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The Role of Internal Audit-based Risk Achieving Optimal Use of Financial Engineering Tools: "A field study on internal audit management in a sample of Sudanese banks

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Abstract
The study aimed to identify the role of risk-based internal audit in achieving the optimal use of financial engineering tools. To achieve this goal, the researcher adopted a descriptive analytical approach. The questionnaire was used to collect data and was distributed to the study population by following the method of a simple random sample. (150) questionnaires were distributed among the sample, of which (138) were retrieved, for a rate of (92%). Statistical analysis of this data is done through structural equation modeling using factor analysis and path analysis through the AMOS program). The study concluded that the availability of risk-based internal auditing requirements helped to achieve the optimal use of financial engineering tools, and the application of risk-based internal auditing procedures contributed to achieving the optimal use of financial engineering tools. The study presented a number of recommendations, including an interest in applying risk-based internal audit procedures to improve the proper selection of financial engineering tools. Keywords: requirements, procedures, internal audit, risks, financial engineering tools.

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Introduction

It is considered Engineering Finance that Industry New in science the money purposeful basically to Follow-up Good for the project on road merger within Operations Advice Guidance Strategic and analysis Financial, more About its reliance Basic on derivatives Finance And its adoption The spacious on values Movable And guidance Investing in it Intended Loyalty On request And needs Financing that unable Projects alone on Achieve it. And prevail. belief, And we in beginning century One And twenty, that Engineering Finance She can presentation help Effective to achieve Objectives Strategy that planning she has Institutions, but rather go to far from that.

The internal audit function has evolved from conducting a financial audit to include reviews of all aspects of the company's activities (financial audit, operations audit, and compliance audit). The internal audit function has been used to review systems and risk management, as well as to improve corporate governance processes. The goal of the internal audit function has become to add value to the organization and improve the organization's operations in a manner that takes into account the expectations of the organization's stakeholders.

Study problem:

Since the beginning of the 1960s, global financial markets have witnessed a revolution in the fields of financial innovations, which formed the first building block for the crystallization of the concept of financial engineering. The latter will focus on innovating modern tools and risk management tools in a way that ensures that companies plan for their future and serve their goals, on the one hand, and on the other hand, ensuring a positive return for Islamic economies as a whole through the development of financial markets and providing them with various financing tools and mechanisms that achieve the goals of all participants (Sergio, M. Focardi., &Fabozzi, Frank, j, 2004) [20]. Although that Then appearance needs New and advanced means

finance different from Where design and dates entitlement make from Asir on This is amazing Media Finance, In her image Traditional and its tasks old, Saturation desires investors and participants in Markets the money generally, So it appeared need For innovation Creativity and means New To meet This is amazing Needs (Abu Zaid, 1996, p. 28) [1]. A number of specialists were consulted to develop new products that contribute to mitigating risks, by getting rid of legislative and environmental restrictions that stand in the way of hedging against risks. Technological development has contributed to the success and development of financial engineering. Some believe that risk-based internal auditing helps in evaluating the regulatory aspects of the institution, which helps the institution's risk management improve its various functions and assess various risks (Al-Karaawi, 2011, p. 214). Therefore, the problem of the study can be summarized in what is the impact of risk-based internal auditing in achieving the optimal use of financial engineering tools.

Importance of the Study

The importance of the study lies in its addressing a modern topic, namely the relationship between risk-based internal auditing and the optimal selection of financial engineering tools. This is due to the importance of financial engineering tools at the present time, given the banks' reliance on them to reduce risks. This study can also provide recommendations that can guide the field of practical application by clarifying the extent of risks surrounding these tools and choosing the best among them through conducting a precise analysis conducted by internal auditing based on a study of the risks surrounding these tools, which can clarify the amount of return achieved from them and the risks they are exposed to. It also helps in raising the productive efficiency of banks by creating tools that help reduce risks and increase profitability.

Study Objectives

1. Identify the concept, requirements and procedures of risk-based internal auditing.
2. Clarifying the relationship between risk-based internal audit requirements and the optimal selection of financial engineering tools.
3. Measuring the relationship between risk-based internal audit procedures and the optimal selection of financial engineering tools.

