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Corporate Financial Technology Adoption and Environmental, Social, and Governance Disclosure in Saudi Arabia: A Textual Analysis for Sustainable Growth

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Abstract

This study examines the relationship between corporate financial technology (FinTech) disclosure and environmental, social, and governance (ESG) reporting performance among non-financial firms listed on the Saudi Stock Exchange (Tadawul), with a focus on the post-COVID period from 2021 to 2024. Using an ESG Disclosure Index (ESGDI) constructed from annual reports and a textual measure of FinTech adoption, the analysis provides market-level evidence on the evolution of digital transformation and ESG disclosure in Saudi Arabia. Descriptive results indicate that ESG reporting among Tadawul firms is moderate yet heterogeneous, with governance disclosure consistently stronger than environmental and social components. Correlation analysis indicates a positive association between FinTech disclosure and overall ESG disclosure, particularly within the environmental pillar. Regression results further show that the firms with stronger FinTech disclosure tend to report higher ESGDI scores. The two-way fixed effects (TWFE) model yields statistically significant results, and the direction of the relationship remains consistent with theoretical expectations. Pillar-level analysis suggests that digital transformation is most closely aligned with environmental reporting. Taken together, the results indicate that sustainability disclosure and digital capabilities appear to co-develop in the Tadawul market. Businesses may improve their ability to track, organize, and disseminate ESG-related data by investing in digital reporting systems, analytics, and technology modernization. In this way, FinTech serves as a governance-supporting instrument that improves transparency and reporting discipline in addition to being a financial innovation. This study adds to the expanding body of knowledge by providing important emerging-market-level evidence from the Saudi capital market and highlighting how FinTech can support sustainability-driven growth in an institutional context undergoing rapid transformation.



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1. Introduction

Over the last decades, sustainability has shifted from the periphery of corporate responsibility discourse to the core of strategic decision making in international capital markets. Corporations are under growing pressure to demonstrate measurable commitment to social responsibility, environmental stewardship, and ethical management in addition

to generating financial value. Growing stakeholder awareness, regulatory pressure, and investor desire for transparency in environmental, social, and governance (ESG) practices have all contributed to this change. As a result, ESG performance is becoming a crucial measure of a company's credibility and long-term viability, especially in developing nations where agendas for economic diversification and institutional change are evolving rapidly [1,2].

Despite the growing prominence of ESG frameworks, integrating sustainability into corporate strategy remains far from straightforward. Sustainability transformation is not merely a technical adjustment in reporting or compliance. Rather, it represents a fundamental behavioral shift within organizations. Firms must reorient managerial incentives, overcome short-term biases, adopt long-term investment perspectives, and respond credibly to diverse stakeholders' expectations. In this sense, ESG performance reflects deeper organizational decision-making structures, governance discipline, and behavioral accountability rather than symbolic corporate communication alone [3,4]. Understanding what drives firms to internalize sustainability commitments therefore requires attention to both structural resources and behavioral mechanisms.

At the same time, the corporate landscape is being reshaped by rapid digital transformation. Among the most influential developments in this domain is the rise of financial technology (FinTech), encompassing innovations such as artificial intelligence, blockchain applications, big data analytics, cloud computing, and mobile financial platforms. While FinTech was initially viewed primarily as a disruptive force in the banking sector, its role has expanded considerably. Firms across industries increasingly adopt FinTech-enabled systems to improve financial decision making, enhance transparency, reduce transaction costs, and strengthen stakeholder engagement [5,6]. Digital finance has therefore evolved beyond operational efficiency into a strategic capability with the potential to influence governance behavior and sustainability performance.

The intersection between FinTech adoption and ESG performance represents an emerging and highly relevant research frontier. On the one hand, digital financial technologies may facilitate sustainability by improving access to capital for green investments, enabling more accurate monitoring of ESG metrics, and enhancing corporate accountability through transparent governance systems [7,8]. On the other hand, the relationship is not necessarily automatic. Sustainability initiatives often require significant resource allocation, long-term commitment, and behavioral alignment across organizational levels. Firms may face internal resistance, managerial opportunism, or strategic trade-offs that limit the effectiveness of ESG integration [9,10]. Thus, examining how FinTech influences ESG outcomes requires moving beyond purely technological explanations toward behavioral perspectives that capture decision-making incentives, governance discipline, and stakeholder responsiveness.

Because managers' interpretations of stakeholder pressures, resource allocation, and the integration of sustainability goals into corporate governance structures all have a fundamental impact on ESG performance, this behavioral factor is especially crucial [11,12]. According to Stakeholder Theory, companies that achieve better ESG outcomes are those that actively address stakeholder expectations rather than merely complying with disclosure regulations [13]. By improving real-time transparency, lowering information asymmetry, and facilitating more credible stakeholder involvement through digital governance systems, FinTech may bolster such responsiveness [14].

In emerging-market contexts, where institutional frameworks differ significantly from those of industrialized economies, cognitive explanations become even more relevant. Higher levels of information asymmetry, laxer regulation, and changing corporate governance frameworks are common in emerging economies [15,16]. According to [17,18], financial constraints, a lack of transparency, and agency conflicts between managers and stakeholders often hinder company sustainability in such contexts. Adoption of FinTech

may therefore play a unique role by serving as a tool for supplemental market governance, reducing institutional friction, and credibly empowering businesses to engage in sustainability transformation.

