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DOES OWNERSHIP STRUCTURE INFLUENCE THE RELATIONSHIP BETWEEN DIGITAL TRANSFORMATION AND FIRM FINANCIAL HEALTH? EVIDENCE FROM SAUDI ARABIA

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ABSTRACT

This study explores how Digital Transformation affects the financial health of non-financial firms in Saudi Arabia and examines the moderating role of ownership structure on this relation. This study obtained data from annual report of 61 Saudi firms from 2020 to 2024. This study uses the Panel-Corrected Standard Errors (PCSE) method for testing our research hypothesis. The empirical findings reveal that digital transformation positively affects a firm's financial health by improving operational cash flows performance. Our findings also show the positive effect of DT on financial health is strengthened when Managers or Foreign Investors own shares in the firm. The findings offer practical insights for policymakers and investors regarding the overall advantages of digital investments and institutional oversight. Our results would help firms, managers and investors to realize the role of DT in enhancing operating cash flow performance, promoting financial stability. Ultimately, for stakeholders, the Digital Transformation Index (DTI) acts as a reliable signal of a firm's future readiness and its capacity to meet operational liabilities effectively. For policy makers and regulators, this study confirms that the digital goals of Saudi Vision 2030 are effectively improving firm performance, increasing innovation, and supporting the need for flexible governance rules. According to Resource Dependence Theory, this study is one of the first to show how the Saudi Vision 2030 digital goals link directly to firm financial health. In the context of Saudi Vision 2030, our results demonstrate that combining digital innovation with strong corporate governance is essential for achieving sustainable economic performance.

PLAIN LANGUAGE SUMMARY

This study examines how adopting digital technologies aligned with Saudi Vision 2030 improves the financial stability and cash flow performance of companies in Saudi Arabia. By analyzing 61 Saudi firms from 2020 to 2024, the research finds that digital transformation is not just a technical upgrade but a vital tool for ensuring

a company can meet its financial obligations and operate efficiently. Interestingly, the positive impact of these digital investments is even stronger when company managers or foreign investors hold significant shares, as their oversight ensures that technology is used effectively to drive growth. These findings suggest that for Saudi businesses to thrive, they must combine digital innovation with strong leadership and diverse ownership. For investors and policymakers, the study provides a clear roadmap showing that digital progress is a reliable indicator of a company's future readiness and long-term financial health in an increasingly digital economy.

KEYWORDS: Digital Transformation; Firm Financial Health; Cash Flow Performance; Ownership Structure; Resource Dependence Theory; Saudi Arabia.

1. INTRODUCTION

Digital transformation (DT) is an essential change in how businesses operate, including a complete transforming of organizational processes, culture, and customer experiences through the use of digital technologies (Begkos et al., 2024; Jesus, 2024). This transformation is driven by an essential strategy to use data, automation, and accessibility to build innovative products and services, improve operational efficiencies, and maintain competitive advantage in a globalized and digitized marketplace (Boratyńska, 2019; Hamdy et al., 2025). DT's implication extends across a wide range of operations, including accounting and auditing, supply chain management, and customer relations (Al-Okaily, 2025; Chen et al., 2021; Sidorova et al., 2024).

DT can significantly decrease operating costs, reduce errors, and enhance resource allocation by automating regular operations, optimizing processes, and boosting data analytics (Chen and Zhang, 2024; Huang and Cheng, 2024; Yonghong et al., 2023). Additionally, DT can improve information symmetry and real-time data analytics and enhances resource efficiency (Liu et al., 2023; Pu, 2024; Ying, 2024). According to Chen et al. (2024) and Zhao et al. (2025), DT is also essential for improving the quality of business innovation, and lowering the risk of debt default. Also, Digital capabilities can also improve a company's creditworthiness by increasing financial transparency and operational stability, potentially lowering the cost of equity capital and facilitating access to trade credit financing (Hong et al., 2023; Liu and Wang, 2023; Ren et al., 2024; Zhou and Li, 2023).

Firm financial health (FFH) is a key concept in corporate finance, referring to a company's total financial strength, stability, and operational health (Bahodirovich, 2025; Li et al., 2025). It is a multidimensional concept that includes a company's ability to earn appropriate returns, retain adequate liquidity, manage debt effectively, and sustain long-term growth (Guan et al., 2024; Widati et al., 2025). Financial health is critical for attracting investors, obtaining favourable financing arrangements, and managing economic uncertainty, all of which contribute to a company's market value and competitive strength (Hong et al., 2023; Ren et al., 2024).