Study Concepts

First: Risk-based internal audit

An organization's internal control represents another mechanism for corporate governance, as the internal control structure is considered the first line of defense that represents the interests of shareholders and other stakeholders. Internal control is defined as processes designed to assess and provide reasonable assurance about the achievement of objectives represented by the reliability of financial reports and Efficiency and effectiveness of operations and compliance with laws and regulations (Al-Sawy, 2010, p. 42) [8] It is also defined as the process of providing an objective and independent opinion to the management of the facility, to determine whether the risks of that facility have been managed to reach acceptable levels of risk (Nasr, 2011, p. 458) [7]. It is also defined as "an evaluation and advisory activity that provides independent and objective guarantees aimed at adding value to the institution and working to achieve its objectives by providing reasonable assurance to the Board of Directors that the risks of the institution are being managed effectively, and providing the necessary advice and recommendations to improve the risk management process" (Najm, 2013, pp. 181-183) [2].

The Institute of Internal Auditors (IIA) has highlighted the roles of risk-based internal auditing in identifying risk factors, providing management with risk assessment results, and providing assurance that audit systems are sufficient to mitigate risks (Saloum *et al*., 2012, pp. 211-212) [4]. The internal audit plan is implemented according to four requirements (Ouseif, 2014, pp. 21-22):

1. Reliance on specialists: The internal auditor is not an expert in all aspects of
2. The organization's activities, and his failure to rely on a specialized expert when reviewing a field outside his scope of expertise requires him to seek to understand the nature of the field and the surrounding circumstances, relying on those in charge of implementation.
3. Following the process approach: The internal audit team must follow the process approach when performing its work, by evaluating the group of activities that make up the process to be reviewed, to identify the strengths that must be developed and the weaknesses that must be eliminated in each activity, which ultimately leads to achieving the desired outcome of implementing the process as a whole.
4. Conduct a self-assessment of internal audit risks: The internal audit team should strive to conduct a self-assessment of internal audit risks through workshops attended by specialists in the field under review. The aim is to identify the main audit risks and find control solutions that reduce those risks.
5. Introducing modern technologies in auditing: The use of modern technology not only leads to accuracy and speed of completion, but also helps raise the level of quality. Like any other function, internal auditing can be developed by relying on modern technological methods.

Risk-based audit procedures should include the following steps (Al-Nawas, 2019, p. 77):

1. Determine the efficiency of the organization's operations, services, and functions, and then identify the activities within them that should be audited, while identifying audit risks and documenting the risk management structure and internal audit system.
2. Use a recording and measurement system to describe and assess risks for critical sections.
3. Implement a risk-based audit plan through implementation, reporting, and monitoring.
4. The program includes a monitoring process to regularly assess and update risks for all critical business units and systems.
5. Use a risk recording system. Risk registers are used as a means of recording and documenting all assessments and decisions made in relation to identified risks and as an action plan.

Second: Financial engineering tools:

The term "financial engineering" means different things to different people. This is not surprising, as the field is still relatively closed and the term has not been clearly defined. The term financial engineering came into use after the discovery of the Black-Scholes-Merton options pricing

model in the early 1970s. This scientific breakthrough led to a new way to solve practical financial problems by designing customized contracts and dynamically replicating them using market-traded instruments. The International Federation of Financial Engineers defines financial engineering as the development and application of innovative technology to solve financial problems. Financial engineering is defined as a branch of finance that seeks solutions to risks and various financial problems, primarily (Kolb, Robert. W. and Overdahl, James. A, 2004) [16] through financial derivatives. It is also defined as the innovation and development of financial systems, processes, and instruments to provide innovative solutions to financing and investment problems. (Sergio, M. Focardi., &Fabozzi, Frank, j, 2004) [20]

Financial engineering reduces risks, stimulates financial markets, contributes to achieving prosperity, and increases economic efficiency and productivity. Dealing with financial engineering tools is less expensive than dealing with basic assets such as stocks and bonds. Financial and banking institutions and investors can use financial engineering tools to hedge against potential risks. Financial engineering tools also reduce costs, increase returns, expand the range of available financing and investment alternatives, and reduce the risk of loss if they are well managed. In addition, financial engineering tools support the services provided by financial and banking institutions to their clients and contribute to diversifying their investment portfolios (Al-Abadi, 2008, p. 110).