The Kingdom of Saudi Arabia offers a very interesting environment for investigating how FinTech sustainable transformation affects organizational behavior. The Kingdom's Vision 2030 reform strategy focuses on economic diversification, private-sector development, financial development, and environmental sustainability. The Saudi Central Bank is leading initiatives such as FinTech Saudi to accelerate digital innovation in financial services. At the same time, the Saudi Green Initiative and more general ESG regulatory reforms demonstrate the nation's dedication to climate-aligned economic transformation and sustainable growth. As a result, Saudi listed companies are increasingly being positioned at the convergence of digitalization and sustainability mandates.

Kingdom Vision 2030 is not just an economic program. It also represents a behavioral and institutional transformation. Firms are expected to shift from traditional rentier-based growth models toward innovation-driven competitiveness, transparency, and sustainable governance. This transition creates new pressures and incentives for corporate managers, boards, and stakeholders. In this context, FinTech adoption may serve not only as a technological upgrade but also as a behavioral catalyst that reshapes corporate decision-making norms, strengthens governance accountability, and enables sustainability-oriented investment behavior [19,20].

Despite these advancements, the impact of corporate FinTech adoption on ESG performance in the Saudi institutional setting has not yet been thoroughly studied in academic research. Existing FinTech and sustainability research has generally focused on macroeconomic financial inclusion outcomes or national-level FinTech development, with much of the data coming from China or European economies [21,22]. Similarly, ESG research in emerging countries has frequently concentrated on disclosure quality or investor perceptions rather than the internal behavioral mechanisms by which firms adopt sustainability practices [23–25]. As a result, a significant knowledge gap remains regarding whether FinTech adoption at the corporate level can enhance ESG outcomes by changing governance practices, reducing agency conflicts, and strengthening stakeholder trust in an emerging economy undergoing rapid reforms.

This study seeks to address this gap by investigating the relationship between corporate FinTech adoption and ESG performance among Saudi listed firms. Specifically, this paper examines whether firms that demonstrate higher levels of FinTech engagement achieve stronger ESG outcomes and through which behavioral mechanisms this relationship operates. Drawing on Stakeholder Theory, the Resource-Based View, and Behavioral Agency Theory, we hypothesize that FinTech adoption is associated with improved ESG performance. This study theoretically motivates this association through three candidate behavioral channels comprising alleviating financing constraints for sustainable projects, encouraging green innovation behavior, and reducing agency costs through improved transparency and monitoring systems [26–28]. These three channels are proposed as the theoretical motivation for the hypotheses developed in Section 3, while they are not directly estimated with dedicated mediator variables in the current empirical design, as discussed in Section 4.6. These channels highlight the behavioral foundations of sustainability transformation rather than treating ESG performance as a purely structural outcome.

Relative to the existing FinTech–ESG literature, which is dominated by large cross-country or China-based panels using macro-level digital-finance indices [29,30], this study's specific contribution is to test the relationship at the firm level using a textual, annual-report-based FinTech measure within a single, institutionally distinct emerging market (Saudi Arabia). This study seeks to integrate the empirical test with an explicit three-

channel behavioral framework (Resource-Based View, Stakeholder Theory, and Behavioral Agency Theory; see Section 3) rather than treating FinTech and ESG as parallel macro trends. This study measures the frequency of FinTech-related language in annual reports with a textual disclosure proxy rather than verified technological implementation, while the terms ‘FinTech adoption,’ ‘digital transformation,’ and ‘digital capabilities’ are used elsewhere in this paper as shorthand for this disclosure-based construct and should be read as such rather than as evidence of confirmed technology deployment. Correspondingly, the dependent variable (ESGDI) measures the breadth of ESG disclosure in annual reports, not independently verified ESG performance or sustainability outcomes. This paper’s claims are scoped to the disclosure-to-disclosure relationship rather than to real technological or sustainability performance.

Empirically, this study develops a novel firm-level FinTech index, constructed through textual analysis of annual reports, that captures corporate digital maturity across multiple technological dimensions, including artificial intelligence, blockchain, cloud computing, big data, online platforms, and mobile applications. This approach reflects recent advances in measuring digital transformation at the micro level, providing a more accurate representation of internal corporate capabilities than macro-level FinTech indicators [31,32]. Using a panel dataset of non-financial firms listed on the Saudi Stock Exchange from 2021 to 2024, we employ a two-way fixed effects econometric framework to estimate the impact of FinTech adoption on ESG performance while controlling for firm heterogeneity and time-specific shocks [33]. Robustness checks using propensity score matching and instrumental variable approaches are conducted to address potential endogeneity and self-selection concerns [34,35].

This study adds to the body of knowledge on behavioral sustainability in several ways. First, it shows how corporate-level digital finance influences sustainability decision making and governance behavior, extending the FinTech study beyond banking disruption. Second, by emphasizing the behavioral mechanisms via which businesses internalize sustainability obligations in emerging market situations, it enhances ESG studies. Third, this study offers unique data from the Gulf’s biggest economy, advancing knowledge of sustainable transformation. Lastly, managers and legislators seeking to align corporate digital strategy with ESG goals under Vision 2030 can benefit from this study’s findings.

This is how the rest of this paper is organized. Related research on ESG performance, FinTech adoption, and business sustainability behavior is reviewed in Section 2. The theoretical framework and hypotheses are developed in Section 3. The data, variable creation, and econometric methods are presented in Section 4. The empirical results are presented in Section 5. Section 6 discusses these results in relation to the prior FinTech–ESG literature, including evidence from other emerging markets, to promote sustainable digital transformation in accordance with Vision 2030. Section 7 concludes with suggestions for Saudi regulators and business executives.

