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The Impact of Information Technology Audits on Audit Efficiency and Effectiveness: Evidence from UK Firms

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ABSTRACT

This study investigates the role of information technology audits in enhancing audit efficiency and effectiveness, focusing on empirical evidence from United Kingdom firms between 2016 and 2022. As firms become increasingly reliant on digital systems, the integration of information technology audit practices becomes a critical component of both internal and external assurance functions. The research utilizes a panel firm-level dataset and applies econometric techniques, including fixed-effects regression, to evaluate how variables such as automation tools, information technology audit integration, auditor competency, and information technology audit budget influence audit outcomes. The results indicate that practices like automation and integration have a statistically significant positive effect on audit performance. Additionally, budgetary allocation and information technology competency contribute substantially to audit efficiency and effectiveness. However, audit frequency alone does not show a strong correlation, highlighting the importance of strategic integration and audit quality over procedural repetition. The findings have practical implications for policymakers, audit practitioners, and organizations seeking to optimize audit functions in a digital environment. Recommendations include regulatory support for information technology audit adoption, increased investment in audit automation, and upskilling audit professionals in information technology competencies.

INTRODUCTION

The distinction between effectiveness and efficiency is fundamental in business and economics. Effectiveness refers to the extent to which an organization achieves its objectives—essentially, doing the right things to generate intended outcomes. Efficiency, on the other hand, concerns how optimally resources are utilized to achieve these objectives with minimal waste—doing things right, with an emphasis on maximizing outputs from given inputs. While both concepts are necessary for sustained organizational success, they often require different strategies and measurement approaches. Balancing these two dimensions is particularly challenging in today's rapidly evolving digital business environment, where the stakes for both achieving organizational goals and optimizing resource use are higher than ever. With the advent of digital business environments, organizations have become highly dependent on complex information systems for both strategic decision-making and routine operations (Indriyanto, 2023; Shaukat et al., 2025). Enterprise resource planning systems, cloud computing, and real-time analytics now play a central role in how modern businesses function. This digital transformation, while bringing immense opportunities for innovation and efficiency, also introduces a host of new risks (Farras et al. 2025; Audi et al., 2025). System failures, data breaches, and cyber threats have become prominent concerns, often threatening business continuity and eroding stakeholder confidence. These risks are particularly acute given the interconnectedness of digital networks and the rising sophistication of cyberattacks. Traditional audit approaches—historically focused on financial controls and compliance—may not adequately address the multifaceted threats presented by this new landscape.

The demand for information technology audits has increased significantly in recent years, as organizations recognize the need to ensure the reliability, security, and integrity of their IT environments (Ilori et al., 2024; Khalid et al., 2025; Arshi et al., 2025). IT audits involve systematic evaluations of an organization's information technology infrastructure, policies, and operations. These assessments are designed to determine whether existing controls sufficiently protect assets, maintain data integrity, and align with applicable regulations and industry best practices. They also help identify potential vulnerabilities and recommend improvements to mitigate risk. The scope of IT

audits can range from reviewing system access controls and network security to evaluating business continuity plans and disaster recovery protocols. As such, IT audits have become a cornerstone of modern risk management and corporate governance (Haider et al., 2025; Idrees et al., 2025).

Despite their recognized importance, however, many organizations still treat information technology audits as an auxiliary process rather than as an integral component of the overall audit function. This limited integration can result in inefficiencies and reduce the overall effectiveness of the audit process (Karim et al., 2020; Kodithuwak & Pacillo, 2025). When IT audits are siloed or only sporadically implemented, organizations may miss emerging risks, duplicate audit activities, or fail to align IT controls with broader organizational objectives. Such gaps are particularly problematic in highly regulated industries, such as banking, healthcare, and energy, where the consequences of data breaches or system failures can be especially severe. Leading organizations are moving toward a more integrated approach to auditing, in which IT audits are embedded within the overall audit framework and closely aligned with enterprise risk management strategies. This integration enables auditors to provide a more comprehensive assessment of organizational effectiveness and efficiency, linking IT controls with business performance metrics and strategic objectives. Additionally, regular IT audits facilitate a culture of continuous improvement, encouraging organizations to adapt proactively to technological change and evolving cyber threats.

There remains a lack of empirical evidence and quantitative analysis regarding the impact of information technology audits on audit performance, which limits the development of best practices and policies. Furthermore, questions persist about the measurable benefits of information technology audits in improving audit efficiency (such as reducing cost, time, and redundancy) and effectiveness (such as enhancing control evaluation and risk identification) (Turetken et al., 2020; Minella, 2025). This study addresses this gap by evaluating how information technology audits contribute to audit effectiveness and efficiency through a data-driven and theoretical approach using audit and financial data from 2016 to 2022. The main objective of the study is to empirically examine the role of information technology audits in enhancing the effectiveness and efficiency of the auditing process within organizations. By identifying quantifiable relationships between audit performance indicators

and information technology audit practices, the study aims to offer theoretical and practical insights for corporate management, regulators, and auditors. The study assesses the extent to which information technology audits impact audit efficiency, measured by metrics such as cost, audit cycle duration, and resource utilization, and evaluates their impact on audit effectiveness, measured by internal control evaluation, fraud detection, and regulatory compliance.