Financial engineering is the lifeblood of financial innovation, and has many objectives, the most important of which are:

1. Reducing financial risk is usually achieved by creating and developing a variety of innovative financial instruments that can be engineered in specific combinations to build risk exposure centers and manage these risks in the best possible way.
2. Restructuring cash flows for better financial management, such as using swaps to change variable loan rates to fixed rates for tax purposes or for better cash flow predictability.
3. Reducing transaction costs by enabling the creation of large-scale positions and entering into specific transactions at relatively low cost, as the costs of trading using financial engineering tools are often lower than those of traditional methods.
4. Enhancing profit opportunities by developing new tools that can be used in investment, speculation, and hedging.
5. Improving the liquidity of the financial market in general and those dealing in financial engineering instruments in particular by opening up access to a wide range of new instruments characterized by relatively high liquidity.

Fourth: Developing hypotheses and the relationship between variables:

1. **The relationship between risk-based internal audit requirements and the optimal selection of financial engineering tools:** A study by Masoud Ali (2014, p. 122) concluded that governance mechanisms activate risk-based internal auditing. Ziani Abdelhak's study (2013-2014) [22] concluded that the internal audit function plays a new role in monitoring risk management processes and tracking risks (internal and external) that may affect the organization's activity. Sean De La Rosa's study (2007) [19] also indicated that Internal audit can add value to the overall risk management process in two ways: auditors can provide assurance to the audit committee and executive management that the overall risk management process is being implemented effectively, efficiently, and in accordance with the approach. Internal audit can use the outputs of the overall risk management process to develop a risk-based audit plan and identify high and unexpected risks. A study identified that implementing a risk-based internal audit approach requires the availability of the necessary professional competencies and the need for ongoing development and qualification. Where the study (Muhammad, 2014 AD) confirmed: There is a direct relationship between the use of financial engineering tools and risk management in banks. Risk management, through measuring and assessing risks, enables optimal selection among available financial engineering tools. From the above, the first hypothesis can be deduced, which states the following:

- Risk-based internal audit requirements impact the optimal use of financial engineering tools.

2- The relationship between risk-based internal audit procedures and the optimal selection of financial engineering tools: A study (Spiral, Laura F. & Page, Michael, 2006) [21] confirmed that strong internal audit procedures can reduce the risks to which a company is exposed. A study by Mukhtar (2016) also explained: The risks of Islamic financing formulas are represented by financing instruments based on ownership and debt. The contribution of financial engineering is limited only to sales formulas such as Murabaha and Ijarah, while the solutions applied in managing the risks of participation are few and non-existent in the field of speculation. Some of the procedures adopted by the bank in managing risks are contrary to the principle of sharing in profit and loss. The study (Jihan, 2008, p. 77) confirmed that Risk-based internal auditing procedures help organizations identify and assess risks, enabling them to move as a profession to the forefront of risk management. This demonstrates the link between internal auditing and effective risk management. A study (Spiral, Laura F. & Page, Michael, 2006) [21] has demonstrated the importance of risk management in banks by leveraging the efficiency of risk management systems in making investment decisions. From the above, the second hypothesis can be deduced, which states the following:

Risk-based internal audit procedures influence the optimal use of financial engineering tools.

Study Model: To achieve the study objectives and based on the research problem, a study model was presented that clarifies the dimensions that comprise the study variables and the relationship between those variables:

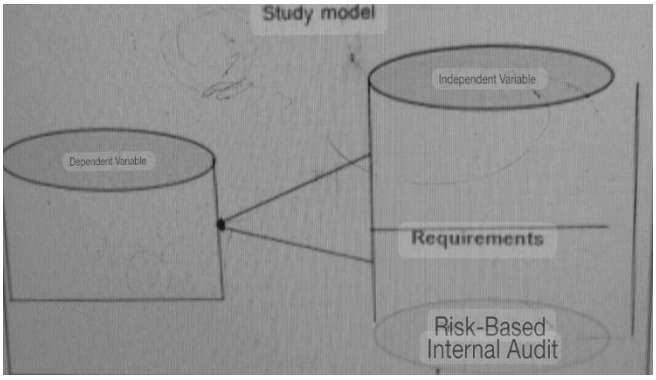


Fig 1: For financial engineering tools Prepared by the researcher, 2022 AD

Study methodology:

To achieve the study objectives and test the validity of the hypotheses, the researcher followed the descriptive analytical approach by describing the phenomenon under study. Data were collected from secondary sources represented by books, periodicals, conferences, and theses, while primary data sources represented by the questionnaire tool, where the researcher designed a questionnaire. The questionnaire included three axes, and each axis included seven statements that the researcher deemed sufficient to measure the axis. The questionnaire was designed according to a five-point Likert scale consisting of five levels, where the number (5) was given for strongly agree, (4) for agree, (3) for neutral, (2) for disagree, (1) for strongly disagree, where this questionnaire was distributed to the study sample, and the study community consisted of employees in the internal audit department in Sudanese banks (Director of the Internal Audit Department, Head of the Internal Audit Team, and a member of the internal audit team), as for the study sample, it was randomly selected from the study community and the simple random sample method was used where the researcher distributed a number of (150) questionnaires, a number of (138) questionnaires were retrieved, i.e. (92%), all of which were valid for analysis. The sample size was determined according to the following equation:

Whereas:

The standard value of the normal distribution at a 95% confidence level.

The probability of the trait being studied being achieved in the population. (When p is unknown, Timpson prefers that it be taken as 0.5 because it gives the largest possible sample size to achieve the trait being studied.) Statistical adjustment on both sides of p.

To test the stability of the study tool, Cronbach's Alpha coefficient was calculated, which reached a value of (0.89), which is a value that indicates the stability of the study tool.

Field study data analysis:

Table 1: Descriptive analysis of personal data of the study sample individuals

percentage %	Number (n)	Categories	Sample characteristics
47.8%	66	Bachelor's	Academic qualification
29.7%	41	Higher Diploma	
15.3%	21	Master's	
5%	7	PhD	
2.2%	3	Other	
100%	138	the total	
22.45%	31	business management	Scientific specialization
51.48%	71	accounting	
11.59%	16	economy	
8.69%	12	Financial and Banking Sciences	
5.79%	8	Other	
100%	138	the total	
13%	18	Internal Audit Manager	Job title
26.1%	36	Internal Audit Team Leader	
58.7%	81	Internal Review Team Member	
2.2%	3	Other	
100%	138	the total	
49.2%	68	5 years and younger	Years of experience
26.8%	37	From 6 to 10 years	
13.8%	19	From 11 to 15 years	
8%	11	From 16 to 20 years old	
2.2%	3	More than 20 years	
100%	138	the total	

Source: Prepared by the researcher from field data using the Statistical Package for the Social Sciences (SPSS) 2022.

It is clear to the researcher from Table (1) that the majority of the sample members are bachelor's degree holders, as their percentage reached (66%) of the total sample size, and (34%) of the study sample members are postgraduate degree holders, and that the majority of the sample members' academic specialization is in the field of accounting, at a rate of (71%). This percentage indicates that the primary information was collected from individuals who have academic and professional qualifications in the field of accounting and auditing, and that the job title of the sample members included (18%) internal audit managers and (36%) internal audit team heads. These indicators indicate that the sample members have high professional experience in the field of internal auditing. Also, (68%, 37%, 19%, 11%, 3%) of the study sample members have less than 6 years of experience, from 6 to 10 years, from 11 to 15 years, 16 to 20 years, and more than 20 years, respectively.

Exploratory factor analysis: Factor analysis is a multivariate statistical method used to address multiple variables that are related to each other with varying degrees of relationships and to arrive at independent classifications (factors) based on qualitative (classificatory) foundations. The researcher examines these foundations and determines the presence of common characteristics according to the theoretical framework and

scientific logic with which he began. Factor analysis is a statistical method that requires conditions for its use, precision in observing these conditions, and a definition of the limits and capabilities of the method. The conditions that must be observed are as follows:

1- The KMO scale used to measure the sufficiency of the sample size to achieve the conditions for conducting factor analysis must be greater than or equal to (0.50).

Bartlett's test should be Bartlett's Test Morale.

Eigen Value for each factor should not be less than one.

To verify the validity of the model, the Statistical Package for the Social Sciences (SPSS v23) and AMOS v24 were used to conduct the exploratory general analysis and confirmatory factor analysis of the study model consisting of the two independent variables (risk-based internal audit requirements, risk-based internal audit procedures), and the dependent variable (optimal use of financial engineering tools). The principal components method and the Veromax factor rotation method were used to determine the saturation coefficients, and the statements with a loading coefficient less than 0.50 were deleted. KMO was used to test the adequacy of the sample size, and Bartlett's test was conducted as an indicator of the relationship between the variables. (Field, 2005, p206) [14]

Exploratory factor analysis of independent and dependent variables:

Table 2: Exploratory factor analysis of independent variables (sample size: 138)

the third	The second	the first	The worker phrase	The number
		0.544	Availability of sufficient professional experience for the members of the audit team in the institution's activities	1
		0.617	Follow the process approach when performing tasks by evaluating the set of activities that make up the process to be reviewed.	2
	0.733		Providing control solutions that reduce audit risks	3
0.761			Introducing modern technologies in auditing	4
0.762			Continuing professional education for review team members	5
0.704			Identify the strengths that need to be maintained and the weaknesses that need to be eliminated in each activity.	6
		0.684	Determine the efficiency of the organization's operations	7
		0.743	Use a recording and measurement system to describe and assess risks for important sections of roads.	8
		0.503	Implement a risk-based audit plan through implementation, reporting, and monitoring.	9
		0.714	The program includes a monitoring process to regularly assess and update risks for all critical business units and systems.	10
		0.584	Use of a risk scoring system	11
	0.761		Providing consulting services To management regarding the risks surrounding financial engineering tools	12
	0.818		Providing advice to management on the selection of financial engineering tools by balancing the return achieved from them and the risks surrounding them.	13
55.25%		Total percentage of explained variance		
0.818		Kaiser-Meyer-Olkin Measure of Sampling Adequacy		
651.72		Bartlett's Test of Sphericity		

Source: Prepared by the researcher from field data using the Statistical Package for the Social Sciences (SPSS) 2022.

It is clear from Table (2) that the first factor was saturated with phrases (11, 10, 9, 8, 7, 2, 1) respectively and can be called "professional experience", the second factor was saturated with phrases (13, 12, 3) and can be called "use of modern technologies in auditing", and the third factor was saturated with phrases (6, 5, 4) and can be called "providing advisory services regarding the selection of financial engineering tools".

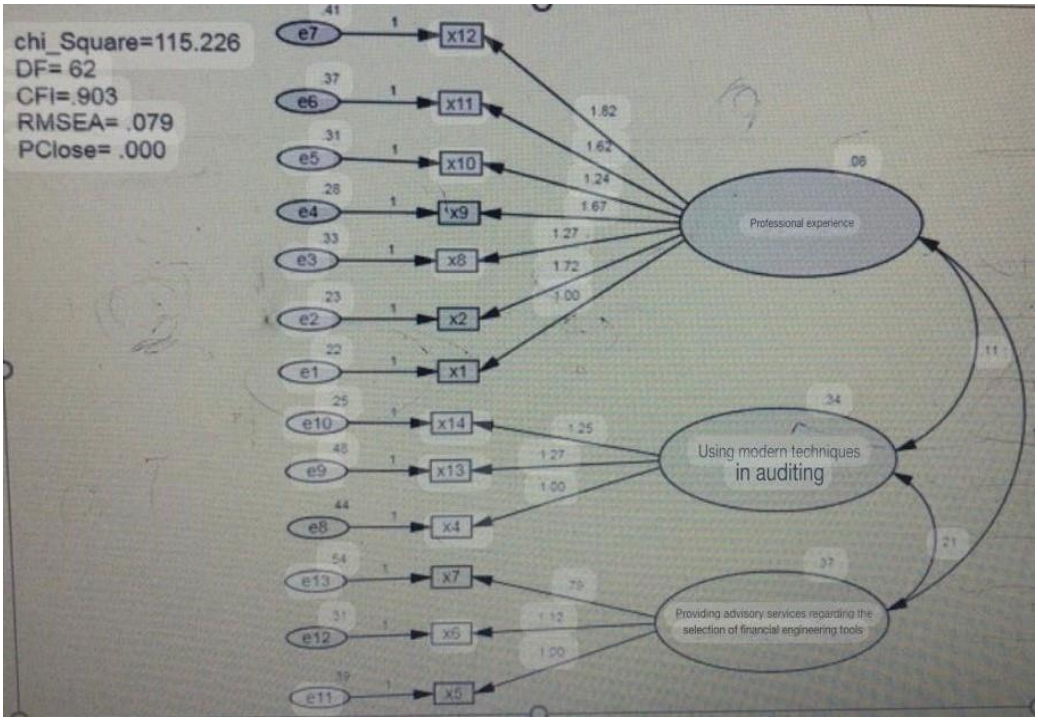
Table 3: Exploratory factor analysis of the dependent variable (sample size: 138)

the second	the first	The worker phrase	The number
	0.732	Benefit from price changes in international financial markets to adjust the investment portfolio	1
	0.882	Using securitization as a primary strategy to hedging against risk	2
0.768		Investment methods characterized by high security factor and low risk	3
0.661		Designing innovative financial instruments such as credit cards, new types of stocks and bonds, and designing innovative hedging contracts.	4
0.782		Developing modern, low-cost and practical implementation procedures	5
56.55%	Total percentage of explained variance		
0.750	Kaiser-Meyer-Olkin Measure of Sampling Adequacy		
211.76	Bartlett's Test of Sphericity		

Source: Prepared by the researcher from field data using the Statistical Package for the Social Sciences (SPSS) 2022.