Previous studies have extensively explored the relation between DT and firm performance using a variety of financial performance indicators, such as profitability ratios (e.g., return on assets, return on equity), liquidity measures, and market capitalization ratios (Jardak and Ben Hamad, 2022;

Liu et al., 2023). The relationship between DT and firm performance has explored in various countries such as China, Europe and Sweden. (Chen & Zhang, 2024; Ionaşcu et al., 2022; Jardak & Ben Hamad, 2022; Yonghong et al., 2023). This relationship was explained by resources based view (RBA). RBA argues that organizations gain competitive advantage when they possess valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Digital transformation creates such resources through advanced analytics, automation, and digital platforms. Some studies support this perspective such as Chen and Zhang (2024) and Yonghong et al. (2023) found that digital transformation improves profitability and efficiency in Chinese firms, while Ionaşcu et al. (2022) show that European firms with digital transformation increase their ability to enhance sustainability and financial performance. In addition to Jardak and Ben Hamad (2022) showed that digital transformation strengthens competitiveness and performance in Swedish listed companies.

Transaction Cost Theory argues that organizations seek to minimize coordination and operational costs. Digital transformation reduces these costs through automation and improved information flow. (Williamson, 1981). Some prior studies in Saudi Arabia and China supported this theory by explored how digital transformation affects financial decision making (Asiri, 2025; Pu, 2024; Van & Kim, 2025). Asiri (2025) found that digital transformation reduces the cash holdings by improving forecasting accuracy, decreasing uncertainty and reducing transaction cost. Similarly, Pu (2024) indicated that firms with digital transformation have a lower level of liquidity risk. Also, Van and Kim (2025) revealed that digital transformation generally leads to lower cash holdings. Regarding the effect of DT on cost of capital, Hong et al. (2023) and Ren et al. (2024) found that digitalization decreases the cost of equity capital by enhancing information disclosure, reducing information asymmetry and improving stock liquidity. Tuan et al. (2021) indicated that digitalization supports document digitization and reduces processing time and errors.

According to (Teece et al., 1997), Dynamic Capabilities Theory explains how digital transformation enables organizations to innovate, adapt, and respond to environmental changes. Zhao et al. (2025) found that DT enhances innovation quality by improving knowledge management and supporting R&D activities. Additionally, Boratyńska (2019) demonstrated that DT drives value creation by

increasing innovative financial services, reducing transaction costs, and improving customer experience. Also, Digital transformation also strengthens supply chain resilience and sustainability. (Alquraish (2025) and Chen et al. (2021).

Prior studies indicated that the effectiveness of digital transformation initiatives in enhancing financial health is significantly influenced by the company's internal governance mechanisms, particularly its ownership structure (Emingeni et al., 2025; Widati et al., 2025). Different ownership patterns—including concentrated ownership, managerial ownership, corporate ownership, government ownership, and foreign ownership can exert varying pressures and incentives on the company's strategy, resource allocation, and risk-taking behaviour (Nguyen Thi et al., 2023; Van, 2024). For example, foreign ownership often provides strong governance standards and advanced technological capabilities, which may increase the financial benefits on digital investments (Anokhin et al., 2025; Diosimpina et al., 2024). Similarly, institutional investors may seek greater efficiency through the adoption of digital technologies, while managerial ownership can align executive interests with long-term digital strategies that impact cash flows (Safitri and Wulanditya, 2017; Salehi et al., 2017)

Some previous studies highlighted the benefits of DT such as improved operational efficiency, cost reduction, increased revenue streams, and better resource allocation (Chen and Zhang, 2024; Huang and Cheng, 2024; Yonghong et al., 2023). Prior research has largely explored this relationship using a diverse array of financial performance indicators, such as profitability ratios (e.g., Return on Assets, Return on Equity), liquidity measures, and market value ratios (Jardak and Ben Hamad, 2022; Liu et al., 2023). However, despite the critical importance of cash flow as a key indicator of a company's true financial stability and its ability to meet its operational obligations, the empirical evidence regarding the direct impact of digital transformation on financial health measured by cash flow performance remains unexplored in the existing literature. This gap becomes even more pronounced when considering how diverse governance mechanisms, particularly a firm's ownership structure, might influence this crucial relationship.

This study fills a key research gap by examining how digital transformation (DT) affects firm financial health (FFH), with a particular focus on the moderating role of ownership structure. Saudi

Arabia is selected as an ideal context due to its rapid economic transformation under Saudi Vision 2030, which has accelerated digital adoption across sectors. Despite significant progress, firms face challenges in converting digital investments into financial gains due to high costs, skill gaps, cybersecurity risks, and operational adjustments. Additionally, the diversity of ownership structures means that the impact of DT on financial outcomes varies across firms. (Chen et al., 2024; Wang, 2025; Yang and Masron, 2024).

According to Resource Dependence Theory and transaction cost theory, this study is one of the first to show how the Saudi Vision 2030 digital goals link directly to firm financial health. In the context of Saudi Vision 2030, these results show that interaction digital innovation with strong corporate governance is essential for achieving sustainable economic performance. This study contributes to the literature by providing a specific Digital Transformation Index tailored to an emerging market context. It extends Signalling Theory by demonstrating that the effectiveness of technological signals is dependent on governance mechanisms.