LITERATURE REVIEW

Many researchers have examined the role of information technology audits in enhancing audit efficiency and effectiveness. Brown-Liburd and Vasarhelyi (2015) highlighted that information technology audits improve audit quality by equipping auditors with tools for continuous auditing and monitoring. By enabling ongoing auditing and timely detection of control failures and errors, information technology audits facilitate corrective actions before financial statements are finalized. Kokina and Davenport (2017) explored the integration of machine learning and artificial intelligence in information technology audits, demonstrating that these technologies can automate predictive analytics and anomaly detection, thereby enhancing audit speed and accuracy. Their findings indicate that artificial intelligence-driven information technology audits can significantly improve both the accuracy and timeliness of audit processes.

A recent review by Arwani, Sandi, and Rahmatika (2023) emphasized how advanced technologies have transformed internal audit functions by automating tasks, providing deeper insights, and enabling real-time monitoring of organizational processes. Lapalme and Kabiwa (2019) underscored the importance of effective collaboration and communication between auditees and information technology auditors in maximizing the benefits of information technology audits. Nicolaou and Nicolaou (2012) focused on the need for auditors to develop expertise in cloud risk assessment to maintain audit effectiveness in modern environments.

Cao and Chychyla (2015) demonstrated that information technology audits support enterprise risk management by identifying weaknesses in information technology systems that can affect financial reporting. Their findings suggest that information technology auditors play a key advisory

role in developing control frameworks that align information technology risks with business risks, thereby enhancing risk governance. Thottoli and Ahmad (2022) noted that traditional artificial intelligence audit methodologies may fail to address the main risks associated with emerging technologies, highlighting the need for new frameworks and audit approaches.

Coetzee and Lubbe (2014) investigated risk-based internal audit engagements supported by various information technology audit techniques. These techniques have improved audit process efficiency by enabling auditors to focus on high-risk areas, automate data analytics, and reduce manual testing, resulting in more timely and cost-effective audits. Ahmad Al-Hiyari (2019) examined the use of computer-assisted audit technologies among internal auditors in Jordan, finding that such tools enhance audit efficiency by allowing auditors to analyze complete data populations quickly and accurately, thus reducing reliance on sampling and increasing audit coverage.

Rozario (2018) highlighted the transformative impact of robotic process automation in auditing by automating repetitive tasks such as reconciliation, data extraction, and testing. The adoption of robotic process automation was shown to minimize audit cycle times and enable auditors to dedicate more effort to complex judgmental areas, ultimately improving audit efficiency. Coetzee and Lubbe (2014) also argued that information technology audits enhance audit effectiveness by providing reliable assurance over information technology controls, which are essential for the integrity of financial data. Strong information technology controls reduce the risk of errors and fraud and allow auditors to place greater reliance on automated processes.

Aditya and Ferdiana (2018) reviewed the evolution of modern information technology audit practices and found that increasing information system complexity necessitates a shift from traditional audit approaches to dynamic, risk-based audits supported by advanced information technology tools. The research highlighted the importance of adopting internationally recognized frameworks such as the Control Objectives for Information and Related Technologies (COBIT) to guide information technology audit processes, ensuring comprehensiveness, alignment, and consistency with organizational objectives. They also observed that integrating artificial intelligence and advanced analytics reshapes audit methodologies by enabling auditors to detect patterns and anomalies beyond

manual review. Further, a systematic review by Handayani (2025) supported these conclusions, showing that information technology-driven audits reduce audit cycle times, improve audit report quality, and increase the accuracy of findings. Handayani and Ema Utami (2023) analyzed the application of the COBIT framework in information technology risk management audits, concluding that COBIT 5 is widely used by practitioners and researchers as a comprehensive guide for information technology risk governance and management.

Handayani (2025) analyzed the influence of information technology on audit efficiency and effectiveness, demonstrating that the adoption of audit software, information management systems, and data analytics allows auditors to access and analyze vast datasets rapidly and accurately. The study found that information technology not only accelerates the auditing process but also enhances audit reliability and quality by enabling comprehensive assessments. The research further observed that information technology implementation reduces the likelihood of errors, increases transparency, and supports better internal control and decision-making within organizations. Monica (2025) noted that auditors face new risks and challenges associated with information technology use, such as cybersecurity threats and the need for ongoing upskilling to keep pace with technological advancements.

Although a growing body of literature highlights the potential of information technology (IT) audits to enhance audit efficiency and effectiveness, several critical research gaps remain, particularly regarding empirical evidence from developed markets like the United Kingdom. Much of the current research (e.g., Brown-Liburd & Vasarhelyi, 2015; Kokina & Davenport, 2017; Akim, 2020; Mate, 2022; Arwani et al., 2023) focuses on conceptual frameworks, case studies, or technological advancements, often in the context of internal audits or emerging markets, with limited quantitative analysis addressing external audit outcomes or broader organizational impacts. Existing studies frequently emphasize the theoretical benefits of IT audit integration, automation, and advanced analytics, but provide relatively little firm-level, panel data evidence on how these practices translate into measurable improvements in audit cycle duration, cost reduction, control evaluation, and risk identification. Furthermore, the literature does not adequately explore the role of moderating variables

such as IT audit budget allocation, auditor digital competency, and the strategic integration of IT audits within overall assurance frameworks. Most prior works concentrate on technology adoption or risk management in isolation, rather than investigating the interaction between IT audit practices and audit performance outcomes across diverse organizational settings. Moreover, while frameworks such as COBIT are often recommended, there is little empirical research examining their practical impact on audit efficiency and effectiveness in UK firms operating within a digitalized environment. Consequently, there is a need for robust, data-driven research employing panel econometric methods to quantify the specific effects of IT audits on audit outcomes and to identify the organizational and resource factors that maximize these benefits.