It is clear from Table (3) that the first factor was saturated with phrases (2,1) respectively and could be called "using securitization to hedge against risks", and the second factor was saturated with phrases (5,4,3) and could be called "using financial engineering tools as a tool to evaluate financing plans ".

Confirmatory factor analysis:



Source: Prepared by the researcher from field data using the (Amos) 2022 program.

Fig *2*: Confirmatory factor analysis of independent variables

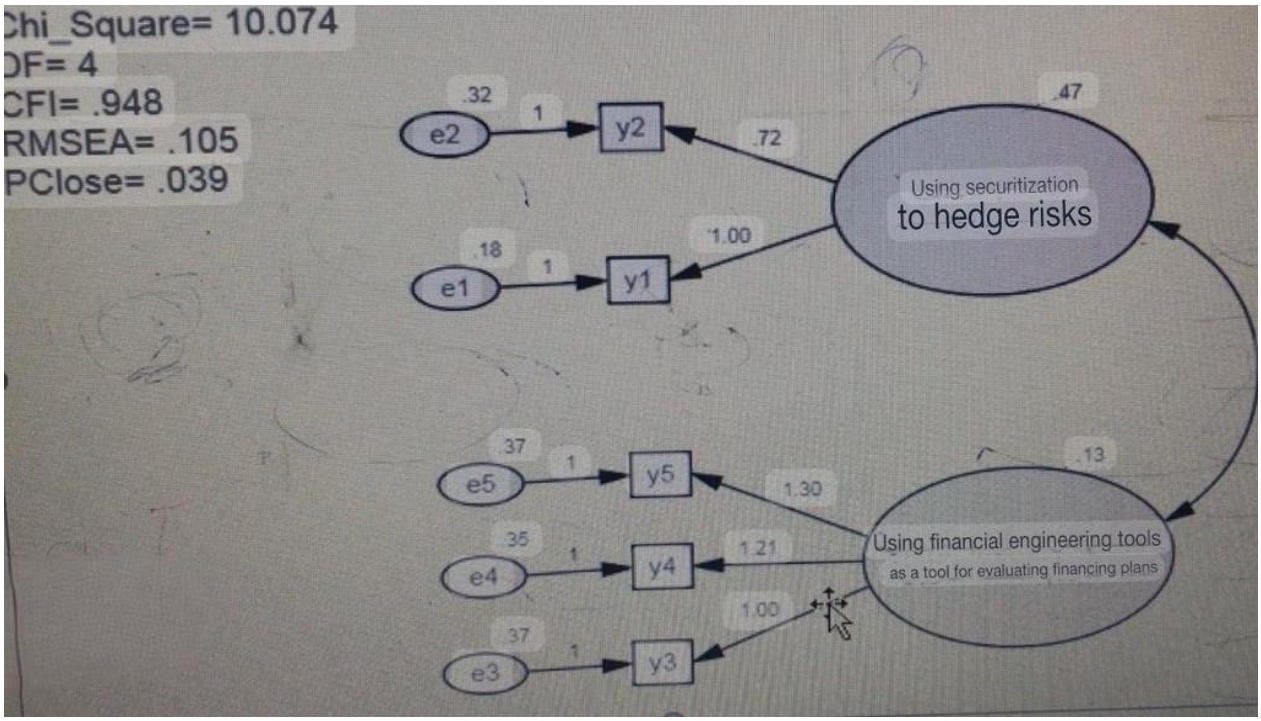
Conformity quality indicators:

In light of the assumption of consistency between the variables included in the analysis and the matrix assumed by the model, many indicators are produced indicating the quality of this consistency, and the assumed model of the data is accepted or rejected in light of them.