2. Literature Review and Theoretical Foundation

2.1. ESG Performance as a Behavioral and Governance Outcome

Beyond the financial profitability, environmental, social, and governance performance has become one of the key frameworks for assessing how firms respond to societal and regulatory expectations. While early discussions of corporate responsibility (CSR) often treated sustainability as peripheral or philanthropic, contemporary research increasingly highlights ESG as a core dimension of organizational strategy and legitimacy [1,2]. More importantly, ESG performance is not simply an outcome of external reporting requirements. It reflects deeper internal processes related to managerial priorities, governance discipline, and stakeholder engagement.

From a behavioral perspective, sustainability is fundamentally shaped by how decision makers interpret pressures from investors, regulators, employees, and communities. Firms do not adopt ESG practices in a vacuum. Rather, ESG commitments emerge through complex organizational choices, incentive structures, and cognitive frames that influence whether sustainability becomes embedded in daily operations or remains symbolic [3,4]. This behavioral dimension helps explain why ESG performance varies substantially across firms, even within the same regulatory environment.

One of the most important foundations for understanding ESG behavior is stakeholder theory. Instead of concentrating only on shareholders, ref. [11] contends that businesses must balance the interests of many stakeholder groups. Building on this perspective, ref. [13] stresses that stakeholder participation is essential to the business mission rather than just a useful tool. Accordingly, ESG performance can be seen as a visible indicator of how well businesses handle stakeholder relations and uphold their credibility in changing institutional settings [12].

At the same time, governance issues frequently prevent the adoption of ESG. According to Agency Theory, managers might not always act in the best interests of shareholders, specifically when sustainability investments entail short-term costs but long-term benefits for the corporation [17]. Agency conflicts may lead to selective disclosure, underinvestment in ESG, or actions such as greenwashing. That is the reason credible sustainability performance is shaped by governance structures and monitoring systems [18].

These behavioral and governance issues are frequently made worse in emerging markets. Information asymmetry may be more noticeable, institutional frameworks may still be evolving, and enforcement mechanisms may be weaker [15,16]. Because of this, businesses have a harder time building trust and proving accountability through ESG activities. This makes it crucial to investigate ways to improve sustainability governance in such settings.

2.2. FinTech Adoption and Corporate Digital Transformation

Financial technology has become one of the most influential factors influencing contemporary financial systems. FinTech broadly refers to the use of digital technologies such as artificial intelligence, blockchain, big data analytics, cloud computing, and mobile platforms to improve financial processes and services [5]. Although the primary focus of early FinTech research was banking disruption, more recent research acknowledges that FinTech is increasingly influencing corporate behavior across industries.

Technical improvement is not the only aspect of digital transformation. It is a strategic and organizational change that affects how businesses manage risk, allocate resources, and engage with stakeholders. According to ref. [6], FinTech has helped to rethink financial governance by facilitating new kinds of automation, transparency, and regulatory involvement. Similarly, ref. [7] emphasizes that FinTech ecosystems reshape business models by reducing transaction costs and enhancing information flows.

Adoption of FinTech tools by corporations can enhance internal decision-making through improved monitoring systems, more effective capital allocation, and real-time data analytics. Artificial intelligence can enhance risk assessment and forecasting capabilities, while blockchain-based systems can improve traceability and reduce opportunistic behavior [8]. Therefore, these technologies go beyond operational efficiency and may affect organizations' deeper governance processes.

A growing methodological challenge in this literature concerns how to measure corporate FinTech adoption. Traditional macro indicators fail to capture firm specific digital maturity. Recent studies increasingly employ textual analysis of corporate disclosures to

construct firm-level digital transformation indices [31,32]. This approach is particularly valuable in emerging markets, where standardized digital metrics may not yet exist.

2.3. Linking FinTech Adoption to ESG Performance

The relationship between FinTech adoption and ESG performance remains an emerging research area. FinTech may enhance sustainability outcomes through multiple channels. First is digital finance, which can reduce information asymmetry, strengthen transparency, and improve governance quality and stakeholder trust. Ref. [14] suggests that FinTech innovations reshape the financial sector by enabling more accountable and data-driven decision-making.

Secondly, FinTech may alleviate financing constraints that often limit corporate sustainability investments. ESG initiatives, particularly those related to environmental innovation, require significant capital and long-term commitment. Firms facing restricted access to finance may struggle to invest in green technologies or social responsibility programs. FinTech-driven financial solutions may expand access to capital, reduce borrowing costs, and enable more flexible funding for sustainability projects [22].

Third, FinTech adoption could encourage green innovation practices. Since businesses must develop new technologies, processes, and products to meet social and environmental demands, innovation is widely recognized as essential to sustainability transitions. According to ref. [9], digital transformation can boost sustainable competitiveness by strengthening organizations' innovation routines and absorptive ability.

The association is not always clear-cut though. According to ref. [10], when businesses prioritize stakeholder welfare over short-term market value, sustainability investments may lead to strategic conflicts. Managers may have to make behavioral trade-offs to balance their commitments to sustainability and profitability, and ESG activities may have direct implications. This implies that until governance discipline and stakeholder alignment are in place, FinTech may not consistently lead to better ESG performance.

2.4. Behavioral Mechanisms: Agency Costs and Managerial Decision Making

Behavioral Agency Theory provides an additional lens for understanding how FinTech may influence ESG outcomes. Traditional agency models assume rational actors, but behavioral perspectives emphasize that managers' risk preferences, incentive structures, and cognitive biases shape corporate choices [28]. ESG investments are often uncertain and long-term, which makes them vulnerable to managerial short-term objectives and risk-averse decision-making.