THEORETICAL FRAMEWORK

The theoretical foundation of this study is grounded in the Resource-Based View of the firm and Agency Theory, both of which are well-established in the auditing and management literature (Meng et al., 2023). The Resource-Based View posits that a firm's internal resources and capabilities—if they are valuable, rare, inimitable, and non-substitutable—can provide a sustained competitive advantage (Ilori et al., 2024). Within this framework, information technology audit functions are conceptualized as strategic resources that enhance control, reliability, and organizational efficiency. Effective implementation of information technology audits allows firms to manage technological risks, strengthen internal controls, and improve data accuracy, thereby increasing audit effectiveness and efficiency (Meng et al., 2023). Agency theory, on the other hand, describes the relationship between agents (such as managers or auditors) and principals (owners), emphasizing the need for monitoring mechanisms to ensure agents act in the best interests of principals (Karhan, 2019; Tila & Cera, 2021; Clark, 2022; Geda, 2023; Wahyuni et al., 2024; Iqbal & Hayat, 2025). In this context, information technology audits function as monitoring tools that can reduce information asymmetry and mitigate the risks of misreporting and fraud. By improving control mechanisms and transparency, information technology audits enhance trust and minimize the costs associated with excessive oversight (Indriyanto, 2023; van Zanden, 2023).

These theories support the argument that information technology audits are not merely technical activities but are also critical governance and strategic tools that significantly influence audit outcomes (Al-Ahdal & Hashim, 2022). To formalize this theoretical relationship, the following functional model is proposed:

$$AE = f(ITAUD, AUTOAUD, ITBUD, ITCOMP, FREQ, DUM, \varepsilon) \quad (1)$$

The equation, AE, is the efficiency or effectiveness of the audit based on the context. ITAUD is the level of IT Audit Implementation, and ITBUD represents IT Audit Budget allocation. The use of automated audit tools is represented by AUTOAUD, and ITCOMP represents Auditor IT competency. Frequency of audit is represented by FREQ. DUM represented the dummy measure of REG (Regulatory Dummy), BIG4 (Big Four Auditor Dummy). Lastly, error term is given as ε. This theoretical framework shows how different components of IT audit practice influence the dependent outcome, whether effectiveness or efficiency of audit (Indriyanto, 2023) . This function can be represented in a more precise form by using a linear regression model for empirical application (Karim & Hasan Mahmoud AL-Shatnawi, 2020).

$$AE_i = \beta_o + \beta_1 ITAUD_i + \beta_2 ITBUD_i + \beta_3 AUTOAU + \beta_4 ITCOMP_i + \beta_5 ITFREQ_i + \beta_6 DUM + \varepsilon_i \quad (2)$$

β_0 is the intercept and $\beta_1, \beta_2, \beta_3 \ldots, \beta_5$ are the main coefficients showing the marginal impact of all independent variables, ε_i which is the error term, and it is assumed to be distributed normally.

TABLE 1: LIST OF INDEPENDENT VARIABLES FOR THIS RESEARCH

Variables	Description
AE	Audit Efficiency (AEFF): It is measured through metrics like. Audit cycle time (in days).Audit Effectiveness (AEFFV): It is measured by. Number of internal control deficiencies identified. Number of material misstatements detected. Compliance score according to regulatory assessments
ITAUD	The index or binary score in the financial data shows the extent of IT audit integration (1=fully integrated and 0=none)
ITBUT	It is the percentage of the audit budget allocated to IT audits.
AUTOAUD	The total number of automated tools used includes CAATs, IDEA, and ACL.
ITCOMP	It is the index based on training hours, certifications, and years of IT audit experience.
FREQ	It is the total number of IT audits conducted every year.

This research utilizes secondary data from a range of credible sources. Primary data sources include audit committee reports and annual reports, which provide information on audit efficiency, audit cycle time, and costs, derived from governance reports of listed companies and publicly available financial statements (Castka & Cory Searcy, 2020). Public databases such as Audit Analytics are used to obtain data on restatements, audit fees, and internal control deficiencies. Firm-level operational and financial data are sourced from Bloomberg and Compustat terminals (Emett & Eulerich, 2024). Reports from professional bodies, including the Institute of Internal Auditors' annual information technology audit reports and ISACA publications, are also utilized (Zhang & Shen, 2022). Additional data are gathered from governmental and academic research publications, peer-reviewed journals, and case studies on performance metrics and information technology audit adoption. United States Securities and Exchange Commission filings, such as 10-Ks, are consulted for audit quality disclosures and control effectiveness (Yunis & Mirza, 2024). All data are collected with careful attention to consistency, completeness, and verifiability to ensure the integrity of the analysis.

