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THE EFFECTIVENESS OF FORENSIC ACCOUNTING TOOLS IN DETECTING FRAUDULENT BANKRUPTCY: EVIDENCE FROM SAUDI ARABIA

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ABSTRACT

This study examines the effectiveness of analytical forensic accounting tools in detecting fraudulent bankruptcy in Saudi Arabia. The study is grounded in the Fraud Triangle and Fraud Diamond theories, which explain the behavioral conditions that enable fraudulent manipulation. Using a quantitative cross-sectional design, data were collected from 416 practitioners and academic experts and analyzed using descriptive statistics, reliability testing, Pearson correlation, and multiple linear regression. The findings show strong agreement on the relevance of analytical tools such as Benford's Law, the Beneish M-Score, ratio and trend analysis, reasonableness testing, and data-mining techniques in identifying indicators of fraudulent bankruptcy. Results reveal significant positive relationships between both dimension and perceived detection effectiveness, with regression analysis confirming that analytical tools meaningfully enhance practitioners' ability to detect fraudulent bankruptcy. The study underscores the importance of strengthening analytical capabilities and standardizing forensic accounting practices within the Saudi context.

KEYWORDS: Forensic accounting, Fraudulent bankruptcy, Saudi Arabia.

1. INTRODUCTION

Accounting plays a central role in modern economies as both a language of business and a mechanism for communicating reliable financial information. However, because financial figures influence strategic and operational decision-making, they remain vulnerable to manipulation and falsification (Efiong, 2012). The early twenty-first century witnessed major corporate scandals described by Ball (2009) as a "tsunami of accounting fraud" including the collapses of Enron and WorldCom. These events exposed the involvement of senior executives in falsifying financial records and raised critical questions about why fraud occurs and why regulatory bodies sometimes fail to detect or report it (Zahra et al., 2007).

Financial fraud has since become one of the most significant global challenges, prompting reforms such as the Sarbanes-Oxley Act of 2002, which sought to strengthen transparency and accountability in financial reporting (Oxley, 2007). Despite these reforms, the accounting profession continues to face increasing pressure due to growing complexity of business environments and rapid evolution of fraudulent schemes (Okoye & Ndah, 2019). Technological advancements have further enabled fraudsters to conceal misconduct more effectively, making fraud detection increasingly difficult (Vousinas, 2019).

In response to these challenges, forensic accounting has emerged as a multidisciplinary field that integrates accounting, auditing, law, data analytics, and investigative techniques to uncover financial irregularities and support legal proceedings (Tiwari & Debnath, 2017; Botes & Saadeh, 2018). Since Maurice Peloubet introduced the term in 1946, the profession has expanded significantly, requiring advanced analytical and investigative capabilities (Holley, 2020). Forensic accountants today employ variety of tools including data mining, ratio analysis, trend analysis, Benford's Law, and the Beneish M-Score to detect complex fraud schemes (DiGabriele, 2009; Davis et al., 2010; Amahalu, 2017).

Financial fraud is closely linked to corporate bankruptcy, as manipulated financial statements may conceal or contribute to impending failure (Daurrohmah et al., 2022). Although bankruptcy is a legitimate legal mechanism, some individuals misuse it to evade obligations by concealing or transferring assets. Given the severe economic consequences of fraudulent bankruptcy (Box et al., 2020), effective investigation requires skilled forensic accountants capable of ensuring the integrity and independence of financial examinations (Nunn et al., 2006).

In Saudi Arabia, ongoing economic reforms and regulatory developments have increased the need for robust fraud-detection practices. Yet, despite the recognized importance of forensic accounting, and to the best of the researcher's knowledge limited if any, empirical research has examined how forensic tools are perceived or applied in detecting fraudulent bankruptcy within the Saudi context.

Despite the growing importance of forensic accounting in detecting financial irregularities, existing research has focused primarily on general financial fraud rather than fraudulent bankruptcy specifically (Al-Saad, 2013; Ijeoma, 2015). Although prior studies have examined analytical tools such as ratio analysis, trend analysis, Benford's Law, the Beneish M-Score, reasonableness testing, and data-mining techniques, their effectiveness in identifying manipulation associated with bankruptcy filings remains largely unexplored (Amahalu, 2017; Oyedokun et al., 2018). Furthermore, most previous research has been conducted in regulatory and economic environments that differ significantly from Saudi Arabia, limiting the applicability of their findings to the local context (Daurrohmah et al., 2022; Kamal & Aydın, 2022).

To the best of the researchers' knowledge, no empirical study has investigated how both accounting practitioners and academic experts in Saudi Arabia perceive the usefulness and effectiveness of these six forensic accounting tools in detecting fraudulent bankruptcy.

The significance of this study stems from the growing attention to bankruptcy cases in Saudi Arabia following the introduction of the Saudi Bankruptcy Law, which seeks to enhance transparency and protect creditors' rights. Despite these reforms, fraudulent bankruptcy remains a challenge, especially with the increased use of digital financial systems that enable concealment and manipulation of financial data. This underscores the need for analytical tools capable of detecting irregularities beyond the reach of traditional auditing.

Forensic accounting tools such as: Benford's Law, the Beneish M-Score, ratio and trend analysis, reasonableness testing, and data-mining techniques have been widely recognized for their ability to detect anomalies and financial manipulation. However, empirical evidence on their use and perceived effectiveness in the Saudi context remains limited.