Our findings offer practical insights for Saudi policymakers and investors regarding the synergistic value of digital investments and institutional oversight. Our results would help firms, managers and investors to realize the role of DT in enhancing operating cash flow performance, promoting financial stability. Ultimately, for stakeholders, the Digital Transformation Index (DTI) acts as a reliable signal of a firm's future readiness and its capacity to meet operational liabilities effectively. For policy makers and regulators, this study confirms that the digital goals of Saudi Vision 2030 are effectively improving firm performance, increasing innovation, and supporting the need for flexible governance rules. Therefore, our study seeks to address two key research questions: What is the impact of DT on FFH, specifically measured through cash flow performance, in Saudi Arabia? How do various dimensions of ownership structure—including, managerial ownership and foreign ownership—moderate the relationship between DT and firms' cash flow performance within the Saudi Arabian context?

The rest of this paper is structured in the following manner: Section 2 provides background information on the Saudi Arabia setting. Section 3 is literature review and hypothesis research. Section 4 provide the methods. Lastly, Sections 5, 6, and 7 present our findings, discuss their implications, and provide the conclusion, respectively.

2. SAUDI ARABIA CONTEXT

Saudi Arabia provides a unique and highly relevant context for examining the relationship between digital transformation (DT), free cash flow (FCF), and ownership structure due to its rapid economic and technological evolution under Saudi Vision 2030. The Kingdom's commitment to DT, an essential part of Saudi Vision 2030, is significantly altering its institutional and economic environment. The Ministry of Finance established important digital initiatives aimed to improve the effectiveness and transparency of public financial management, for example, The shift from paper-based to fully digital transactions, financial process automation, and significant increases in service delivery speed are some of these reforms. Key initiatives like the Tahsil system and the Etimad platform demonstrate the government's commitment to advanced digital infrastructure. Collectively, these developments have improved accounting, budgeting, and increased transparency, and boosted Saudi Arabia's economic competitiveness. (Ministry of Finance, 2025).

At the same time, Saudi Arabia's corporate environment is characterized by diverse ownership structures, including family, institutional, concentrated, and state ownership, which play a critical role in shaping firms' financial decisions and performance. Within this context, cash flow performance emerges as a key indicator of financial health, influencing investment decisions and firm sustainability. The interaction between DT and ownership structures provides a unique setting for examining how governance mechanisms influence financial performance. so that Saudi Arabia an appropriate empirical context for developing outcomes relevant to both emerging markets and the corporate finance literature.

3 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

3.1. Digital transformation and firm financial health

Prior research has extensively investigated the multidimensional implications of digital transformation (DT) on corporate outcomes. While several studies focus on DT's impact on traditional accounting performance and profitability (Chen & Zhang, 2024; Jardak & Ben Hamad, 2022), others emphasize its strategic role in reducing the cost of equity capital (Hong et al., 2023) and mitigating various financial risks (Sayari, 2024; Chen et al., 2024). Furthermore, DT has been linked to non-financial benefits, such as improved supply chain resilience (Alquraish, 2025) and enhanced quality of

accounting information systems (Hamdy et al., 2025).

From a theoretical perspective, the Resource-Based View (RBV) posits that digital transformation creates valuable, rare, and inimitable resources. By integrating advanced analytics, artificial intelligence, and automation, firms can develop unique digital capabilities that lead to a sustainable competitive advantage (Barney, 1991; Yonghong et al., 2023). These resources allow firms to optimize their internal processes, which in turn reflects positively on their overall financial stability and health.

Complementing the RBV, Transaction Cost Theory suggests that DT significantly minimizes coordination and operational costs. Through improved information flow and higher forecasting accuracy, digital tools reduce the uncertainties and costs associated with traditional business transactions (Williamson, 1981; Asiri, 2025). Empirical evidence supports this, showing that firms adopting DT tend to optimize their cash holdings and experience lower liquidity risks (Pu, 2024; Van & Kim, 2025).

Moreover, Dynamic Capabilities Theory explains how DT enables firms to innovate, adapt, and respond rapidly to environmental and market shifts. By fostering a culture of digital agility, companies can drive long-term value creation and operational continuity (Teece et al., 1997; Boratyńska, 2019). This adaptability is crucial for maintaining financial health in volatile markets, as it ensures that the firm's revenue streams and cash-generating activities remain resilient to external shocks (Zhao et al., 2025).

In the context of reporting and transparency, Signaling Theory suggests that DT serves as a powerful signal of a firm's future readiness and operational maturity. When firms invest in high-level digital technologies, they signal to investors and creditors that they possess the infrastructure necessary to meet long-term liabilities effectively. This enhanced transparency reduces information asymmetry and may improve the firm's creditworthiness and access to financing, further stabilizing its financial health (Hong et al., 2023; Ren et al., 2024).