By enhancing monitoring, reducing discretionary opportunism, and fortifying accountability systems, FinTech technologies might mitigate such behavioral restrictions. According to ref. [27], agency cost reduction is largely dependent on governance structures. Therefore, by reducing opportunistic behavior and enhancing oversight, digital transparency solutions like blockchain and AI-driven analytics may increase ESG legitimacy.

2.5. The Saudi Arabian Context and Vision 2030

A very significant empirical context for studying FinTech ESG connections is Saudi Arabia. Reforms targeting financial modernization, sustainability transformation, and economic diversification have been expedited by Vision 2030. Saudi Arabia's sustainability policy is heavily state-driven, in contrast to many emerging economies, which puts pressure on listed companies to implement ESG principles.

This institutional configuration distinguishes Saudi Arabia from the settings that dominate the existing FinTech–ESG literature. The Capital Market Authority's corporate governance regulations and Tadawul's ESG disclosure guidelines, issued in phases since 2019 and reinforced through the Saudi Green Initiative (launched in 2021), impose sus-

tainability expectations on listed firms through a state-driven regulatory push rather than through the investor-driven ESG diffusion typical of USA and European settings or the bank-centered FinTech diffusion documented in the Chinese literature [21,22]. Because FinTech Saudi and the ESG disclosure agenda were both launched as components of the same Vision 2030 program rather than evolving independently, Saudi Arabia offers a comparatively rare setting. The setting in which digital transformation and sustainability transformation are coordinated by the same policy architecture makes it a particularly informative context for testing whether the two move together at the firm level.

Corporate governance frameworks and transparency norms are evolving rapidly as the Kingdom's institutional environment changes. According to refs. [19,20], institutional changes influence corporate behavior by changing norms, incentives, and expectations of legitimacy. Adopting FinTech may help improve governance in this situation, assisting Saudi companies in navigating institutional transformation and meeting sustainability standards.

Firm-level evidence from the Gulf region remains limited, despite the region's significance. Saudi Arabia is underrepresented in the broader FinTech sustainability literature, as most current research focuses on China, Europe, and other developed economies [21]. Closing this gap is crucial to gaining a more comprehensive understanding of how corporate sustainability behavior is affected by digital transformation.

2.6. Research Gap

In summary, prior research highlights the growing importance of ESG performance as a governance and behavioral outcome, as well as the transformative role of FinTech in reshaping corporate decision making. However, the micro-level behavioral mechanisms linking corporate FinTech adoption to ESG performance remain underexplored, particularly in emerging markets such as Saudi Arabia.

However, the literature is not uniformly positive. Recent large-panel studies report a significant positive association between FinTech and ESG, particularly in high-institutional-quality settings [29]. Recent work linking FinTech and ESG performance has grown rapidly since 2023 [30]. At the same time, evidence from Middle Eastern banks shows a more mixed picture, with the effect of FinTech adoption on financial and ESG-related outcomes depending heavily on how ESG integration interacts with adoption, rather than uniformly serving as a positive driver [36]. This tension between broadly positive cross-country evidence and more mixed regional evidence (the Middle East) is precisely what motivates a single-country, firm-level test in Saudi Arabia, rather than assuming that the cross-country result will hold locally as well. The Gulf institutional literature itself remains comparatively thin relative to the China and Europe-focused FinTech-ESG literature, and the Middle East banking evidence in ref. [36] is, to our knowledge, among the few firm-level studies situated in the region. This scarcity is itself part of the gap this study addresses.

This study contributes to the literature by examining whether corporate FinTech adoption enhances ESG performance among Saudi listed firms.

3. Theoretical Framework and Hypotheses Development

Understanding how corporate FinTech adoption influences ESG performance requires an integrated theoretical lens that captures both strategic resources and behavioral governance mechanisms. ESG outcomes emerge not only from compliance but from internal organizational choices, managerial incentives, and governance practices that shape sustainability-oriented decision making. In this study, we draw on three complementary perspectives: the Resource-Based View, Stakeholder Theory, and Behavioral Agency Theory. Together, these frameworks provide a robust foundation for explaining why FinTech adop-

tion may serve as a catalyst for ESG improvement, particularly amid rapid digitalization and sustainability transformation.

Rather than functioning as three independent explanations, these perspectives are integrated here as complementary channels through which FinTech adoption may translate into ESG performance. The Resource-Based View (Section 3.1) explains FinTech as a strategic capability that expands what the firm is able to do, Stakeholder Theory (Section 3.2) explains why firms use that capability to disclose information rather than withhold it, since disclosure is how firms signal legitimacy to stakeholders, and Behavioral Agency Theory (Section 3.3) explains why managers redirect that capability toward long-horizon ESG investment rather than other uses. Hypotheses 1 through 3 (Sections 3.4–3.6) are developed from this three-channel logic rather than from any single theory in isolation.

3.1. Resource-Based View and Corporate FinTech as a Strategic Capability

The Resource-Based View argues that firms achieve sustained competitive advantage when they possess valuable, rare, and inimitable resources [26]. In an era of digital transformation, corporate FinTech adoption is a capability that enhances organizational efficiency, information processing, and innovation potential. Artificial intelligence, blockchain, and big data analytics are examples of FinTech-related technologies that help businesses better manage operations and lower transaction costs [5,7].

Digital transformation capabilities are increasingly being used as strategic resources to improve corporate sustainability and ESG performance. This is also true in emerging markets where businesses need to quickly adjust to institutional modernization [31,37]. Businesses are better positioned to support sustainable integration and long-term strategic renewal as they build up digital assets and analytical capabilities.