This study contributes by providing one of the

first empirical assessments of how Saudi practitioners and academics perceive the effectiveness of these six tools in detecting fraudulent bankruptcy. The findings can support courts, regulators, bankruptcy trustees, and forensic accountants in identifying the most reliable tools, while also guiding SOCPA and academic institutions in designing training programs that emphasize advanced analytical methods. The study further lays groundwork for future research using real bankruptcy cases to strengthen the forensic accounting framework in Saudi Arabia.

Given this gap, the present study adopts an exploratory approach to investigate how practitioners and academics perceive the effectiveness of six key forensic accounting tools- Benford's Law, the Beneish M-Score, ratio analysis, trend analysis, reasonableness testing, and data-mining techniques- in detecting fraudulent bankruptcy in Saudi Arabia. By integrating insights from both professional and academic communities, the study provides an initial empirical foundation for understanding how these tools are viewed within the local environment and shows opportunities for further research and practical development.

1. Literature Review

Research on forensic accounting has considerably expanded across different jurisdictions, reflecting its growing importance in combating financial fraud. Early studies emphasized the conceptual foundations and professional relevance of forensic accounting. For example, Al-Saad (2013) highlighted the increasing demand for forensic services in Saudi Arabia and underscored the need for specialized skills and structured professional standards. Similar conclusions were drawn in other contexts, where researchers stressed the importance of forensic accountants' competencies such as: investigative skills, analytical reasoning, legal knowledge, and ethical conduct in addressing complex fraud cases (Ijeoma, 2015; Martinez-Figueroa, 2015; Oyedokun, 2016; Abdullah & Nour, 2018; Tiwari & Debnath, 2017). A substantial body of literature has examined the tools and techniques used in forensic investigations. Several studies explored analytical tools such as data-mining techniques, ratio analysis, trend analysis, and computer-assisted audit techniques (CAATs), demonstrating their relevance in detecting financial irregularities and improving the quality of financial reporting (Popoola et al., 2016; Al-Dulaimi & Tbeishat, 2017; Amahalu, 2017; Oyedokun et al., 2018; Ismail et al., 2018). These studies consistently found that analytical tools enhance fraud detection Capabilities, particularly when combined with strong professional judgment and domain expertise.

Other studies focused on the skills and attributes required for effective forensic accountant practice. Martinez-Figueroa (2015) and Tiwari & Debnath (2017) emphasized the importance of communication skills, ethical conduct, digital forensics knowledge, and investigative techniques. Popoola et al. (2016) further demonstrated that forensic accountants outperform traditional auditors in fraud-risk assessment due to higher levels of knowledge and skill.

Despite the breadth of research, several limitations emerge. First, although tools such as Benford's Law, the Beneish M-Score, and reasonableness testing have been discussed in the context of earnings manipulation and creative accounting (Ijeoma, 2015; Amahalu, 2017; Oyedokun et al., 2018), their application to fraudulent bankruptcy has not been empirically examined. Second, most studies were conducted outside Saudi Arabia specifically in Nigeria (Ijeoma, 2015; Amahalu, 2017; Oyedokun et al., 2018; Popoola et al., 2016), Jordan (Al-Dulaimi & Tbeishat, 2017), Malaysia (Ismail et al., 2018), Puerto Rico (Martinez-Figueroa, 2015), and Sudan (Abdullah & Nour, 2018) reflecting a body of empirical work developed in regulatory environments that differ significantly from the Saudi context.

Furthermore, previous research has typically examined either practitioners or academics separately, without integrating both perspectives, despite the essential role academics play in shaping professional standards and training future forensic accountants. Only Al-Saad (2013) included both groups, yet the study did not examine analytical tools nor address fraudulent bankruptcy.

Overall, the existing literature provides valuable insights into forensic accounting skills, tools, and professional roles, but no empirical study based on the available evidence has evaluated the effectiveness of the six analytical tools (Benford's Law, Beneish M-Score, ratio analysis, trend analysis, reasonableness testing, and data-mining techniques) in detecting fraudulent bankruptcy within the Saudi context. This gap underscores the need for a localized, evidence-based investigation that incorporates both practitioners' and academics' perspectives.

2. Research Questions

Considering the limited empirical evidence on how forensic accounting tools are perceived and utilized within the Saudi Arabian context, this exploratory study aims to address the following

research questions:

1. How do practitioners and academic perceive the effectiveness of the six forensic accounting tools in detecting fraudulent bankruptcy?
2. To what extent are these six tools: Benford's Law, the Beneish M-Score, ratio analysis, trend analysis, reasonableness testing, and data-mining techniques recognized and applied in professional and academic environments?
3. Which tools are viewed as the most effective indicators of fraudulent bankruptcy?
4. Do perceptions differ between practitioners and academics?

3. Hypotheses Development

In light of the existing gap in the literature and the growing need to evaluate the analytical capabilities of forensic accounting tools, this study seeks to empirically examine their role in detecting fraudulent bankruptcy within the Saudi context. Grounded in the Fraud Triangle and Fraud Diamond theories, which explain how behavioral and situational factors contribute to financial manipulation, the study develops a set of hypotheses to assess the relationship between the use of analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy.

Study Hypothesis

H1: There is a statistically significant positive relationship between the tools and techniques used by forensic accountants and the detection of fraudulent bankruptcy in Saudi Arabia.