Despite these documented benefits, the direct impact of DT on firm financial health (FFH)—specifically measured through the lens of operating cash flow performance—remains significantly under-researched. This research gap is particularly evident in emerging economies such as Saudi Arabia. Under the umbrella of Saudi Vision 2030, the Kingdom is witnessing a rapid digital shift, yet empirical evidence regarding how this technological leap translates into tangible cash-flow-based stability

is still lacking. Based on these arguments, we hypothesize:

H1: DT has a positive impact on FFH, measured through cash flow performance, in Saudi Arabia

3.2. The moderating role of ownership structure

Ownership structure serves as a critical internal governance mechanism that shapes corporate strategy and financial outcomes. According to Agency Theory, ownership patterns—such as managerial, foreign, or institutional ownership—influence the alignment of interests between managers and shareholders, thereby reducing agency costs and improving financial transparency (Jensen & Meckling, 2019; Warfield et al., 1995). Prior research indicates that these structures significantly impact profitability, sustainability, and the predictability of future cash flows, providing a foundation for firm stability (Boshnak, 2024a; Nguyen et al., 2023).

In the context of digital transformation, ownership structure can act as a pivotal moderator that determines the success of technological investments. While DT requires significant capital expenditure and long-term commitment, the presence of sophisticated owners ensures that these resources are not wasted on empire-building or inefficient projects. Institutional and foreign investors, in particular, often provide superior oversight and technical expertise, ensuring that digital investments are effectively translated into operational efficiency and tangible financial gains (Joe & Oh, 2017; Lee & Kim, 2019).

Managerial ownership plays a distinct role in this relationship by mitigating the "horizon problem" associated with long-term digital strategies. When executives hold a significant equity stake, their personal incentives become aligned with the firm's long-term success, encouraging them to adopt digital technologies that enhance future cash flow creation rather than short-term accounting profits (Safitri & Wulanditya, 2017). This alignment reduces managerial opportunism and fosters an environment where digital innovation is used as a tool for sustainable financial stability (Boshnak, 2024a).

Foreign ownership further strengthens the link between DT and financial health by introducing international best practices and advanced monitoring capabilities. Foreign investors from developed markets often demand higher levels of transparency and digital integration to facilitate remote monitoring and reduce information asymmetry. Consequently, firms with higher foreign ownership are more likely to leverage DT to improve

their reporting quality and cash flow management, signaling their commitment to global governance standards (Nguyen Thi et al., 2023; Phan, 2024).

Furthermore, Resource Dependence Theory suggests that diverse ownership structures provide firms with essential external linkages and digital know-how. Foreign and institutional owners act as "resource providers" who facilitate access to global digital networks and specialized knowledge, which are crucial for the successful implementation of complex technologies like AI and Blockchain. This external support reduces the operational risks associated with digital shifts, ensuring that the transformation process contributes positively to the firm's liquidity and overall financial health (Anokhin et al., 2025; Diosimpina et al., 2024).

Therefore, the efficiency of DT initiatives is highly contingent upon the firm's internal monitoring environment, which is fundamentally driven by its ownership structure. Without strong oversight and aligned incentives, the financial benefits of digitalization may be diminished by agency conflicts or poor strategic execution. In the Saudi Arabian context, where corporate governance is rapidly evolving, understanding how different ownership types catalyze the financial returns of digital investments is essential. Based on the preceding arguments, we hypothesize:

H2: Managerial ownership moderates the relationship between digital transformation and cash flow performance.

H3: Foreign ownership positively moderates the relationship between digital transformation and cash flow performance

4. DATA AND METHODOLOGY

4.1. Sample Selection

The research focuses on the Saudi capital market, which is one of the Middle East's most important emerging markets, particularly in based on the "Saudi Vision 2030" initiative to promote digital economy growth. Initially, the population consisted all firms listed on the Saudi Exchange (Tadawul) between 2020 and 2024. A number of criteria for exclusion were implemented. First, financial firms, such as banks and insurance companies, were excluded due to their special capital needs and accounting standards. Second, firms with missing or partial data on digital transformation initiatives or ownership structures were excluded from the model's equations in order to avoid bias. Our final sample included 61 non-financial firms, resulting in 305 firm-year observations. The data are obtained from the Refinitiv Eikon database and audited

annual reports. To test the hypotheses: We processed our data using the panel corrected standard error

(PCSE) approach. The following Table (1) was created to show criteria for sample selection.

Table 1: Sample Selection.