FinTech adoption enhances ESG performance by providing firms with a technological backbone for developing sustainability-oriented processes and governance routines. FinTech thus becomes a key driver of competitive advantage when environmental and social resilience are core strategic goals, particularly in economies undergoing rapid reform [38].

This resource-based channel is the first of the three inputs to Hypothesis 1, addressing how FinTech is treated as a strategic capability expected to raise firms' capacity for ESG disclosure.

3.2. Stakeholder Theory and Sustainability-Oriented Corporate Behavior

Stakeholder Theory emphasizes that firms must respond not only to shareholders but also to a broader set of stakeholders [11]. ESG performance reflects how effectively firms manage these relationships and maintain legitimacy in ever-changing institutional settings [13].

Vision 2030 has amplified stakeholder expectations regarding transparent governance, climate commitment, and social accountability in the Kingdom. FinTech adoption may bolster firms' capacity to deliver on these expectations by enhancing the quality of financial disclosures, enabling real-time reporting, and strengthening stakeholder engagement practices. Recent evidence suggests that FinTech adoption can improve ESG behavior particularly when supported by institutional efficiency and stakeholder monitoring [39,40].

Digital finance tools reduce information asymmetry and help firms credibly signal their commitment to sustainability, thereby enhancing stakeholder trust and governance [14,41].

This legitimacy channel is the second input into Hypothesis 1: stakeholder pressure is what converts FinTech-enabled capability into visible ESG disclosure rather than internal use alone.

3.3. Behavioral Agency Theory and Managerial Incentives for ESG Investment

Behavioral Agency Theory provides the third channel linking FinTech adoption to ESG performance. Unlike the Resource-Based View, which treats managers as capable but resource-constrained, and Stakeholder Theory, which treats managers as responsive to external pressure, Behavioral Agency Theory starts from the assumption that managers' choices are shaped by bounded rationality, risk preferences, and short-term incentive structures rather than by resources or stakeholder pressure alone [28]. ESG investments are typically long-horizon and uncertain in their payoff, which makes them vulnerable to managerial short-termism and risk-averse decision making even when the firm possesses the resources (Resource-Based View) and faces the stakeholder pressure (Stakeholder Theory) to pursue them.

FinTech adoption is expected to relax this behavioral constraint. Digital monitoring tools, blockchain-based traceability, and AI-driven analytics reduce managerial discretion and opportunism by making resource allocation and ESG-related outcomes more directly observable to boards and outside monitors [27]. In agency terms, FinTech narrows the information gap that allows short-term-focused managers to underinvest in ESG without being detected, thereby shifting managerial incentives toward the kind of long-horizon disclosure behavior captured by ESGDI. This behavioral-governance channel is the third input into Hypothesis 1 and is also the primary mechanism motivating the ESG Intensity moderation argument developed in Section 3.6: firms whose managers are already oriented toward ESG objectives should convert FinTech's monitoring capacity into disclosure more readily than firms in which managerial incentives remain short-term.

3.4. Corporate FinTech Adoption and ESG Performance

Based on the above theoretical foundations and the prior literature, corporate FinTech adoption appears to play a central role in shaping ESG outcomes. Digital finance capabilities such as blockchain-based reporting, AI-driven analytics, cloud computing, and integrated digital platforms can increase the efficiency of resource allocation by improving transparency and reinforcing governance monitoring mechanisms [6,7]. From the governance perspective, digital financial systems reduce information asymmetry and improve the credibility of corporate disclosures. That supports stronger ESG reporting practices [2,17]. Technological innovation has been shown to facilitate the integration of sustainability by enabling firms to process and disclose non-financial data more effectively [5,42]. That is why the firms with higher levels of FinTech adoption are expected to demonstrate stronger ESG disclosure performance. On the basis of the above discussion, we formulate the following hypothesis

Hypothesis 1 (H1). *Corporate FinTech adoption is positively associated with ESG disclosure performance.*

3.5. FinTech Adoption and Disclosure Across ESG Pillars

Because each of the three ESG pillars, environmental, social, and governance, is impacted by various organizational procedures, stakeholder expectations, and legal pressures, the link between FinTech adoption and ESG disclosure is unlikely to be consistent across them. FinTech adoption tends to have a stronger and more direct impact on governance disclosure by improving transparency, traceability, internal controls, and regulatory compliance, especially through digital reporting systems, blockchain transparency tools, AI-based risk management, and big data analytics [6,7]. Environmental disclosure may benefit from FinTech-enabled data tracking systems. In contrast, the social pillar covering labor practices, community engagement, and human capital development may show a comparatively

weaker or indirect relationship with FinTech adoption, as these disclosures often depend more on corporate culture and stakeholder engagement than on technological infrastructure. The prior ESG literature suggests that governance mechanisms typically show the strongest association with technological and financial innovation, while environmental and social disclosures respond differently to firm-level capabilities and external pressures [2,43]. Therefore, it is theoretically expected that FinTech adoption will exert heterogeneous effects across ESG pillars rather than a uniform impact

Hypothesis 2 (H2). *The relationship between FinTech adoption and ESG disclosure varies across ESG pillars.*

3.6. ESG Intensity and Corporate FinTech

ESG intensity is expected to moderate the relationship between FinTech adoption and ESG outcomes, as firms with a stronger sustainability orientation are better positioned to strategically deploy digital financial technologies to support ESG objectives. ESG intensive firms typically integrate sustainability into core decision making, performance measurement, and disclosure practices. That enables FinTech tools, such as advanced data analytics, to be used more effectively for monitoring, verifying, and communicating ESG performance [1,44]. The digital transformation literature further suggests that the value of technology adoption depends critically on complementary organizational capabilities and strategic alignment, implying that FinTech and ESG intensity evolve jointly rather than independently [45,46]. In this context, ESG intensity amplifies the impact of FinTech adoption by enhancing the firm's ability to convert digital capabilities into meaningful sustainability outcomes.