The study focuses on companies based in the United Kingdom, chosen for the maturity of their audit practices and the availability of information technology audit data, as recommended by

Farcane & Ovidiu Constantin Bunget (2023). By including data through 2022, the research captures recent developments in information technology audit integration and automation, making the findings more actionable and timely. Figure 1 illustrates the relationship between automation tools and information technology budget over time in the United Kingdom, showing a significant increase in information technology budget during this period, potentially linked to the COVID-19 pandemic. Figure 2 compares automation tools and information technology budget over time, while Figure 3 presents the positive trend of auditor competency from 2016 to 2022 in United Kingdom firms.

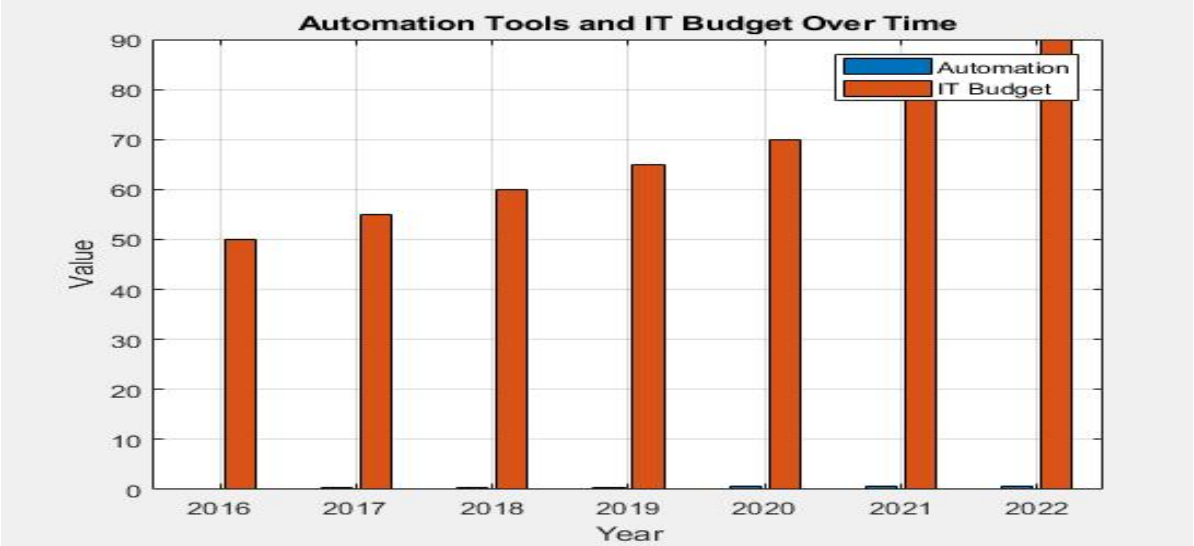

FIGURE 1: COMPARISON BETWEEN AUTOMATION TOOLS AND IT BUDGET OVER TIME

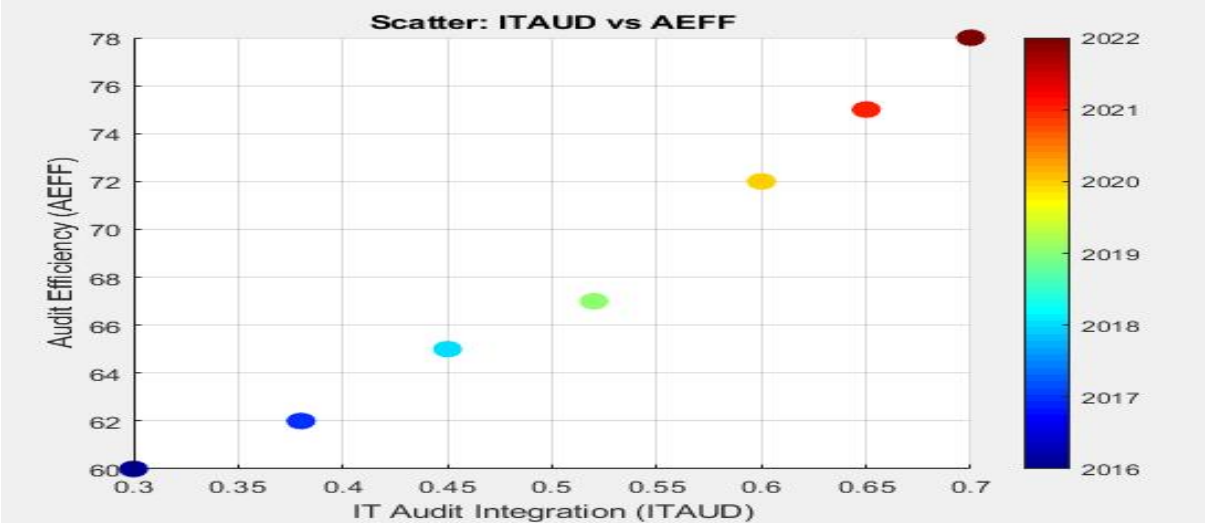

FIGURE 2: COMPARISON BETWEEN AUDIT EFFICIENCY AND IT AUD

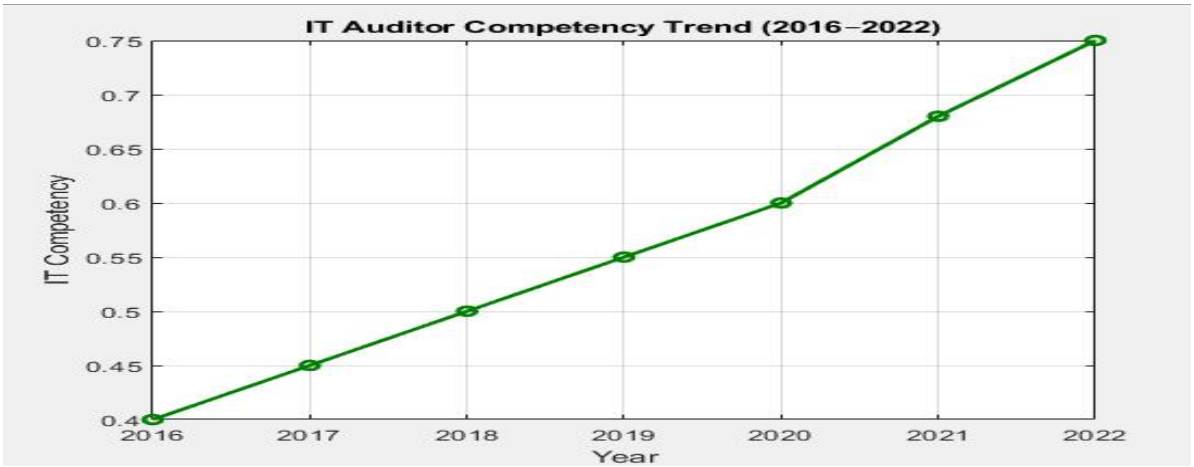

FIGURE 3: TREND OF AUDITOR COMPETENCY FROM 2016 AND 2022

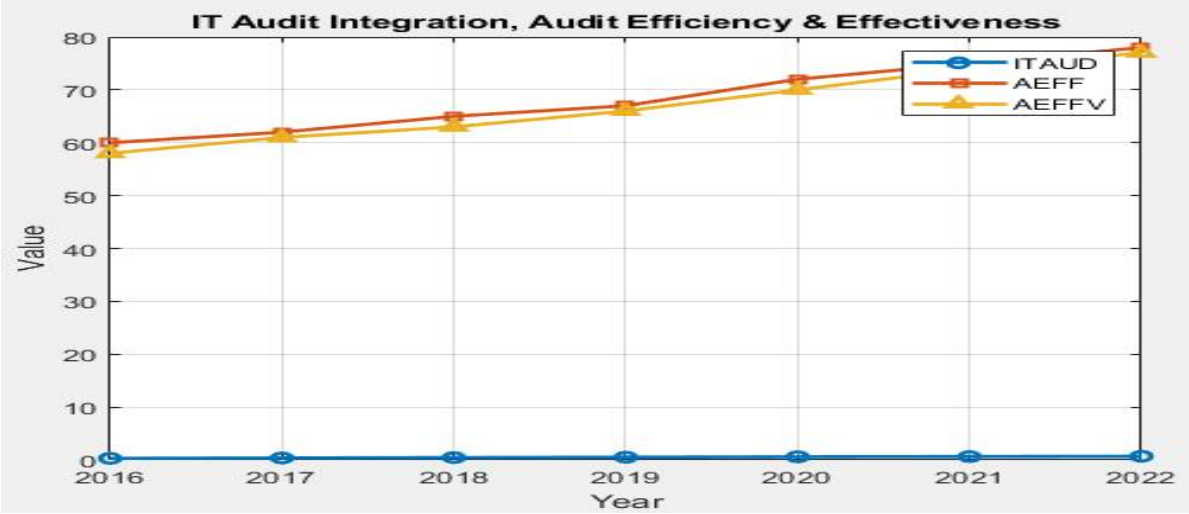

FIGURE 4: IT AUDIT INTEGRATION, AUDIT EFFECTIVENESS, AND AUDIT EFFICIENCY IN PANEL REGRESSION.

ECONOMETRIC METHODOLOGY

It can be noted that econometrics offers a highly robust and scientific approach to testing theoretical relationships between dependent and independent variables by analyzing real-world data through statistical models (Zhang & Shen, 2022). In the context of auditing, econometrics enables empirical validation of how independent variables such as auditor competencies, information technology audit intensity, and audit automation impact dependent outcomes like audit efficiency and effectiveness (Battaglini et al., 2024). As the complexity and integration level of information technology systems in

audit procedures increases, it becomes more challenging to assess audit quality or performance using qualitative assessments alone (Farcane et al., 2023). To isolate, measure, and understand the extent to which information technology audits drive performance outcomes, a quantitative framework is essential for this study (Acheampong, 2023).

In this research, econometric techniques are applied to firm-level data from 2016 to 2022. The use of panel data—drawn from multiple sources and observed over time, allows for the control of time-specific and firm-specific effects, resulting in highly reliable estimations (Yunis & Mirza, 2024). Additionally, panel data helps address potential biases arising from unobservable variables that remain constant over time but vary across firms (Baatwah et al., 2022).