Criteria	Number of Companies	Firm-Year Observations
Initial sample of firms listed on the Saudi Exchange (Tadawul)	90	450
Less: Financial firms (Banks, Insurance, and Financial Services)	(18)	(90)
Less: Firms with missing or incomplete digital transformation data	(7)	(35)
Less: Firms with missing ownership or corporate governance data	(4)	(20)
Final Sample (Non-Financial Sector)	61	305

4.2. Variable Measurement and Research models

Digital Transformation (DT)

DT is an independent variable, and the Digital Transformation Index (DTI) is a relative score designed to measure the actual level of digital Transformation among Saudi non-financial firms. Following the methodology of Li et al. (2020), we use a content analysis approach in which the actual DT is computed by dividing the total number of digital

technologies implemented by the firm by the index's maximum potential score. The index items are chosen in accordance with the objectives of the National Transformation Program (NTP) in Saudi Arabia. this multi-item index captures the intensity and breadth of digital adoption, covering infrastructure, operations, and governance (Li et al., 2020). The DT index in table (2) consists of 12 key items categorized into three dimensions, specifically tailored to the Saudi "Vision 2030" digital landscape:

Table 2: Digital Transformation Index (DTI) for Saudi Firms.

Dimension	Item	Keywords (Search Terms)
I. Strategic Foundation	1. Cloud Computing	Cloud, Azure, AWS, SaaS, Virtual Server Cybersecurity, NCA, Encryption, Firewall Vision 2030, Roadmap, Digital Goals
	2. Cybersecurity	
	3. Digital Strategy	
II. Emerging Technology	4. Artificial Intelligence	AI, Machine Learning, ML, Algorithms Big Data, Data Mining, Predictive Analytics IoT, Sensors, Smart Devices, Tracking
	5. Big Data & Analytics	
	6. Internet of Things (IoT)	
III. Operational Integration	7. ERP Systems	SAP, Oracle, ERP, System Integration RPA, Automation, Robotics, Digitized Workflow Digital Payment, Fintech, Cashless, E-wallet
	8. Process Automation	
	9. Fintech & Payments	
IV. Governance & Channels	10. Digital Leadership	CDO, Digital Committee, Tech Board Online Sales, Web Store, Digital Channel Blockchain, Ledger, Smart Contract
	11. E-commerce	
	12. Blockchain	

4.3. Financial Health

Financial health is the dependent variable; FFH can be measured using a variety of accounting and market-based metrics, such as profitability ratios (e.g., Return on Assets, Return on Equity) and solvency ratios (e.g., Debt-to-Equity); however, this study focuses on cash flow performance (operating cash flow to total liabilities) as a key indicator. Cash flow provides an unadulterated view of a company's operational, investment, and financing performance (Ayash, 2020; Bahodirovich, 2025; Mirza and Azfa, 2010).

4.4. Ownership Structures

Several studies have used a variety of attributes to measure ownership structure, including institutional ownership, foreign ownership, managerial ownership, family ownership, and concentration ownership. This study focuses on foreign ownership and managerial ownership as indicators of ownership structure. Managerial ownership (Mowner) is defined as the percentage of equity held by officers and directors. (Jensen and Meckling's, 1976; Warfield et al.'s (1995) Foreign ownership (Fowner) is calculated as the proportion of shares

held by foreign investors. (Phan, 2024; Beck and Brown, 2015; Anokhin et al., 2025).

4.5. Control Variables

Recent empirical research has highlighted the importance of firms' characteristics as one of a determinant of firm financial health and reporting quality. Firm size and age are commonly used as predictors of stability; larger, older firms benefit from strong internal controls and greater access to capital markets, reducing financial distress (Astuti et al., 2025). Regarding profitability, Campbell et al. (2008) found that firms with higher profitability performed

better than those with lower profitability. Also, leverage (Lev) is an important factor to evaluate firm performance. Berger and Di Patti (2006) indicated that firms with lower debt levels have increase their ability to obtain finance. Finally, Audit Quality (Big4) remains an essential element of financial integrity in Saudi Arabia, with respected auditors performing as an external monitoring mechanism that improves the credibility of financial indicators and promotes long-term stability (Habtoor, 2022).

Table 3: Present the variables and their Measurement.

Table 3: Measurements of Variables.

Variables	Name	Abbreviation	Measure
Dependent Variable	Firm Financial Health (FFH)	Opliab	Operating Cash Flow / Total Liabilities.
Independent Variable	Digital Transformation	DT	An index measuring the actual level of digital technology adoption. Actual DT = DT adopted by firms / DT index
Moderating Variable	Managerial Ownership Foreign Ownership	Mowner Fowner	Number of shares owned by executives and board members / Total shares. Percentage of shares held by foreign investors.
Control Variables	Firm size	SZ	The log of total assets
	Leverage	LEV	Debt/ Assets
	Audit Quality	Big4	A Dummy variable takes (1) if the firm is audited by Big 4 and (0) otherwise
	Age	Liq	Number of years since the firm's legal incorporation.
	Profitability	ROA	Net Income / Total Assets.

4.6. Research models

To investigate the proposed hypotheses, we use a hierarchical panel data regression technique. Model (1) evaluates the direct impact of the Digital

Transformation Index (DTI) on financial health, as measured by (Opliab). To examine corporate governance's crucial impact, Model 2 offers interaction terms between DTI and ownership structures (Mowner and Fowner).