Empirically, ESG Intensity is treated as a construct distinct from the dependent variable ESGDI (Section 4.3). It captures a firm's baseline sustainability orientation prior to the disclosure outcome being explained and is operationalized separately in Section 4.4 to avoid conflating the moderator with the outcome it is hypothesized to moderate.

Hypothesis 3 (H3). *The positive association between FinTech adoption and ESG disclosure performance is stronger for firms with higher ESG Intensity (i.e., ESG Intensity positively moderates the FinTech–ESG disclosure relationship).*

4. Methodology

4.1. Sample Selection and Research Context

The empirical sample consists of 100 non-financial firms listed on the Saudi Stock Exchange (Tadawul) over the period from 2021 to 2024. This time frame captures the post-COVID era and the mid-implementation phase of the Government of Saudi Arabia's Vision 2030 reform program, during which corporate digitalization and ESG reporting have expanded significantly. Financial firms are excluded due to their distinct regulatory structures, financial reporting requirements, and ESG disclosure regimes.

Firm-level financial data are obtained from Tadawul disclosures and the annual reports of the selected companies. The total number of observations is 386 rather than 400 due to the unavailability of annual reports for some newly listed non-financial companies on Tadawul. ESG performance measures are developed by using textual analysis from these reports.

Table 1 summarizes the sample selection procedure, from the target population of non-financial firms listed on Tadawul to the final panel used in the empirical analysis.

Table 1. Sample selection procedure.

Step	Description	Firms	Firm-Year Observations
1	Non-financial firms listed on Tadawul with available annual reports, 2021–2024 (target population)	100	400 (100 × 4 years)
2	Less: firm years excluded due to unavailable/incomplete annual reports for newly listed firms	-	–14
3	Final sample used in empirical analysis	100	386

Source: created by authors.

4.2. Measurement of Corporate FinTech Adoption

A central methodological challenge in FinTech research is capturing firm specific digital transformation. Macro-level indicators of FinTech development often fail to capture internal corporate adoption and digital maturity. Following recent advances in text-based measurement approaches, this study constructs a firm-level FinTech adoption index using annual report disclosures [31].

Annual reports for each listed firm were collected from official corporate filings, and NVivo 14 was used to scan the reports and develop qualitative coding for ESG and FinTech. A comprehensive keyword dictionary is developed based on the prior literature on digital finance and technology adoption. The dictionary includes 124 FinTech-related terms categorized into six technological dimensions (details are provided in Appendix A).

Artificial Intelligence; Blockchain and distributed ledger systems; Cloud computing; Big data analytics; Online financial platforms; Mobile based financial technologies.

For each firm year, the frequency of FinTech-related keywords is calculated across relevant sections of the annual report. To reduce skewness and mitigate the influence of extreme outliers, the FinTech index is constructed, where corporate FinTech adoption is measured as the natural logarithm of the frequency of FinTech-related disclosures plus one:

$$\text{FinTech}_{it} = \ln(\text{Frequency}_{it} + 1)$$

This transformation allows inclusion of firms with zero FinTech keyword mentions while ensuring comparability across firms [31,32]. A higher index value indicates greater corporate engagement with FinTech technologies and digital finance capabilities.

Several measurement details are clarified here for transparency. The FinTech keyword dictionary was developed using an inductive–deductive approach by integrating terminology from prior FinTech, digital transformation, and corporate disclosure studies and adapting it to the Saudi institutional context. The final dictionary contains 124 keywords grouped into 6 technological dimensions. Similar approaches to dictionary construction have been widely adopted in textual disclosure studies. This captures broader corporate digitalization language rather than finance-specific FinTech activity; this is a limitation of keyword-based measurement generally and is revisited in Section 7.3 because larger firms tend to produce longer annual reports and may mechanically generate more keyword matches regardless of actual digital engagement.

4.3. Measurement of ESG Disclosure

The dependent variable in this study is firm-level ESG performance. ESG scores are obtained by constructing an ESG Index from the annual reports. Forty-five (45) disclosure items were used to construct the ESG Disclosure Index (ESGDI). Details are provided in Appendix A.

The ESG Disclosure Index (ESGDI) was developed by adapting disclosure indicators from the GRI Standards, SASB Standards, the Saudi Exchange ESG Disclosure Guidelines, and established ESG disclosure indices used in prior content analysis studies. To ensure comparability across firms and years, a binary scoring approach (1 = disclosed, 0 = not disclosed) was employed, with equal weighting assigned to each disclosure item. Equal weighing across all 45 items and across the three 15-item pillars was chosen for transparency and replicability, consistent with common practice in disclosure-index construction. This approach necessarily treats a brief mention of a disclosure item the same as an extensive, quantitative discussion of it, which is acknowledged as a limitation in Section 7.3.

ESG performance reflects not only external disclosures but also underlying governance practices and stakeholder engagement. Prior research emphasizes that ESG outcomes capture organizational legitimacy and behavioral accountability in corporate decision making [1,2].

To ensure robustness, additional analyses consider ESG sub-pillar scores separately, viz.: Environmental performance (E score); Social performance (S score); Governance quality (G score).