The dataset includes companies from the United Kingdom across various sectors such as healthcare, financial services, manufacturing, and information technology, as these industries maintain complex information technology systems and face high regulatory compliance burdens (gov.uk, 2025). Only medium to large, publicly listed companies were selected, given their likelihood of disclosing comprehensive audit information and having formalized information technology audit functions (Yunis & Mirza, 2024). The focus on UK companies is based on the maturity of their audit practices and the availability of information technology audit data in the region (Farcane et al., 2023). The period from 2016 was chosen due to the implementation of global regulatory frameworks, such as COSO 2013 updates and GDPR preparation, which increased attention on information technology risks (Acheampong, 2023). During the COVID-19 era (2020–2021), remote auditing and information technology audit tools gained prominence due to digital transformation and lockdowns (Emett & Eulerich, 2024). Including data through 2022 allows the study to capture recent developments in information technology audit integration and automation, making the findings more actionable and timely (Karim & AL-Shatnawi, 2020).

This chapter presents the mathematical framework for exploring the impact of information technology audits on audit efficiency and effectiveness, detailing the main variables, data sources, and software used for data analysis. Descriptive analysis is used to provide insights into the central tendencies and distributions of the variables, presenting summary statistics such as standard deviation,

mode, mean, minimum, and maximum (Battaglini et al., 2024).

The Hausman test is used to choose between the fixed and random effects models. It evaluates the null hypothesis that the preferred model is random effects, where no correlation exists between individual effects and regressors. When the p-value is less than 0.05, the fixed effects model is deemed more appropriate (Battaglini et al., 2024). The Hausman test essentially determines whether correlation between error terms and regressors is present or not (Greene, 2003). The following is the Null hypothesis:

H_0 : $\boldsymbol{E\left(\frac{\mu_i}{X_{it}}\right) = 0}$ Random Effect is efficient and consistent.

The Hausman test statistic is

$$\boldsymbol{h = \hat{q}[Var\,(\hat{q})]^{-1}\,\hat{q}}$$

In panel data analysis, certain factors such as geography, culture, or leadership may remain constant over time yet still influence outcomes. If these are not controlled for, results may be biased. The fixed effects model assumes that there is a correlation between the regressors and unobservable individual errors. In this model, the slope parameters can change, while the intercept remains constant (Brooks, 2014). When correlation exists between error terms and regressors, the fixed effects model is the appropriate choice. The fixed effects model is

$$Y\_it=\beta X\_it+\eta\_i+\varepsilon\_it \qquad (3)$$

Where Y_it dependent variable vector, X_it is independent and control variable matrix, η_i is individual specific effect, and ε_it is random error term and i = 1,2,…… N and t = 1,2,……, T.

RESULTS AND DISCUSSION

This section presents detailed empirical findings from the analysis of data collected from firms between 2016 and 2022. The results are organized into two parts: correlation analysis and descriptive statistics. These initial findings provide valuable insights into the distribution, central tendencies, and interrelationships among the primary variables of the study.

As shown in Table 2, the average audit efficiency value is 0.673, while audit effectiveness is slightly higher at 0.745. This suggests that, on average, audits are more effective than efficient, likely

due to a stronger focus on risk mitigation over speed or cost. The standard deviations for both metrics indicate moderate variability across years and firms (Indriyanto, 2023). The mean value for information technology audit integration is 0.582, indicating that more than half of the firms have integrated information technology audits to some extent. The average information technology audit budget is 14.23%, reflecting a substantial allocation of resources to technology-related audits. Firms use an average of 2.76 automation tools, with some utilizing up to five different audit automation systems, underscoring increasing reliance on technologies such as data analytics platforms, artificial intelligence-based control testing, and continuous auditing tools (Acheampong, 2023). The information technology competency index is 6.41 on a 10-point scale, demonstrating a relatively high level of proficiency among audit personnel. The frequency of information technology audits is slightly less than twice per year, suggesting a semi-annual schedule or variation based on risk exposure (Karim & AL-Shatnawi, 2020). Among the control variables, approximately 51% of firms were audited by Big Four firms, and 46% operated under stricter regulatory regimes such as General Data Protection Regulation compliance. These statistics provide a strong foundation for subsequent regression and correlation analyses (Wahyuni & Astuti, 2024).

TABLE 2: DESCRIPTIVE STATISTICS

Study Variables	Mean	Standard Deviation	Minimum	Maximum
AEFF	0.673	0.149	0.320	0.910
AEFFV	0.745	0.128	0.410	0.970
ITAUD	0.582	0.234	0	1
ITBUD	14.23	6.712	3	33
AUTOAUD	2.76	1.12	0	5
ITCOMP	6.41	1.80	2	10
FREQ	1.89	0.66	1	4
FSIZE (Log Total Asset)	8.34	0.79	6.10	10.30
REG (Regulatory	0.46	0.49	0	1