H2: There is a statistically significant positive

Relationship between the effectiveness of applying forensic accounting practices and the detection of fraudulent bankruptcy in Saudi Arabia.

4. Theoretical Framework

4.1 Fraud Theories Underpinning Forensic Accounting

- Fraud Triangle Theory

Cressey's Fraud Triangle explains fraud through three conditions: pressure, opportunity, and rationalization (Cressey, 1953). Pressure arises from financial or performance demands; opportunity emerges from weak controls; and rationalization allows perpetrators to justify unethical actions (Abdullahi & Mansor, 2015; Tutino & Merlo, 2019). These elements frequently appear in bankruptcy-related manipulation.

- Fraud Diamond Theory

Wolfe and Hermanson (2004) expanded the model by adding capability, emphasizing that fraud requires the technical skills, authority, confidence, and resilience to execute and conceal misconduct. Empirical studies show that capability is especially relevant in complex schemes such as asset concealment and financial statement manipulation (Schuchter & Levi, 2015; Peprah, 2018).

The Fraud Triangle and Fraud Diamond theories explain the behavioral conditions that lead to fraudulent bankruptcy, including financial pressure, opportunities created by weak internal controls, rationalization, and the offender's capability to manipulate records. These theories clarify why fraudulent behavior occurs, whereas forensic accounting tools focus on how to detect the financial irregularities that arise from such behavior. Accordingly, the theories provide the behavioral justification for employing analytical forensic techniques, even though the tools themselves are not directly linked to specific fraud elements. Instead, the tools operate as objective methods for identifying unusual patterns and inconsistencies that may indicate fraudulent bankruptcy.

4.2 Analytical Foundations of Forensic Accounting Tools

The increasing prevalence of fraudulent activities in modern business environments has intensified the need for analytical mechanisms capable of detecting manipulation within financial records. This development has strengthened the role of forensic accounting, which emerged to bridge accounting and legal practices, and to support litigation processes (Tiwari & Debnath, 2017). Major corporate scandals further heightened public awareness of financial misconduct and accelerated the evolution of forensic accounting as a specialized field within the broader accounting profession (Botes & Saadeh, 2018).

Technological advancements have also contributed to the rise of more sophisticated fraud schemes, reinforcing the importance of forensic accounting tools in evaluating the accuracy and reliability of financial information (Das, 2020). Prior studies consistently highlight that the presence of forensic accountants enhances corporate credibility and reduces the likelihood of creative accounting practices (Ijeoma,2015). Research has also demonstrated the effectiveness of analytical technique such as Benford's Law and the Beneish M-Score in identifying financial irregularities and detecting fraudulent reporting (Oyedokun, 2022). Further empirical evidence shows that forensic accounting tools play a significant role in improving the integrity of financial data and supporting fraud detection efforts (Emmanuel et al., 2018). Studies evaluating forensic techniques emphasize the importance of methods such as data-mining, ratio analysis, and

trend analysis in uncovering anomalies that may indicate fraudulent activity (Eko et al., 2020).

The effectiveness of these tools depends heavily on the forensic accountant's ability to apply them with strong analytical judgment, investigative skills, and professional skepticism. Research underscores the need for practitioners to master specialized tools and techniques alongside cognitive, personal, and professional competencies to ensure accurate and legally defensible findings (Sharma & Panigrahi, 2013; Akinbowale et al., 2020; Ewa, 2022).

These analytical foundations form the basis for the six forensic accounting tools examined in this study, each contributing to the detection of fraudulent bankruptcy by identifying irregularities, unusual trends, and deviations from expected financial behavior.

4.3 Key Forensic Accounting Tools Relevant to Detecting fraudulent Bankruptcy

- Benford's Law

Benford's Law is a mathematical rule describing the natural distribution of leading digits in real-world numerical data. Smaller digits—especially 1—appear more frequently, making the law a practical tool for detecting irregularities in financial records.

In forensic accounting, deviations from Benford's expected distribution may indicate manipulation, fabricated numbers, or other fraudulent practices (Oyedokun, 2022). Prior studies showed that applying this law enhances the credibility of financial analysis and supports early detection of accounting irregularities (Ijeoma, 2015).

Because fraudulent bankruptcy often involves altering revenues, expenses, or asset values, Benford's Law provides a quick and effective method for identifying unusual patterns that may signal intentional misstatement.

- Beneish M-Score

The Beneish M-Score is a statistical model developed to identify the likelihood of earnings manipulation by analyzing specific financial ratios derived from a company's statements. The model incorporates indicators such as asset quality, sales growth, depreciation, leverage, and accruals to detect unusual patterns that may signal intentional misstatement (Oyedokun, 2022).

Studies highlight its effectiveness as a forensic tool because it provides a quantitative assessment of whether reported earnings may have been manipulated, making it particularly relevant in detecting fraudulent financial reporting that often precedes fraudulent bankruptcy (Eko et al., 2020).

- Ratio Analysis

Ratio analysis is one of the fundamental tools used in forensic accounting to evaluate the consistency and reliability of financial information. By comparing key financial ratios—such as profitability, liquidity, leverage, and efficiency—across periods or against industry benchmarks, analysts can identify unusual fluctuations that may indicate manipulation or fraudulent reporting (Eko et al., 2020).