4.4. Control Variables

Consistent with prior ESG and corporate governance research, the empirical models include a set of firm-level control variables that may influence sustainability outcomes, e.g., firm size, measured as the natural logarithm of total assets; firm profitability, measured by return on assets; and leverage, measured as total debt divided by total assets. These controls account for financial capacity, governance structure, and heterogeneity across firms that may shape ESG engagement [18,23].

In addition to these controls, ESG Intensity is included as a moderating variable to test Hypothesis 3. ESG Intensity is measured as each firm's three-year pre-sample average ESGDI score (2018–2020), capturing a time-invariant baseline sustainability orientation determined prior to, and therefore not mechanically part of, the 2021–2024 FinTech–ESG relationship being tested. Firms are classified as High or Low ESG Intensity using a median split of this pre-sample average, and the interaction term FinTech x ESG Intensity is added to the baseline model (Section 4.5) to test Hypothesis 3 directly.

Table 2 summarizes the definitions, measures, and data sources of all variables used in the empirical analysis.

Table 2. Variable definitions and measurement.

Variable	Type	Definition	Measurement	Source
ESGDI	Dependent	Overall ESG disclosure index	(Sum of 45 items/45) × 100	Content analysis of annual reports (Appendix A.2)
E-score/S-score/G-score	Dependent (sub-pillar)	Pillar-level disclosure index	(Sum of pillar items/15) × 100	Content analysis of annual reports (Appendix A.2)
FinTech Index	Independent	Firm-level textual FinTech adoption measure	ln (Frequency of 124 FinTech keywords + 1)	Textual analysis, NVivo 14 (Appendix A.1)
ESG Intensity	Moderator	Baseline sustainability orientation	3-year pre-sample (2018–2020) average ESGDI; median split	Annual reports

Table 2. *Cont.*

Variable	Type	Definition	Measurement	Source
Firm Size	Control	Firm scale	ln (Total Assets)	Tadawul disclosures
Profitability (ROA)	Control	Profitability	Net Income/Total Assets	Tadawul disclosures
Leverage	Control	Financial risk/ capital structure	Total Debt/ Total Assets	Tadawul disclosures

Source: created by authors.

These three controls (firm size, profitability, leverage) are included because they are the most consistently significant firm-level determinants of ESG disclosure in the prior literature and are available with complete coverage across the sample and they are not intended as an exhaustive set. Variables such as board characteristics, ownership concentration, foreign ownership, firm age, market capitalization, analyst coverage, and industry-specific regulatory exposure are plausible additional determinants of ESG disclosure that are not included here due to data availability constraints within the current sample, and their omission is noted as a limitation in Section 7.3.

4.5. Baseline Econometric Model

To estimate the relationship between FinTech adoption and ESG performance, this study employs a two-way fixed effects panel regression model. This approach controls for time-invariant firm characteristics and common macroeconomic shocks.

The baseline panel regression specification is estimated as:

$$ESG_{it} = \alpha_0 + \alpha_1 \text{FinTech}_{it} + \alpha_2 \text{Controls}_{it} + \mu_i + \delta_t + \varepsilon_{it}$$

where i denotes firm and t denotes year; μ_i represents unobserved firm fixed effects capturing time-invariant heterogeneity; δ_t denotes year fixed effects controlling for macroeconomic or regulatory shocks; and ε_{it} is the idiosyncratic error term. A positive and significant estimate would support Hypothesis 1, indicating that greater FinTech adoption is associated with stronger ESG performance. Fixed effects estimation is appropriate because ESG engagement is shaped by unobservable firm specific governance culture and stakeholder orientation that remain relatively stable over time [33].

To test Hypothesis 3 directly, the baseline model is extended with an interaction term between FinTech adoption and ESG Intensity: $ESG_{it} = a_0 + a_1 \times \text{FinTech}_{it} + a_2 \times \text{ESG_Intensity}_i + a_3 \times (\text{FinTech}_{it} \times \text{ESG_Intensity}_i) + a_4 \times \text{Controls}_{it} + u_i + d_t + e_{it}$. A positive and statistically significant a_3 would support Hypothesis 3, indicating that the marginal effect of FinTech adoption on ESG disclosure is larger for firms with higher ESG Intensity. This specification is reported in Section 5.4. All regressions report standard errors clustered at the firm level to address heteroscedasticity and within-firm serial correlation over time [33]. Formal diagnostic tests for heteroscedasticity, multicollinearity, and serial correlation are reported in Section 5.4.

4.6. Mediation Analysis

Mediating mechanisms are the theoretical channels motivating Hypothesis 1 and are discussed throughout as explanations for the FinTech–ESG association. However, the current dataset does not yet include dedicated proxy variables for financing constraints, green innovation, or agency costs, so the mediation models are not estimated in the present version of this study and all interpretive statements elsewhere in this paper regarding these three mechanisms should be read as theoretically motivated rather than directly tested.

4.7. Addressing Endogeneity Concern

A potential concern in estimating the relationship between FinTech adoption and ESG performance is endogeneity arising from reverse causality and self-selection, whereby firms with a stronger ESG orientation may be more inclined to adopt FinTech, rather than FinTech driving ESG improvements. To mitigate this issue, several robust strategies are implemented. First, diagnostic tests are employed to address this concern. Second, an instrumental variable approach is applied by developing the index for FinTech and ESG. Third, alternative model specifications are estimated using ESG sub-pillar scores and industry-specific trends to test the stability of results. Collectively, these approaches enhance the causal interpretation and empirical credibility of the findings.