Dummy)				
BIG4 (Big Four Auditor Dummy)	0.51	0.50	0	1

Table 3 presents the correlations among the variables. The correlation matrix reveals that audit effectiveness and audit efficiency have a strong positive correlation (r = 0.642), indicating that improvements in audit efficiency are generally associated with greater audit effectiveness, and vice versa (Emett & Eulerich, 2024). Within the correlation matrix, all information technology audit-related independent variables—namely, AUTOAUD, ITBUD, ITAUD, ITCOMP, and FREQ—are significantly and positively correlated with the dependent variables. This supports the theoretical proposition that information technology audits enhance audit outcomes (Ilori & Nwosu, 2024). The highest correlations with audit effectiveness are observed for AUTOAUD (r = 0.566) and ITAUD (r = 0.587), suggesting that both integration and automation of information technology audit practices play a vital role in improving audit quality (Zheng & Pu, 2023). Multicollinearity concerns are minimal, as all pairwise correlations are below the common threshold of 0.7. This is further confirmed by the variance inflation factor test conducted during regression analysis (Zhang & Shen, 2022). Of particular note, audit frequency displays the weakest positive correlation with both audit effectiveness and efficiency, implying that the integration and quality of information technology audits may be more important than audit frequency alone. These correlations establish a strong preliminary foundation for subsequent regression analysis and confirm the conceptual relationship posited in the econometric and theoretical models: information technology audit mechanisms are positively related to both audit effectiveness and efficiency (Meng & Yahya, 2023).

TABLE 3: CORRELATION MATRIX

Variable	AEFF	AEFFV	ITAUD	ITBUD	AUTOAUD	ITCOMP	FREQ
AEFF	1	0.642**	0.531**	0.441**	0.493**	0.472**	0.369**
AEFFV		1	0.587**	0.503**	0.566**	0.515**	0.433**
ITAUD			1	0.478**	0.495**	0.446**	0.388**
ITBUD				1	0.453**	0.405**	0.311**

AUTOAUD	1	0.537**	0.358**
ITCOM		1	0.421**
FREQ			1

** shows the significance level at 1% ($p<0.01$)

Table 4 shows that if the probability value is below 5%, the null hypothesis is rejected, indicating that the fixed effects model is preferred. The results confirm this, as the significant p-value is less than 0.05, favoring the use of the fixed effects model. This analysis evaluates the impact of information technology audit variables on audit effectiveness and efficiency.

TABLE 4: RESULTS OF THE HAUSMAN TEST

Test	Chi-Sq. Statistics	Chi-Sq. df	Prob.
Value	12.652	6	0.0016

In the regression results presented in Table 5, information technology audit integration (ITAUD) is highly significant in both models, confirming that greater integration of information technology audits leads to improved audit effectiveness and efficiency. Automation (AUTOAUD) also demonstrates a strong positive effect, reinforcing the argument that automation can substantially enhance audit performance (Anwar Mohammed, 2023). Although audit frequency (FREQ) is not significant in either model, this finding supports earlier results suggesting that frequency alone does not have a substantial impact. Both information technology competency (ITCOMP) and information technology audit budget (ITBUD) are statistically significant, indicating that staff competency and budgetary support for information technology are important factors in achieving accurate audit outcomes (Yunis & Mirza, 2024). The control variables—Big Four auditor (BIG4) and regulatory environment (REG)—are also highly significant, suggesting that both regulatory compliance and audit firm quality play vital roles in audit outcomes. The relatively high R-squared value, indicating that the independent variables explain more than 60% of the variation in the dependent variables, demonstrates a strong model fit (Indriyanto, 2023).

TABLE 5: RESULTS OF FIXED EFFECTS REGRESSION ANALYSIS

Variables of study	Model A: AEFF (Efficiency)	Model B: AEFFV (Effectiveness)

ITAUD	0.087***(0.018)	0.091***(0.015)
AUTOAUD	0.043**(0.010)	0.051***(0.009)
ITBUD	0.005*(0.003)	0.007**(0.003)
ITCOMP	0.027**(0.011)	0.034***(0.010)
FREQ	0.022(0.015)	0.019(0.014)
FSIZE	0.009 (0.008)	0.014*(0.007)
BIG4	0.038*(0.020)	0.044**(0.019)
REG	0.041**(0.019)	0.046**(0.017)
R-squared	0.622	0.658
Adj. R-squared	0.607	0.641
Observations	714	714

* p<0.1, **p<0.05, ***p<0.01

The regression coefficients and their statistical significance provide strong support for most of the study's hypotheses. When information technology is implemented significantly in firms, particularly through automation, it enhances both the effectiveness and efficiency of audits (Al-Taee & Flayyih, 2023). However, the frequency of information technology audits is not supported as a significant factor, indicating that simply increasing audit frequency does not improve audit quality unless accompanied by skilled personnel, automation, and technological integration (Alhloul & Kiss, 2023). Firms regulated under strict regimes, such as the General Data Protection Regulation, or those audited by Big Four firms, consistently demonstrate better audit outcomes due to more mature processes and high accountability standards (Zheng & Pu, 2023). These findings are highly consistent with previous literature emphasizing the role of resources, technology, and competency in audit success, and also validate the application of econometric models for quantifying audit outcomes and informing managerial and policy decisions (Al-Taee & Flayyih, 2023). The main aim of the study was to assess the role of information technology audit in increasing audit effectiveness and efficiency. Findings from descriptive statistics, regression modeling, and correlation analysis demonstrate that information technology audit practices have been increasingly adopted by firms between 2016 and 2022, as

evidenced by a mean integration score (ITAUD) of 0.582. This indicates that more than half of the firms in the sample have adopted information technology in their audit functions to some degree, particularly in highly regulated and large organizations (Acheampong, 2023). Furthermore, regression and correlation analyses reveal a strong positive relationship between audit outcomes and information technology audit integration, indicating that such integration goes beyond technological support and substantively enhances audit quality (Indriyanto, 2023).