Table 4: Conformity quality indicators

PClose	RMSEA	CFI	CMIN/DF	DF	CMIN	Indicator
0.000	0.079	0.903	1.858	62	115,226	value
Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Interpretation

Source: Prepared by the researcher from field data using the (Amos) 2022 program.



Source: Prepared by the researcher from field data using the (Amos) 2022 program.

Fig *3*: Confirmatory factor analysis of the dependent variable

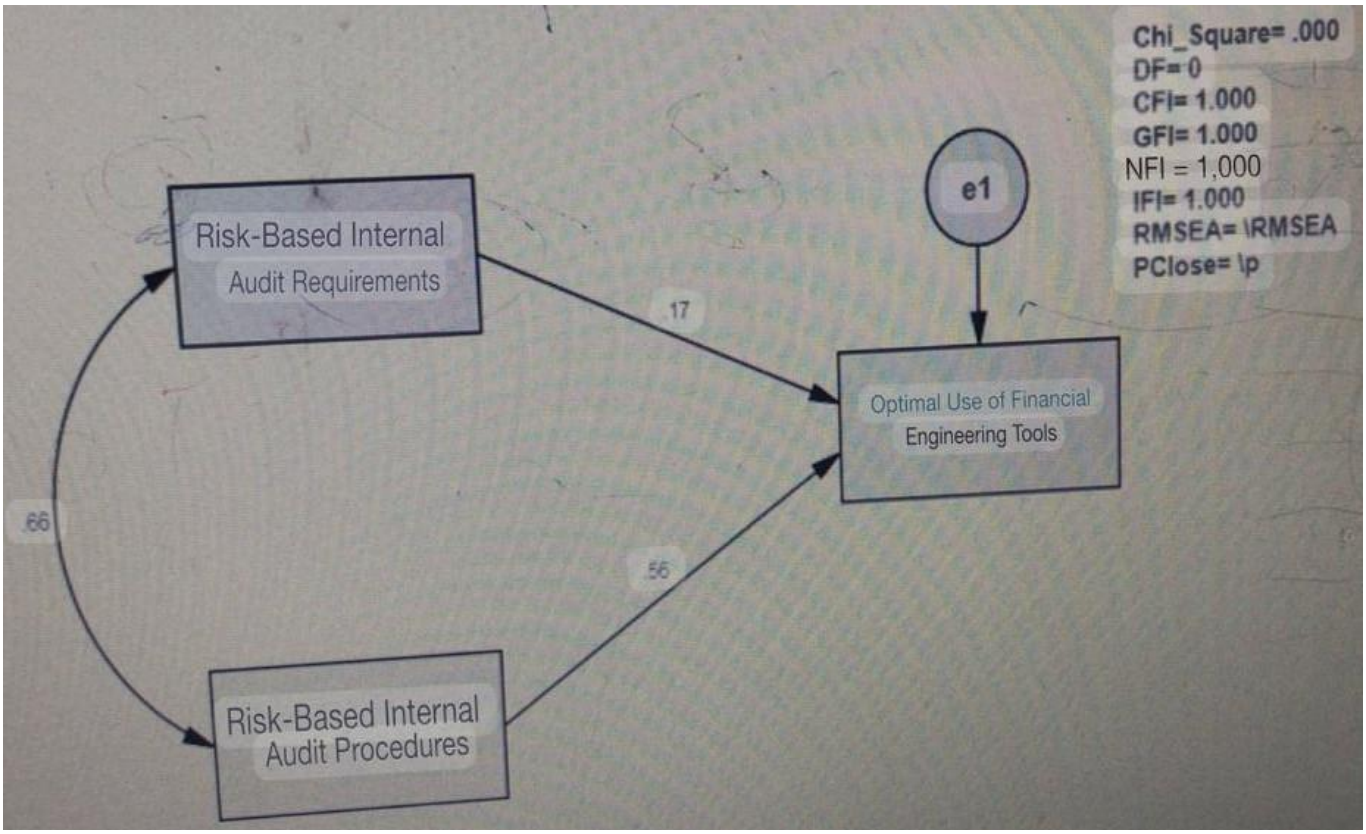
Conformity quality indicators:
In light of the assumption of consistency between the variables included in the analysis and the matrix assumed by the model, many indicators are produced indicating the quality of this consistency, and the assumed model of the data is accepted or rejected in light of them.