1. The Direct Effect Model (Base Model)

This model tests whether Digital Transformation (DT) significantly drives Operational Liabilities (Opliab), while controlling for firm-specific characteristics.

$$FFH_{it} = \beta_0 + \beta_1 DT_{it} + \beta_2 Mown_{it} + \beta_3 Fown_{it} + \beta_4 SZ_{it} + \beta_5 Lev_{it} + \beta_6 Age_{it} + \beta_7 Big4_{it} + \beta_8 ROA_{it} + \varepsilon_{it} \quad (1)$$

2. The Moderating Effect Model (Interaction Model)

This is the core of your study. It tests how different ownership types (Managerial and Foreign) "amplify" or "catalyze" the signal of Digital Transformation.

$$FFH_{it} = \beta_0 + \beta_1 DT_{it} + \beta_2 DT * Mown_{it} + \beta_3 SZ_{it} + \beta_4 Lev_{it} + \beta_5 Age_{it} + \beta_6 Big4_{it} + \beta_7 ROA_{it} + \varepsilon_{it} \quad (2)$$

$$FFH_{it} = \beta_0 + \beta_1 DT_{it} + \beta_2 DT * Fown_{it} + \beta_3 SZ_{it} + \beta_4 Lev_{it} + \beta_5 Age_{it} + \beta_6 Big4_{it} + \beta_7 ROA_{it} + \varepsilon_{it} \quad (3)$$

where: *FFH* represents financial health of firm (1) at the year (*t*), *DT* is the digital transformation, *SZ* is firm size, *age* is firm age, *LEV* is the leverage, *ROE* is return on equity, *Big4* is audit quality, *Mown* is managerial ownership, *Fown* Foreign ownership, *DT*Fown* is interaction variables to test the moderating role of *Fown*, *DT*Mown* is interaction variables to test the moderating role of *Mown*.

4.7. Research Technique

Initially, the study employs the Ordinary Least Squares (OLS) estimation to investigate the link between Digital Transformation and financial health. However, diagnostic testing found severe economic problems in panel data. The Breusch-Pagan/Cook-Weisberg test identified heteroscedasticity (Prob > chi-square = 0.000), while the Wooldridge test proved the presence of first-order serial correlation (autocorrelation) (Prob > F = 0.000), among the 305 firm-year observations.

To solve problems associated with OLS assumptions, this study adopts the Panel Corrected Standard Errors (PCSE) estimate technique established by Beck and Katz (1995). The PCSE method is most effective for "Longitudinal" or "Cross-sectional Time-series" data, when the number of units (61 firms) is relatively small in comparison to the complexity of errors. Compared to ordinary OLS, the PCSE technique provides more accurate and conservative standard errors by effectively neutralizing the bias caused by immediately

apparent correlation and heteroscedasticity across Saudi non-financial firms. In addition, we employ the endogeneity test to analyze the endogeneity problem in our models, and the results show that there are no endogeneity problems in any of the models.

5. DATA ANALYSIS AND RESULTS

5.1. Descriptive Analysis

Table (4) show the result of the descriptive analysis of variables used in the study. The results indicate that the minimum and maximum level of DT vary from 16% to 91% with a mean of 49%. This means that the level of digital transformation among the Saudi firms in the sample falls within a moderate range. The operating cash flow cover on average 47% of total liabilities. Managerial ownership exists in 6.2% of the sample observation Regarding control variables, the results show that the average of ROA in Saudi firms is 4.4%. The total debt represents on average 21% of total assets. The Saudi firms age ranges from 8 to 74 years., also foreign ownership exists in 4.3% of the sample observation. The average firm size and Big4 are 8.93 and 44% respectively.

Table 4: Descriptive Statistics.

Variables	N	Min	Max	Mean	Std. Dev
DT	305	0.16	0.91	0.49	0.21
Oplia	305	-0.73	1.57	0.47	0.48
Mown	305	0	0.61	0.062	0.075
Fown	305	0	0.16	0.043	0.028
SZ	305	4.96	10.52	8.93	1.21
Lev	305	.002	0.91	0.21	0.26
Big4	305	0	1	0.44	0.49
Age	305	8	74	35.35	16.39
ROA	305	-0.74	0.59	0.044	0.09

5.2. Correlation Matrix

Table (5) show correlation between variables to

test the strength and the directions of the relationships, additionally the Variance Inflation Factor (VIF) test to report multi-collinearity issues between the independent variables. the correlation matrix shows significant positive associations between the dependent variable (Opliab) and key

predictors such as DT, Fown, SZ, age, and ROA. Also, Lev is negatively associated with Opliab. Furthermore, The VIF values for all predictors are well below the conservative threshold of 10, with the highest value being 2.75 for firm age, indicating the absence of multi-collinearity issues.

Table 5: Correlation Matrix.