Sudden or unexplained changes in ratios often signal potential irregularities, making ratio analysis an effective method for detecting financial distortions commonly associated with fraudulent bankruptcy (Emmanuel et al., 2018).

- Trend Analysis

Trend analysis reviews financial information across several periods to identify patterns, shifts, or unusual movements that may indicate manipulation. By tracking changes in revenues, expenses, assets, and liabilities over time, forensic accountants can detect inconsistencies that deviate from expected operational or industry trends (Eko et al., 2020).

Sudden spikes, unexplained declines, or irregular fluctuations often signal potentially fraudulent activity, making trend analysis a valuable tool for identifying behaviors commonly associated with fraudulent bankruptcy (Emmanuel et al., 2018).

- Reasonableness Testing

Reasonableness testing evaluates whether reported financial figures are logical and consistent with expected business conditions. By comparing actual results with independently estimated or industry-based expectations, forensic accountants can identify values that appear unusually high, low, or inconsistent with normal operational patterns (Emmanuel et al., 2018).

When financial data significantly deviates from what would reasonably be expected, such discrepancies may indicate manipulation or misstatement, making this technique particularly useful in detecting irregularities associated with fraudulent bankruptcy (Akinbowale et al., 2020).

- Data- Mining Techniques

Data-mining methods are used to uncover hidden patterns and associations in extensive datasets to identify anomalies that may indicate fraudulent activity. These techniques help forensic accountants detect unusual transactions, hidden trends, and irregular financial behaviors that traditional methods may overlook (Eko et al., 2020).

Studies show that data-mining enhances fraud detection by improving the quality of evidence, supporting predictive analysis, and strengthening decision-making in financial investigations (Bangura, 2020; Oyedokun, 2022).

Because fraudulent bankruptcy often involves complex and concealed manipulation, data-mining provides an effective analytical approach for uncovering patterns consistent with financial misconduct.

4.4 Integrated Analytical Perspective

The six forensic accounting tools offer complementary analytical perspectives, with each tool detecting a different type of financial irregularity. When applied together, they provide a more complete and reliable assessment of potential fraud by revealing patterns and inconsistencies that may not appear through a single method. Combining numerical tests, ratio-based indicators, trend behavior, and data-driven techniques strengthens the overall ability to detect fraudulent bankruptcy and increases the likelihood of uncovering hidden or intentional misstatements.

4.5 Linking the Theoretical Foundations to the Conceptual Model

Based on the theoretical foundations discussed above, the six forensic accounting tools represent the primary analytical mechanisms through which fraudulent bankruptcy can be detected. Fraud theories explain the behavioral motivations behind manipulation (Cressey, 1953; Wolfe & Hermanson, 2004), while the analytical literature demonstrates how each tool identifies specific irregularities associated with such behavior (Botes & Saadeh, 2018; Saleh, 2018; Emmanuel et al., 2018; Eko et al., 2020; Oyedokun, 2022). Accordingly, the conceptual model of this study positions the six tools: Benford's Law, the Beneish M-Score, ratio analysis, trend analysis, reasonableness testing, and data-mining techniques as the independent variables expected to influence the perceived effectiveness of detecting fraudulent bankruptcy, which serves as the dependent variable. This alignment ensures that the empirical investigation is grounded in both behavioral theory and analytical evidence.

5. Methodology

5.1 Research Design

This study adopts an inductive research approach supported by a quantitative cross-sectional design. The inductive orientation guides the development of the conceptual model by moving from existing empirical evidence and documented forensic accounting practices toward broader theoretical conclusions regarding the relationship between the use of analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy within the Saudi context.

To empirically test this model, the study employs a quantitative cross-sectional design, which is appropriate for measuring perceptions, comparing respondent groups, and examining relationships between the two dimensions at a single point in time. A descriptive-analytical style supports this design: the descriptive component outlines the theoretical foundations and analytical techniques that collectively form the first Dimension, while the analytical component evaluates how this Dimension relates to the perceived effectiveness of detecting fraudulent bankruptcy.

The primary data used in this study were originally collected through a structured questionnaire developed and validated in the researcher's doctoral dissertation. For the purposes of this article, the same dataset is used to address the study's exploratory objectives, ensuring consistency with the original instrument and alignment with the current research focus.

5.2 Sample and Data Collection

Data for this study were collected through an electronic self-administered questionnaire distributed to four key respondent groups: academic experts, forensic accountants, bankruptcy trustees, and external auditors. Based on Cochran's formula, and using a 95% confidence level with a 5% margin of error, the required sample size was calculated as 416 valid responses were obtained, providing sufficient statistical power for the analyses conducted. Descriptive statistics—frequencies and percentages—were used to summarize the demographic characteristics of the sample and ensure clear representation of the targeted groups.

5.3 Study instrument

The study instrument consisted of two main sections:

Section 1: Demographic Information, this section captured key demographic and professional characteristics of respondents, including professional role (academic expert, forensic accountant, bankruptcy trustee, or external auditor), gender, educational qualification, nationality, professional certifications, years of experience, and current workplace.

Section 2: Perceptions of Forensic Accounting

Tools and Effectiveness, this section measured respondents' perceptions of the analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy. All items were assessed using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." The items were adapted from the validated questionnaire developed in the researcher's doctoral dissertation and re-analyzed in this study to align with the derived two-Dimension model.