Table 5: Conformity quality indicators

PClose	RMSEA	CFI	CMIN/DF	DF	CMIN	Indicator
0.039	0.105	0.95	2.518	4	10,074	value
Acceptable	Not acceptable	Not acceptable	Acceptable	Acceptable	Acceptable	Interpretation

Source: Prepared by the researcher from field data using the (Amos) 2022 program.

Path analysis for hypothesis testing:
The study hypotheses were tested by using structural equation modeling using path analysis.



Source: Prepared by the researcher from field data using the (Amos) 2022 program.

Fig *4*: Structural model for path analysis To test hypotheses

Table 5: Conformity quality indicators

P	RMSEA	IFI	NFI	GFI	CFI	CMIN/DF	DF	CMIN	Indicator
0.000	0	1,000	1,000	1,000	1,000	0	0	0	value
Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable	Interpretation

Source: Prepared by the researcher from field data using the (Amos) 2022 program.

Testing the first hypothesis: Risk-based internal audit requirements affect the optimal use of tools. Financial engineering.

Table 6: Results of the first hypothesis test

The result	significance level $p \leq 0.05$	Critical Ratio CR		standard Error SE	Impact coefficient value B	Direction of influence	
Statistically significant	0.042	2,035	0.078	0.159	Optimal use of financial engineering tools	←	Risk-based internal audit requirements

Source: Prepared by the researcher from field data using AMOS, 2022.

Table (6) shows that the value of the beta impact coefficient indicates a positive impact on the dependent variable (optimal use of financial engineering tools), as the beta value reached (0.159), which indicates that the risk-based internal

audit requirements have a positive impact on the optimal use of financial engineering tools, as a change of one unit in the independent variable (risk-based internal audit requirements) will lead to a change of (0.159) in the dependent variable. To determine the statistical significance, the value of the critical ratio was calculated. CR, where its value reached (2.035), which is greater than (1.96), and its significance level value was (0.000), meaning that it is less than the statistical significance level (0.05). Therefore, the hypothesis is accepted, meaning that the requirements of internal audit based on risks have a positive impact on the optimal use of financial engineering tools.

Testing the second hypothesis: Risk-based internal audit procedures affect the optimal use of financial engineering tools.

Table 7: Results of the second hypothesis test

The result	significance level $p \leq 0.05$	critical ratio CR	standard error SE	Impact coefficient value B	Direction of influence
Statistically significant	0.000	6,697	0.075	0.503	Optimal use of financial engineering tools ← Risk-based internal audit procedures

Source: Prepared by the researcher from field data using AMOS, 2022.

Table (7) shows that the value of the beta impact coefficient indicates a positive impact on the dependent variable (optimal use of financial engineering tools), as the beta value reached (0.503), which indicates that risk-based internal audit procedures have a positive impact on the optimal use of financial engineering tools, as a change of one unit in the independent variable (risk-based internal audit procedures) will lead to a change of (0.572) in the dependent variable. To determine the statistical significance, the value of the critical ratio was calculated. CR, where its value reached (6.697), which is greater than (1.96), and its significance level value was (0.000), meaning that it is less than the statistical significance level (0.05). Therefore, the hypothesis is accepted, meaning that risk-based internal audit procedures have a positive impact on the optimal use of financial engineering tools.

Results:

Through what was discussed in the theoretical framework and field study, the following results were reached:

- The availability of risk-based internal audit requirements helped achieve optimal use of financial engineering tools.
- The proper application of risk-based internal audit procedures contributed to achieving the optimal use of financial engineering tools.
- The high professional experience of the members of the risk-based internal audit team contributed to achieving the appropriate selection among the available financial engineering tools.
- The use of modern technology in the risk-based internal audit process has helped achieve optimal use of financial engineering tools.
- Continuing professional education for members of the risk-based internal audit team contributed to the development of new solutions using financial engineering tools that are appropriate to the surrounding circumstances.

Recommendations:

By presenting the results of the study, the following recommendations can be made:

- Focus on the availability of risk-based internal audit requirements to achieve the most appropriate selection among financial engineering tools.
- Proper application of risk-based internal audit procedures to enable the internal audit team to provide sound suggestions regarding the selection of financial engineering tools.
- Developing the professional capabilities of the members of the risk-based internal audit team by identifying the available financial engineering tools and how to choose among them. On high precision and using modern technology to achieve the organization's goals.
- Conducting continuous training courses for members of the risk-based internal audit team to learn about the variables surrounding professionalism and the risks of financial engineering tools and the mechanism for choosing among them.

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