit quality). Therefore, X (risks) \rightarrow causes the application of Z (procedures), and the procedures affect the final outcome - Y (quality, transparency). In the structure of the developed mathematical model, the variables used are classified according to the functional role they fulfill in the causal and decision influencing relationships. Thus, they have been coded as follows:

Table 1. Significance of variables

Symbol	Meaning	Variable type
X	Risks identified in the audit process	Independent variables (input)
Z	Audit procedures applied	Intermediate variables (decision mechanisms)
Y	Results of the audit process	Dependent variables (output)

Source: Author

The table below, presents the risks specific to the audit of financial liabilities, correlated with the usual procedures applied by the auditor in practice.

Table 2. Risk assessment and audit procedures

Cod	Risks identified	Code	Procedures applied	Code	Variable
X ₁	Lack of supporting documents	Z ₁	Review of contracts	Z ₇	Application of audit procedures
X ₂	Denaturarea dobânzilor	Z ₂	Verification of accounting policies	Z ₈	Audit reporting
X ₃	Confirmation of balances	Z ₃	Audit quality maintained	Y ₁	Maintained audit quality
X ₄	Understatement of liabilities	Z ₄	Verifying compliance	Y ₂	Transparency of financial statements
		Z ₅	Assessing risks and controls	Y ₃	Improving financial transparency
		Z ₆	Audit planning		

Source: Author

Classification allows a systemic approach to auditor decision making and facilitates mathematical modeling of causal relationships, while providing a basis for logical and comparable assessment of audit performance in varied contexts. Hence:

- ✓ X variables represent the external determinants or observable situations that generate the need for auditor intervention. They are treated as inputs to the decision-making system, as they trigger the application of specific procedures.
- ✓ Z variables correspond to professional response mechanisms (e.g. checks, confirmations, assessments) and are considered as process or intermediate variables, as they mediate the relationship between risk factors and the final outcome. They are controllable by the auditor and reflect conscious actions to reduce risks.
- ✓ Y-variables reflect the final effects of decisions and actions taken and are dependent on both the nature of the risks (X) and the intensity and appropriateness of the procedures applied (Z). They serve as indicators of audit quality and the level of financial transparency achieved as a result of the engagement.

The functional relationships between these variables reflect the influence of the risks on the auditor's decisions and, therefore, on audit quality. The table below summarizes the logical relationship between the risks identified, the procedures applied and the variables included in the model, forming the formal basis of the analytical structure used in the validation phase.

Table 3. Correlation between identified risks, audit procedures applied and variables in the mathematical model

Code and risk	Applied procedures	Chain of variables	Functional explanation
X ₁ – Lack of supporting documents	Z ₁ - Review of contracts Z ₅ - Risk assessment Z ₇ - Application of procedures	$X_1 \rightarrow (Z_1, Z_5) \rightarrow Z_7 \rightarrow Y_1 \rightarrow Y_2 \rightarrow Y_3$	Lack of supporting documentation leads to the need for contract review and risk assessment. They contribute to a rigorous application of audit procedures (Z ₇), which positively influences audit quality (Y ₁) and, by extension, financial transparency (Y ₂ , Y ₃).
X ₂ – Misrepresentation of interest rates	Z ₇ – Application of procedures	$X_2 \rightarrow Z_7 \rightarrow Y_1 \rightarrow Y_2 \rightarrow Y_3$	The risk of incorrect interest rates leads directly to the application of specific procedures (Z ₇). This has a direct impact on audit quality and indirectly on reporting transparency.
X ₃ – Misreporting of	Z ₂ - Verification of accounting policies	$X_3 \rightarrow Z_2, Z_4, Z_3 \rightarrow Z_8 \rightarrow Y_2 \rightarrow Y_3$	Reporting errors can arise from incorrect accounting policies (Z ₂) or

debts	Z ₄ - Compliance verification Z ₃ - Confirmation of balances Z ₈ - Audit reporting		unaudited balances (Z ₃), which requires compliance checks (Z ₄) and influences the content of the audit report (Z ₈). This directly affects the level of financial transparency (Y ₂) and the perception of financial transparency (Y ₃).
X ₄ – Undervaluation of debts	Z ₃ - Confirmation of Balances Z ₄ - Compliance Check Z ₈ - Audit Reporting	$X_4 \rightarrow Z_3, Z_4 \rightarrow Z_8 \rightarrow Y_2 \rightarrow Y_3$	The understatement of liabilities can be identified through external confirmations (Z ₃) and compliance checks (Z ₄), which determine the content of the final report. This has consequences for transparency and the confidence of users of financial information.

Source: Author

It should be noted that audit planning (Z₆), although essential to the mission, is not included in the correlation table because it is not a procedure directly applicable to an individual risk, but a general framework that underpins the selection and application of the other procedures.

Having established the conceptual relationships between the risks identified (X), the procedures applied (Z) and the results of the audit process (Y), it is necessary to formalize these interactions in the form of a coherent mathematical model. The proposed model is intended to quantify the influences between the variables and to allow a systemic analysis of how the risks and the auditor's professional reactions contribute to determining audit quality and the transparency of financial information.

Having established the functional relationships between the identified risks, the procedures applied and the results of the audit process, the next step is to formalize these links in a coherent analytical framework. The proposed model is based on a simplified functional type formula:

$$Y=f(X,Z) \quad (1)$$

where:

X represents the risks related to financial liabilities;

Z comprises the procedures applied by the auditor during the engagement;

Y reflects the final outcome of the audit, expressed in terms of the quality of the assessment and the level of financial transparency achieved.

This simplified formulation provides the necessary basis for expressing the functional relationships between the key audit variables and will be the starting point for applying the model in the subsequent stages of the research.