Key information technology audit factors influencing audit performance—such as automation tools (AUTOAUD), information technology competency (ITCOMP), and information technology audit budget—were found to be statistically significant with notable effect sizes. For example, AUTOAUD had the highest standardized coefficients, confirming that deploying automated tools like continuous monitoring systems, artificial intelligence-based anomaly detection, and data analytics software plays a critical role in boosting both audit effectiveness and efficiency (Emett & Eulerich, 2024). Additionally, ITCOMP and ITBUD were highly significant at the 5% and 1% levels, indicating that investing in training and recruiting competent information technology audit personnel is associated with better performance outcomes. These results align with the study's second research objective and validate its conceptual framework (Karim & AL-Shatnawi, 2020). To further analyze the relationship between audit outcomes and information technology audit practices, panel data econometrics using fixed effects regression modeling was employed. R-squared values of 0.622 for audit efficiency and 0.658 for audit effectiveness indicate that information technology audit variables explain a substantial proportion of the variance in audit performance, underscoring the strength of the analytical methodology (Ado & Rashid, 2020). These findings are both statistically and theoretically consistent, supporting the earlier assumptions in the study's econometric and theoretical models. The significant positive effects of variables such as AUTOAUD, ITBUD, and ITAUD confirm that digitalization in the audit process enhances effectiveness by improving fraud detection, internal control accuracy, and compliance, while efficiency gains are realized through reduced cost, time, and manual workload (Yunis & Mirza, 2024).

The study offers important implications for policymakers and practitioners in the auditing field.

The strategic integration of information technology audits should be viewed as an essential part of audit strategy, not merely a technical support function. Firms that incorporate information technology audits, system integration, and automation into their core processes can realize improvements in both audit quality and speed (Wahyuni & Astuti, 2024). Audit committees and senior management should prioritize information technology audit integration at strategic and operational levels by allocating resources for tools and systems, building information technology audit teams, and aligning information technology audit objectives with the overall risk management framework (Wahyuni & Astuti, 2024).

The adoption of automation tools is particularly effective in enhancing audit performance. Firms should deploy technologies such as continuous auditing systems and artificial intelligence-based fraud detection to minimize human error and streamline workflows, allowing auditors to focus on judgment-intensive tasks and increase the value of audit insights (Pronoza & Chernyshov, 2023). It is essential to view automation as a dynamic capability requiring ongoing governance, continuous updates, training, and integration with evolving enterprise resource planning systems (Pronoza & Chernyshov, 2023). Finally, the competency of information technology auditors is crucial to achieving positive audit outcomes. Organizations should ensure that audit staff possess technical skills by supporting certifications, ongoing training, and upskilling in data analytics, emerging technologies, and cybersecurity (Alhloul & Kiss, 2023).

CONCLUSIONS AND POLICY IMPLICATIONS

This study aimed to explore the extent to which information technology audit practices influence audit effectiveness and efficiency in United Kingdom-based organizations. Panel data from 2016 to 2022 across a diverse sample of firms was analyzed using econometric techniques. The findings provide robust evidence of the positive role played by information technology audits in enhancing audit outcomes. Regression and correlation analyses confirm that these variables have statistically significant positive relationships with both audit effectiveness and efficiency. Information technology audit integration and automation, in particular, have the strongest impact, highlighting the critical value of digital systems and technology in modern audit functions. This research concludes that

information technology audit practices are a transformative force for contemporary auditing. The significance of variables such as information technology competency, automation, integration, and budget underscores the dual operational and strategic value of information technology audits in a high-functioning audit environment. Automation, in particular, is shown to play a pivotal role in improving audit functions by increasing processing speed, minimizing errors, supporting real-time assurance activities, and enhancing fraud detection. However, the effectiveness of these technologies depends on the competency of audit professionals, emphasizing the necessity of ongoing training, certifications, and professional development. The findings also indicate that the frequency of information technology audits does not significantly affect audit outcomes, suggesting that the integration and quality of information technology audit practices are far more important than the number of audits conducted. This supports the argument that a technology-driven and strategic approach is more effective than a purely procedural one. Furthermore, regulatory compliance and external assurance quality contribute significantly to superior audit outcomes. Firms operating in stringent regulatory environments and engaging Big Four auditors achieve better results due to stronger infrastructure, higher standards, and greater commitment to best practices.

For practical implications, firms should recognize that deploying audit tools alone is insufficient. Continuous updates, integration with evolving enterprise resource planning systems, and ongoing investment in governance are essential. Organizations must also prioritize the technical skills of their audit staff through certifications and regular training in data analytics, emerging technologies, and cybersecurity to fully realize the benefits of information technology audit tools and systems.

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