	Opliab	DT	Mowner	Fowner	size	lev	roa	age	Big4	VIF
opliab	1									-
DT	0.287***	1								2.59
Mown	0.086	-0.084	1							1.18
Fown	0.246***	0.310***	0.261***	1						1.53
SZ	0.583***	-0.129**	0.115**	0.087	1					2.50
Lev	-0.377***	0.347***	0.132**	0.227***	-0.565***	1				1.93
ROA	0.497***	0.408***	0.112**	0.478***	0.242***	0.004	1			1.63
age	0.557***	0.582***	-0.062	0.152***	0.427***	-0.068	0.395***	1.000		2.75
Big4	0.239***	0.456***	0.045	0.261***	0.245***	0.107**	0.397***	0.550***	1.	1.62

5.3. Regression results and Testing Hypotheses

5.3.1. DT and Financial health

Using the PCSE approach, the results in table (6) demonstrate that digital transformation (DT) has a positive effect on firm financial health (cash flow performance). This indicates that Digital Transformation (DT) is a crucial driver of company financial health. According to Resource-Based View (RBV), this finding means that investments in digital technology improve internal operations and increase cash flow efficiency. This finding is consistent with Abouelela et al. (2025); Schiavi et al. (2024); Hong et al. (2023); and Ren et al. (2024). Liu et al. (2023).

Furthermore, Managerial Ownership (Mowner)

has a positive relationship with cash flow performance (Opliab), showing that managers are more driven to maximize cash flows when they have a personal investment in the company. Similarly, Foreign Ownership (Fowner) has the greatest influence, showing that foreign investors are providing better monitoring and technological abilities that greatly enhances operating cash flow performance (Opliab).

In terms of control variables, firm size, age, and ROA have significant positive coefficients, whereas leverage and Big 4 auditing have a significant negative impact on the ratio. Overall, the model has strong reliability and explanatory power, with an R-squared of 0.715, indicating that it correctly explains 71.5% of variations in cash flow performance.

Table 6: The effect of DT on FFH using PCSE.

Opliab	Coef	Std. Err	Z	P-value
DT	.42	.17	2.46	0.014**
Mowner	.71	.22	3.19	0.001***
Fowner	3.14	.60	5.21	0.000***
Size	.03	.01	1.65	0.098*
Lev	-.18	.11	-1.68	0.094*
Age	.003	.001	3.36	0.001***
Roa	.74	.31	2.34	0.019**
Big4	-.13	.03	-3.92	0.000***
Cons	51.68	15.41	3.35	0.001
Firm- effect	Yes			
Year- effect	Yes			
R2	0.71			
Prob	0.000			
Notes: *** **, and * represent significance at the 1%, 5%, and 10% levels, respectively				

5.3.2. Managerial ownership, DT, and Financial health

Table (7) show the regression results of interaction variable DT×Mowner. Our results show that the interaction variable DT×Mowner has a positive and significant coefficient. This finding confirms that the positive relation between DT and financial health (opliab) is supported by managerial ownership. This result is consistent with agency theory. This suggest that greater managerial ownership encourages firms to use digital tools to boost transparency, improve financial health, and reduce agency costs. This result is consistent with the findings of Boshnak (2024a) and Safitri and Wulanditya (2017). According to Signalling Theory, Mowner act as a signal enhancer:

when managers own equity, managers indicate to the market that they are personally invested to the success of digital initiatives. The findings suggest that DT serves as a main indicator of a firm's digitalisation and future readiness. . However, this signal is significantly more credible and stability to external stakeholders when "validated" by high levels of managerial ownership.

Our results for the control variables demonstrate that Size, Age, and ROA are all positive and significant, supporting Institutional Theory. This shows that larger, older, and more profitable firms face higher pressure to commit with international institutional rules in order to sustain global legitimacy and financial stability. Also, the data show that Big4 is negative and significantly associated with financial health (Opliab).

Table 7: The effect of Mowner on the relation between DT and FFH.

Opliab	Coef	Std. Err	Z	P-value
DT	0.44	0.16	2.79	0.005*
DT×Mowner	1.45	0.58	2.47	0.014
Size	0.06	0.02	2.80	0.005*
Lev	-0.12	0.12	-1.00	0.318
Age	0.003	0.001	2.54	0.011
Roa	1.16	0.32	3.58	0.000*
Big4	-0.13	0.03	-3.52	0.000*
Cons	47.08	16.63	2.83	0.005
Firm- effect	Yes			
Year- effect	Yes			
R2	0.68			
Prob	0.000			

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively

5.3.3. Foreign ownership, DT, and financial health

Table (8) displays the regression findings for the interaction variable DT×Fowner. Our findings suggest that foreign ownership has a positive impact on the relationship between DT and operating cash flow performance (Operliab). This suggests that the positive association between DT and financial health (Operliab) is significantly stronger in firms with more foreign ownership. The interaction effect DT×Fowner is consistent with Agency Theory. In an international environment, foreign investors often serve as effective monitors. Their presence reduces the "agency problem" by requiring more transparency and financial stability.