This structure ensured comprehensive coverage of both respondent characteristics and the core analytical constructs of the study.

5.4 Variables

This study includes two main variable groups:

- The independent variables represent six forensic accounting tools: Benford's Law, the Beneish M-Score, ratio analysis, trend analysis, reasonableness testing, and data-mining techniques measured through respondents' perceptions on a five-point Likert scale.
- The dependent variable is the perceived capability of forensic accounting to detect fraudulent bankruptcy. Composite mean scores were used to quantify all variables.

5.5 Data Analysis Techniques

The data were analyzed using descriptive statistics to summarize the demographic characteristics of respondents and the central tendencies of the two study Dimensions. Reliability was assessed using Cronbach's Alpha, with all coefficients exceeding the 0.70 threshold. To examine differences across demographic groups, one-way ANOVA was employed. Pearson's correlation coefficient was used to assess the strength and direction of associations between the study variables, while multiple linear regression was conducted to evaluate the combined predictive effect of the forensic accounting tools on the capability of detecting fraudulent bankruptcy. These analyses align with the two-Dimension model adopted in this derived study.

6. Results

This section presents the empirical findings of the statistical analyses conducted to examine the relationship between the analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy. The results are organized to summarize the sample's composition, followed by the descriptive statistics of the two Dimensions, and the inferential analyses used to test the study hypotheses. Descriptive statistics provide an overview of the demographic distribution of the respondents, including academic experts, forensic accountants, bankruptcy trustees, and external auditors. Subsequent analyses assess the strength and direction of the association between the two Dimensions using Pearson's correlation. In addition, one-way ANOVA is employed to examine differences across demographic groups, while multiple linear regression is used to evaluate the combined predictive effect of the forensic accounting tools on the capability of detecting fraudulent bankruptcy. Together, these analyses provide a comprehensive assessment of whether greater reliance on analytical forensic accounting tools is associated with higher perceived capability to detect fraudulent bankruptcy.

6.1 Descriptive Statistics of the Sample

This section presents the empirical results examining the relationship between analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy. It begins with a summary of respondents' demographic characteristics, followed by descriptive statistics for the two study Dimensions and the inferential analyses used to test the hypotheses. Pearson correlation was applied to assess the strength and direction of the association between the Dimensions, while multiple linear regression was employed to evaluate the combined predictive effect of the forensic accounting tools on the perceived effectiveness of detecting fraudulent bankruptcy. Overall, these analyses assess whether greater reliance on analytical forensic accounting tools corresponds with higher perceived effectiveness in detecting fraudulent bankruptcy. Table (1) reports the demographic distribution of the sample.

Table 1: Demographic Characteristics of the Respondents.

Variable	Category/ Group	Frequency	Percentage (%)
Nationality	Saudi	340	81.7
	Non-Saudi	76	18.3
Profession	Academic Expert	133	32
	Bankruptcy Trustee	34	8.2
	Forensic Accountant	89	21.4
	External Auditor	160	38.5
Gender	Male	310	74.5
	Female	106	25.5
Educational Qualification	Diploma	3	0.7
	Bachelor's Degree	188	45.2
	Master's Degree	135	32.5
	Phd	90	21.6

Professional Certifications	CPA	25	6
	SOCPA	161	38.7
	CFE	25	6
	CIA	156	37.5
	Other	49	11.8
Years of Experience	Less than 5 years	87	20.9
	5 to <10 years	69	16.6
	10 to < 15 years	105	25.2
	15 to 20 years	89	21.4
	More than 20 years	66	15.9

Table (1) summarizes the demographic characteristics of the study sample. Saudi nationals represented 81.7% of respondents, which is expected given the study's focus on the local forensic accounting context. Gender distribution showed that males accounted for 74.5% of the sample, reflecting the current structure of the auditing and forensic accounting professions in Saudi Arabia.

Professionally, external auditors formed the largest group, representing 38.5% of participants, indicating that many respondents have direct involvement in financial reporting and investigative procedures. Most participants held a bachelor's degree (45.2%), while postgraduate qualifications such as master's (32.5%) and PhD degrees (21.6%) were also represented, demonstrating variation in academic preparation across the sample.

Experience levels were distributed across all categories, with the highest concentration in the 10 to less than 15 years range (25.2%), suggesting a balanced mix of mid-career and experienced professionals. Regarding certifications, SOCPA was the most prevalent credential (38.7%), which aligns with its status as the primary national qualification in Saudi Arabia. Other certifications such as CPA, CFE, and CIA appeared at lower percentages, reflecting differences in access to specialized and international credentials.

Overall, the demographic profile reflects a diverse and professionally relevant sample, supporting the robustness of the study's empirical findings.

6.2 Descriptive Statistics of the Study Variables

To test the study hypotheses, descriptive statistics were generated for the items measuring the six forensic accounting tools and the capability of forensic accounting to detect fraudulent bankruptcy. Mean scores and standard deviations were used to assess respondents' overall level of agreement with each item. Pearson correlation coefficients and their corresponding significance values were calculated to examine the associations among the items within each Dimension. These descriptive indicators provide the empirical basis for evaluating the extent to which the proposed hypotheses are supported. Table (1) presents the descriptive results for the Dimension related to forensic accounting tools, while Table (2) reports the descriptive results for the Dimension measuring the capability of forensic accounting to detect fraudulent bankruptcy.