As part of the research, a scaled worksheet was developed for application in financial debt audit assignments as a tool to support the documentation of professional judgment. This worksheet reflects the logical structure of the proposed model and allows quantification of the relationships between the risks identified, the audit procedures applied and the results of the decision-making process. The worksheet is structured in three sections:

1. Risk assessment, comprising items corresponding to each identified risk, rated on a scale from 0 to 1 (e.g. 0 - no risk, 1 - maximum risk observed);
2. Procedures applied: allows to mark the procedures actually used and to scale the intensity of application (e.g. 0 - not applied, 1 - fully applied);
3. The estimation of the audit quality is performed through a synthetic assessment, where several components (procedures applied, documentation, traceability) are integrated into a single final score, expressed on a scale from 0 to 1.

In order to facilitate the practical application of the proposed model and to ensure consistency in the assessment of the auditor's decisions, a standardized worksheet has been developed, as presented in

Table 4.

Table 4. Financial Debt Audit Quality Assessment Form

Code	Risks identified	Situation observed in the audit mission	Score assigned (0-1)
Section 1: Risk assessment (X-variables)			
X ₁	Lack of supporting documentation		
X ₂	Misrepresentation of interest rate gains		
X ₃	Misreporting of debts		
X ₄	Understatement of debts		
Section 2: Assessment of the application of audit procedures (Z-variables)			
Z ₁	Review of contracts		
Z ₂	Review of accounting policies		
Z ₃	Confirmation of balances		
Z ₄	Compliance review		
Z ₅	Risk assessment and controls		
Z ₆	Audit planning		
Section 2: Estimating audit quality			
Z ₇	Application of audit procedures	The application of audit procedures (Z ₇) is assessed by the arithmetic average of four key factors: lack of supporting documentation (X ₁), interest rate misrepresentation (X ₂), contract review (Z ₁) and risk assessment and internal controls (Z ₅). These factors reflect key stages in the audit process, from identifying documentation and financial manipulation, to contract verification and control systems review. Thus, the Z ₇ indicator provides an integrative overview of how audit procedures are applied in practice in a professional and compliant manner.	
Z ₈	Audit reporting	Audit reporting is analyzed through the arithmetic average of two key elements: compliance with the regulatory framework (Z ₄) and the auditor's vigilance in detecting debt understatements (X ₄). Combining these dimensions provides an integrated picture of the effectiveness and quality of the audit report.	
Y ₁	Audit quality maintained	The dependent variable "Audit quality maintained" (Y ₁) is determined as the simple arithmetic mean of the three sub-indicators Z ₅ , Z ₆ and Z ₇ , each reflecting a specific dimension of the quality of the audit process	
Y ₂	Transparency of financial statements	Y ₂ reflects the degree to which the entity's financial statements are presented in a clear, verifiable and reliable manner. This indicator combines the simple arithmetic average of the quality of the audit performed with the transparency and compliance of the audit report, thus providing an overview of the entity's level of openness.	

Code	Risks identified	Situation observed in the audit mission	Score assigned (0-1)
Y ₃	Improving financial transparency	In the proposed model, the variable Y ₃ ,“Improved financial transparency” is equated with Y ₂ , being interpreted as the measurable outcome of the application of the audit and reporting indicators. This assumption reflects a logical identity relationship in which transparency is also perceived as the ultimate indicator of progress in the conduct of financial liability audits.	

Source: Author

This worksheet enables not only the coherent organization of audit evidence, but also the practical application of the mathematical model developed in the research. It can be used in real assignments as well as in simulations or training, contributing to standardization of reasoning and traceability of the audit decision.

The values assigned to each component are expressed on a scale from 0 to 1 and reflect the professional judgment applied in the audit engagement. Although the estimates are not completely objective, they are based on direct observations, supporting documentation and a standardized assessment framework, which allows the auditor's decisions based on these estimates to be reproduced and justified. This type of scaling allows for the transformation of audit findings into measurable variables that can be easily introduced into the functional relationships defined above. In this way, each risk-procedure-result chain can be evaluated and interpreted in a standardized way, according to the scores assigned in the worksheet. These functional relationships, exemplified in Table 3 and Table 4, summarize the logic of the proposed model and delimit the completion of the conceptual and methodological construction stage of the research.

3. Conclusion

The research started from the premise that auditors' decision-making in the context of financial debt risks requires a more rigorous and reproducible approach, both to reduce professional uncertainty and to support transparency in financial reporting. In this respect, the work has contributed to the development of a clear theoretical-methodological framework that integrates risks, audit procedures and expected results in a logical, mathematically formalized structure.

The main results of the research are: the definition and categorization of the relevant variables (X - risks, Z - procedures, Y - results), the construction of a functional model of type $Y = f(X, Z)$, which expresses the influences between the components, and the development of an application tool in the form of a scaled assessment form. The proposed model facilitates the understanding of the relationships between risks and the quality of professional decisions and provides a potential support for professionalizing reasoning in financial auditing.

The limitations of the research include the lack of a real database for testing the model under field conditions, the difficulty in objectifying some ethical or qualitative components of the auditor's decision, and the limited applicability to the audit of financial liabilities with no immediate extension to other components of financial statements.

Future research directions. In view of the complexity of the empirical validation of the proposed model and the need to integrate real data from professional practice, the stage of testing and statistical calibration of the functional relationships will be the subject of a future study. This line of research will aim at applying the evaluation form in concrete audit assignments, analyzing the results using quantitative methods, and drawing conclusions on the reliability, applicability and limitations of the model in different organizational contexts. This may strengthen the practical applicability of the model and help to inform professional decisions in an objective, traceable and ethical manner.

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