According to Signaling Theory, companies with significant foreign investment use their strategic decisions (DT) to indicate quality to the global market. The large coefficient of the interaction term indicates that foreign ownership supports the firm's behaviour by sending a stronger signal to international creditors and stakeholders about the firm's compliance to global standards.

Furthermore, the result of our model is confirmed by an R-squared of 68.5%, showing that the independent variables account for 68% of the variance in Opliab. control variables like as size, age, and ROA commonly show positive and significant influences, indicating that older and profitable firms are more sensitive to these strategic drivers. Big4 auditors have a negative and statistically significant association with Opliab.

Table 8: The effect of Fowner on the relation between DT and FFH.

Opliab	Coef	Std. Err	Z	P-value
DT	0.31	0.16	1.94	0.053

DT×Fowner	2.78	1.005	2.77	0.006
Size	0.06	0.01	3.58	0.000
Lev	-0.09	0.10	-0.92	0.355
Age	0.003	0.001	2.60	0.009
Roa	1.02	0.34	2.96	0.003
Big4	-0.12	0.03	-3.46	0.001
Cons	44.23	14.09	3.14	0.002
Firm- effect	Yes			
Year- effect	Yes			
R2	0.685			
Prob	0.000			
Notes: *** ** and * represent significance at the 1%, 5%, and 10% levels, respectively				

5.4. Robustness Analysis

To assess the reliability and consistency of the primary findings, a robustness analysis was performed using the ratio of operational cash flow to net income (Opincome) as an alternate proxy for the dependent variable. The robustness analysis results using PCSE method in Table (9) provide empirical evidence that Digital Transformation (DT) has a positive and statistically significant impact on financial health (Opincome). The DT coefficients in all three models are consistently significant and confirming the primary findings' stability.

The interaction variable, DT × Mowner, is positive

and significant ($Z = 2.10$, $p < 0.05$), indicating that managerial ownership strengthens the positive impact of digital transformation on financial health (Opincome). The interaction term DT × Fowner resulted in a non-significant coefficient. Furthermore, the control variables Leverage (Lev) and Return on Assets (ROA) have a strong positive relationship with financial health (Opincome). Also, Firm Size and Age don't appear to have any significance. Overall, this supplementary analysis demonstrates that digital transformation enhances the financial health of firms, and managerial ownership increases the positive effect of digital transformation on financial health of firms.

Table 9: The results of robustness Analysis.

Opincome	M1 Z	M2 Z	M3 Z
DT	2.83***	2.53**	3.40***
Mowner	2.36**	-	-
Fowner	1.26	-	-
DT×Mowner	-	2.10**	-
DT×Fowner	-	-	-1.46
Size	-0.08	0.20	0.71
Lev	3.25***	3.48***	3.95***
Age	0.55	0.42	0.22
Roa	2.97***	3.63***	3.42***
Big4	0.21	0.18	0.28
Cons	2.93	2.76	2.04
Firm- effect	Yes	Yes	Yes
Year- effect	Yes	Yes	Yes
R2	0.685	0.40	0.39
Prob	0.000	0.000	0.000
Notes: ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively			

6. CONCLUSION

This study investigates the relationship between Digital Transformation (DT) and financial health within the Saudi non-financial sector and how ownership structure affect on this relationship, we analyze a sample of 305 firm-year observations from

2019 to 2023 Using the Panel Corrected Standard Errors (PCSE) technique for testing our hypothesis. Our findings reveal that digital transformation significantly enhances financial health by improving operational cash flows performance. Our results also show the positive effect of DT on financial health is strengthened with higher managerial and foreign

ownership.

According to Resource Dependence Theory and transaction cost theory, this study is one of the first to show how the Saudi Vision 2030 digital goals link directly to firm financial health. In the context of Saudi Vision 2030, these results show that interaction digital innovation with strong corporate governance is essential for achieving sustainable economic performance. This study contributes to the literature by providing a specific Digital Transformation Index tailored to an emerging market context. It extends Signaling Theory by demonstrating that the effectiveness of technological signals is dependent on governance mechanisms.

The findings offer practical insights for Saudi policymakers and investors regarding the synergistic value of digital investments and institutional oversight. Our results would help firms, managers and investors to realize the role of DT in enhancing

operating cash flow performance, promoting financial stability. Ultimately, for stakeholders, the Digital Transformation Index (DTI) acts as a reliable signal of a firm's future readiness and its capacity to meet operational liabilities effectively. For policy makers and regulators, this study confirms that the digital goals of Saudi Vision 2030 are effectively improving firm performance, increasing innovation, and supporting the need for flexible governance rules. Despite these outcomes, the study has some limitations, including its focus on a particular emerging market and its small sample size. Future study might widen this geographical reach by conducting cross-country comparisons within the Gulf Cooperation Council (GCC) or using primary data to investigate the micro effects of specific technologies such as blockchain and AI.

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