Table 2: Descriptive Statistics for Forensic Accounting Tools Dimension.

	Mean	**Standard Deviation**	**Pearson r**	**Sig. (p - value)**
D1-1	4.12	0.72	0.636**	0.001
D1-2	4.19	0.62	0.738**	0.004
D1-3	4.28	0.62	0.759**	0.000
D1-4	4.28	0.63	0.731**	0.000
D1-5	4.07	0.71	0.752**	0.000
D1-6	4.03	0.72	0.770**	0.000
D1-7	4.27	0.64	0.724**	0.000
D1-8	4.20	0.62	0.752**	0.000
D1-9	4.19	0.63	0.812**	0.000
D1-10	4.06	0.70	0.806**	0.000
D1-11	4.12	0.68	0.778**	0.000
D1-12	3.95	0.76	0.773**	0.000
Total	**4.15**	**0.50**		

***** significant at a=0.01.***

The items presented in the table above are reported using their numerical codes (D1-1 to D1-12).

These codes correspond to the questionnaire statements that measure the Dimension of forensic accounting tools and techniques. The following list provides the full item descriptions to clarify the meaning of each code:

- D1-1: Comparing a company's expenses with those of similar firms using reasonableness testing to detect fraud.
- D1-2: Using ratio analysis to identify potential expense overstatements.
- D1-3: Applying data mining techniques to uncover fraud schemes in bankruptcy cases.
- D1-4: Using asset trend analysis to detect abnormal declines that may indicate asset concealment.
- D1-5: Employing the Beneish model to identify potential manipulation in financial statements.
- D1-6: Applying Benford's Law to detect anomalies in financial data.
- D1-7: Enhancing fraud detection efficiency by combining ratio analysis with other forensic tools.
- D1-8: Using profitability trend analysis to detect manipulation in profit margins.
- D1-9: Using data mining to extract evidence of fraud in suspicious bankruptcy cases.
- D1-10: Detecting asset manipulation using the Beneish model.
- D1-11: Using reasonableness testing to identify potential asset valuation errors.
- D1-12: Applying Benford's Law to detect hard-to-identify fraudulent activities.

The results of the first Dimension demonstrate strong internal consistency and high respondent agreement regarding the effectiveness of forensic accounting tools in detecting fraudulent bankruptcy. Pearson item–total correlations ranged from 0.636 to 0.812, all statistically significant at the 0.01 level, confirming robust internal coherence among the items. The reliability coefficient for this Dimension (0.930) further indicates a high level of measurement stability and supports the overall reliability of the instrument. Mean scores ranged between 3.95 and 4.28, reflecting a strong perception of the importance and usefulness of these tools.

The low standard deviations suggest minimal variability and a high degree of convergence in participants' views. Analytical and technological tools such as: data mining, ratio analysis, trend analysis, reasonableness testing, Benford's Law, and the Beneish model received particularly strong endorsement, highlighting their role in identifying abnormal patterns, detecting manipulation in assets or liabilities, and uncovering fraudulent financial practices. Overall, the findings emphasize the critical contribution of integrated forensic techniques in enhancing the ability of forensic accountants to detect fraudulent bankruptcy.

Table 3: Descriptive for the Forensic Accounting in capability in detecting Fraudulent Bankruptcy.

	Mean	**Standard Deviation**	**Pearson r**	**Sig. (p - value)**
D-1	4.30	0.65	0.807**	0.001
D-2	4.36	0.62	0.856**	0.004
D-3	4.31	0.63	0.882**	0.000
D-4	4.13	0.78	0.841**	0.000
D-5	4.14	0.80	0.835**	0.000
D-6	4.42	0.62	0.781**	0.000
Total	**4.27**	**0.57**		

*****significant at a=0.01***

The items presented in the table above are reported using their numerical codes (D2-1 to D2-6). These codes correspond to the questionnaire statements that measure the Dimension of perceived effectiveness of forensic accounting in detecting fraudulent bankruptcy. The following list provides the full item descriptions to clarify the meaning of each code.

- D2-1: Forensic accounting effectively detects fraudulent bankruptcy and provides the necessary legal evidence.
- D2-2: Forensic accounting assists in presenting evidence to the court to convict the debtor of fraud.
- D2-3: Forensic accounting helps the bankruptcy trustee identify the debtor's concealed assets.
- D2-4: Forensic accounting supports the recovery of funds from fraudulent debtors.
- D2-5: Forensic accounting contributes to reducing the losses incurred by creditors.
- D2-6: The success of forensic accounting in detecting fraudulent bankruptcy depends on cooperation among relevant authorities and effective information sharing.

The results of the second Dimension demonstrate strong internal consistency and high respondent agreement regarding the role of forensic accounting in detecting fraudulent bankruptcy. Pearson item–total correlations ranged from 0.781 to 0.882, all

statistically significant at the 0.01 level, confirming robust internal coherence among the items. The reliability coefficient for this Dimension (0.909) further indicates a high level of measurement stability and supports the overall reliability of the instrument.

Mean scores ranged between 4.13 and 4.42, reflecting a strong perception of the effectiveness of forensic accounting in uncovering fraudulent bankruptcy, providing legal evidence, identifying concealed assets, and reducing creditor losses. The low standard deviations suggest minimal variability and a high degree of convergence in participants' views. Overall, the findings highlight the critical contribution of forensic accounting practices in supporting legal proceedings, enhancing asset recovery, and strengthening the detection of fraudulent bankruptcy.

6.3 Reliability and Internal Consistency

The internal reliability of the study instrument was evaluated using Cronbach's Alpha, and the resulting coefficients ranged from 0.892 to 0.976 across the two Dimensions included in the final model. These values exceed the accepted threshold of 0.70, indicating excellent internal consistency and strong measurement stability. In addition, Pearson item–total correlations were statistically significant at $\alpha = 0.01$, confirming the internal coherence of the items and supporting the construct validity of the instrument. These results demonstrate that both the analytical tools and the dependent variable were measured reliably and are suitable for subsequent hypothesis testing.

6.4 Multiple Liner Regression Analysis

Multiple linear regression analyses were conducted to examine the predictive relationships associated with the two study Dimensions. The first model assessed the extent to which the analytical forensic accounting tools (Dimension Four) contribute to explaining variations in the perceived capability of detecting fraudulent bankruptcy. The second model evaluated the predictive strength of the forensic accounting capability Dimension (Dimension Five) in relation to the overall effectiveness of detecting fraudulent bankruptcy. Together, these models provide a comprehensive understanding of how improvements in the use and application of forensic accounting techniques translate into higher perceived capability to identify fraudulent bankruptcy. Table (4) presents the regression results for the first Dimension, while Table (5) reports the corresponding results for the second Dimension.

Table (4): Multiple Linear Regression Results for Forensic Accounting Tools Dimension.

Variable	B	Std. Error	Beta	t-test	Sig.
Intercept	3.982	0.216	—	18.433	0.000
Professional Certification	0.038	0.023	0.091	1.663	0.097
Nationality	0.034	0.066	0.026	0.515	0.607
Occupation	0.026	0.025	0.067	1.009	0.314
Gender	-0.070	0.061	-0.061	-1.150	0.251
Educational Qualification	0.001	0.042	0.002	0.024	0.981
Work Experience	0.020	0.021	0.053	0.947	0.344

The multiple regression results for Dimension Four show that the intercept is statistically significant (B= 3.982, Sig.= 0.000), indicating a generally high level of agreement among respondents regarding the importance of analytical forensic accounting tools in detecting fraudulent bankruptcy, even before accounting for demographic or professional characteristics. All independent variables: Professional Certification, Nationality, Occupation, Gender, Educational Qualification, and Work Experience recorded non-significant p-values (Sig.> 0.05), demonstrating that none of these demographic or professional factors exert a meaningful influence on respondents' evaluations of analytical tools. The low Beta coefficients further confirm the minimal predictive power of these variables. Overall, the results suggest that perceptions of the importance of analytical forensic accounting tools are stable and consistent across respondents, regardless of individual differences, reflecting the inherently objective and methodological nature of these tools.

Table (5): Multiple Linear Regression Results for Forensic Accounting Capability to detect Fraudulent Bankruptcy Dimension.

Variable	B	Std. Error	Beta	t-test	Sig.
Intercept	4.209	0.242	—	17.406	0.000
Professional Certification	0.065	0.025	0.138	2.560	0.011
Nationality	-0.124	0.074	-0.084	-1.671	0.095

Occupation	0.044	0.028	0.101	1.539	0.124
Gender	-0.028	0.068	-0.021	-0.404	0.687
Educational Qualification	-0.032	0.048	-0.044	-0.677	0.499
Work Experience	0.010	0.023	0.024	0.443	0.658

The regression results for Dimension Five show that the intercept is statistically significant (B= 4.209, Sig.= 0.000), indicating a generally high level of agreement among respondents regarding the importance of professional factors in enhancing the capability to detect fraudulent bankruptcy. Among the independent variables, Professional Certification is the only significant predictor (B = 0.065, Beta= 0.138, Sig.= 0.011), suggesting that holding a professional certification contributes meaningfully to improving this capability. In contrast, Nationality, Gender, Educational Qualification, and Work Experience recorded non-significant p-values (Sig.> 0.05), indicating that these demographic characteristics do not influence respondents' assessments of the Dimension. Overall, the table highlights the central role of specialized professional qualifications, while demographic factors show no meaningful predictive effect.

6.5 Hypotheses Testing

The study's hypotheses were tested using Pearson correlation and multiple linear regression to examine the relationship between forensic accounting tools and practices and the detection of fraudulent bankruptcy. A hypothesis was considered supported when the corresponding p-value was below the 0.05 significance level.

H1: There is a statistically significant positive relationship between the tools and techniques used by forensic accountants and the detection of fraudulent bankruptcy in Saudi Arabia.

H2: There is a statistically significant positive relationship between the effectiveness of applying forensic accounting practices and the detection of fraudulent bankruptcy in Saudi Arabia.

7. Discussion

The findings of the study provide strong empirical support for both hypotheses and highlight the significant role of analytical forensic accounting tools in detecting fraudulent bankruptcy within the Saudi context. The descriptive results revealed consistently high agreement among respondents regarding the importance of analytical techniques—such as ratio analysis, trend analysis, reasonableness testing, Benford's Law, the Beneish M-Score, and data-mining procedures—in identifying financial anomalies. This widespread agreement reflects a shared professional understanding that structured analytical methods are essential for uncovering irregularities associated with fraudulent bankruptcy.

The reliability analysis further confirmed the robustness of the measurement instrument, with both Dimensions demonstrating excellent internal consistency. This strengthens confidence in the validity of the results and indicates that respondents evaluated the analytical tools and perceived effectiveness in a coherent and stable manner.

In relation to H1, the correlation analysis showed a statistically significant positive relationship between the use of analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy. This finding aligns with theoretical expectations and prior literature, confirming that analytical procedures enhance practitioners' ability to identify red flags, detect manipulation, and uncover fraudulent financial behavior. The strength of this association underscores the importance of integrating analytical methods into forensic accounting practice.

Regarding H2, the regression analysis demonstrated that analytical forensic accounting tools significantly predict the perceived effectiveness of detecting fraudulent bankruptcy. This indicates that greater reliance on structured analytical techniques is associated with higher perceived detection capability. The predictive power of these tools reinforces their practical value and highlights their role as essential components of forensic investigation frameworks, particularly in complex cases such as bankruptcy fraud.

Overall, the results collectively affirm that analytical forensic accounting tools are both relevant and effective in detecting fraudulent bankruptcy. The findings contribute to the growing body of literature advocating for the adoption of analytical and technology-driven methods in forensic accounting and emphasize the need for continuous professional development to ensure practitioners are equipped to apply these tools effectively. These insights provide strong empirical support for both hypotheses and highlight the strategic importance of analytical techniques in enhancing fraud detection within the Saudi context.

8. Conclusion

This study provides one of the first empirical examinations of how analytical forensic accounting tools are perceived in detecting fraudulent bankruptcy within the Saudi context. Drawing on

insights from both practitioners and academic experts, the findings demonstrate a strong and consistent recognition of the importance of structured analytical techniques—such as Benford's Law, the Beneish M-Score, ratio and trend analysis, reasonableness testing, and data-mining methods—in identifying financial anomalies and uncovering manipulation associated with bankruptcy fraud. The high levels of agreement across all items highlight the relevance and practical value of these tools in forensic investigations.

The reliability results confirmed the robustness and internal coherence of the measurement instrument, reinforcing confidence in the study's analytical framework. The correlation analysis revealed a statistically significant positive association between the use of analytical forensic accounting tools and the perceived effectiveness of detecting fraudulent bankruptcy, while the regression results further demonstrated that these tools significantly predict perceived detection capability. Together, these findings provide strong empirical support for the study's theoretical expectations and underscore the essential role of analytical techniques in enhancing forensic accounting practice.

Overall, the study contributes to the limited body of knowledge on fraudulent bankruptcy in Saudi Arabia by offering a localized, evidence-based assessment of the six key forensic accounting tools. The results emphasize the need to integrate analytical and technology-driven methods into forensic workflows and highlight the importance of continuous professional development to ensure that practitioners are equipped to apply these tools effectively. The study also offers practical implications for regulators, courts, bankruptcy trustees, and professional bodies such as SOCPA, particularly in designing training programs and strengthening fraud detection mechanisms. Future research may build on these findings by applying the six tools to real bankruptcy cases, enabling deeper insights into their diagnostic accuracy and further advancing forensic accounting practice in the Saudi environment.

9. Limitation, Implication, and Recommendations

9.1 Limitation

Although this study provides valuable insights into the perceived effectiveness of analytical forensic accounting tools in detecting fraudulent bankruptcy, several limitations should be acknowledged. First, the study relied on self-reported perceptions rather than the actual application of analytical tools to real bankruptcy cases, which limits the ability to evaluate their operational accuracy. Second, the research employed a single quantitative method without incorporating qualitative evidence such as interviews or case analyses that could offer deeper contextual understanding. Third, the sample was restricted to practitioners and academics within the Saudi environment; while this enhances contextual relevance, it limits the generalizability of the findings to other regulatory settings. Finally, the study focused on two analytical Dimensions, suggesting that additional forensic techniques, particularly technology-driven and AI-based methods, warrant examination in future research.

9.2 Theoretical and Practical Implication

- Theoretical Implication

The study contributes to the forensic accounting literature by empirically demonstrating the strong relationship between analytical forensic tools and the perceived effectiveness of detecting fraudulent bankruptcy. The findings reinforce theoretical perspectives that emphasize the role of analytical procedures in identifying financial anomalies and support the integration of structured analytical techniques within fraud detection frameworks.

- Practical Implication

The results highlight the practical value of analytical forensic tools in enhancing fraud detection processes. Practitioners can benefit from incorporating ratio analysis, trend analysis, reasonableness testing, Benford's Law, the Beneish M-Score, and data-mining techniques into investigative workflows. The findings also underscore the importance of continuous professional development to strengthen analytical competencies and promote consistent application of forensic techniques across the profession. Regulatory bodies may use these insights to enhance investigative guidelines and encourage the adoption of standardized analytical procedures.

9.3 Recommendations for Future Research

Future studies may apply analytical forensic tools to real bankruptcy datasets to evaluate their operational performance. Mixed-method approaches combining surveys with interviews or case studies could provide valuble insights into how practitioners interpret and apply analytical techniques. Expanding research to include international samples would enhance generalizability and allow cross-country comparisons. Additionally, examining emerging forensic technologies such as machine learning and advanced anomaly-detection models may offer deeper understanding of their potential in detecting complex bankruptcy fraud schemes.

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