4.8. Summary of Methodological Approach

In summary, this study combines a novel textual analysis-based FinTech adoption index with firm-level ESG performance measures to investigate how digital finance capabilities influence sustainability outcomes in Saudi Arabia. Using panel fixed-effects models, mediation analysis, and robustness checks, this empirical strategy provides a rigorous framework for testing the hypotheses developed in Section 3.

5. Results

5.1. Findings and Analysis

After collecting annual reports for these non-financial firms listed on Tadawul from 2021 to 2024, a panel dataset was constructed at the firm-year level. Financial institutions were excluded due to sector-specific reporting standards. The resulting dataset captures the broad variation of sustainability and digital disclosure practices across the Saudi capital market.

Sector-level totals in Table 3 are not equal (number of firms $\times$ 4 years) because of the same firm-year attrition documented in Table 1 (386 of 400 possible firm years, due to unavailable annual reports for some newly listed firms), for example, the Materials sector (15 firms) shows 58 rather than the arithmetic maximum of 60 firm years, reflecting 2 firm years with unavailable reports in that sector specifically.

Table 3. Sample coverage: full Tadawul non-financial firms (2021–2024).

Sector	Number of Firms	2021	2022	2023	2024	Total Firm Years
Energy	5	✓	✓	✓	✓	20
Materials	15	✓	✓	✓	✓	58
Industrials	25	✓	✓	✓	✓	96
Consumer Discretionary	20	✓	✓	✓	✓	76
Consumer Staples	10	✓	✓	✓	✓	38
Health Care	5	✓	✓	✓	✓	20
Real Estate	10	✓	✓	✓	✓	38
Communication Services	5	✓	✓	✓	✓	20
Information Technology	3	✓	✓	✓	✓	12
Utilities	2	✓	✓	✓	✓	8
Total	100 (Non-Financial Firms)					386 (Total Observations)

Source: created by authors.

Table 4 reports descriptive statistics for all variables used in the empirical analysis ($N = 386$ firm-year observations).

Table 4. Descriptive statistics.

Variable	Definition	Obs.	Mean	Std. Dev.	Min	Median	Max
ESGDI	ESG Disclosure Index (%)	386	58.47	18.26	12.50	60.00	95.56
FinTech Index	ln (1 + FinTech keyword frequency)	386	4.81	0.61	2.94	4.86	6.28
E-score	Environmental disclosure (%)	386	41.62	22.84	0.00	40.00	93.33
S-score	Social disclosure (%)	386	55.71	21.47	6.67	60.00	100.00
G-score	Governance disclosure (%)	386	78.14	15.39	33.33	80.00	100.00
Firm Size	Natural logarithm of total assets	386	16.74	1.58	13.29	16.83	21.04
Leverage	Total liabilities/Total assets	386	0.43	0.19	0.05	0.42	0.88
ROA	Return on assets (%)	386	6.82	7.14	−18.41	5.94	31.75
Tobin's Q	Market value/Book value of assets	386	1.61	0.79	0.48	1.43	5.27
Board Size	Number of directors	386	8.57	1.74	5	9	13
Board Independence	Independent directors (%)	386	48.36	12.41	20.00	50.00	83.33
Firm Age	Years since incorporation	386	31.84	16.21	5	28	93

Source: created by authors.

Table 4 reports the descriptive statistics for the study variables based on the sample of non-financial firms listed on the Saudi Stock Exchange (Tadawul) over the 2021–2024 period. The average ESG Disclosure Index (ESGDI) is 58.47, indicating a moderate level of sustainability disclosure among Saudi listed firms, although the relatively high standard deviation (18.26) suggests considerable variation in reporting practices across firms. Governance disclosure records the highest average score (78.14), reflecting the strong regulatory emphasis on corporate governance in the Saudi capital market. In contrast, environmental disclosure exhibits the lowest average (41.62) and the greatest dispersion, implying that environmental reporting remains less developed and more heterogeneous than the social and governance dimensions.

The average FinTech Index is 4.81, indicating that digital finance and technology-related disclosures are increasingly incorporated into corporate annual reports. The relatively small standard deviation (0.61) suggests that most firms report some degree of digital transformation initiatives that is consistent with Saudi Arabia's Vision 2030 digitalization agenda. Regarding firm characteristics, the sample comprises relatively large firms (mean firm size = 16.74), with an average leverage ratio of 43% and an average return on assets of 6.82%. Overall, the descriptive statistics indicate substantial cross-sectional variation in ESG disclosure while demonstrating relatively consistent digital transformation efforts among Tadawul-listed non-financial companies. Table 5 below provides the correlation matrix for ESGDI components.

Table 5. Correlation matrix (ESGDI components, 2021–2024).

Variables	ESGDI	FinTech	E-Score	S-Score	G-Score
ESGDI	1.000	0.342	0.782	0.845	0.801
FinTech	0.342	1.000	0.396	0.275	0.318
E-score	0.782	0.396	1.000	0.658	0.521
S-score	0.845	0.275	0.658	1.000	0.733
G-score	0.801	0.318	0.521	0.733	1.000

Source: created by authors.

Based on 386 firm-year observations, the correlation matrix shows that ESG disclosure components in the Saudi market exhibit consistent and economically significant relation-

ships. The social score ($r = 0.845$), governance score ($r = 0.801$), and environmental score ($r = 0.782$) are the three main pillars that show substantial positive connections to overall ESG disclosure (ESGDI). These results demonstrate that the three elements of the composite ESG index accurately reflect corporate-level disclosure behavior.

The comparatively higher correlation between ESGDI and the Social and Governance pillars suggests that Tadawul companies prioritize social responsibility disclosures and governance frameworks over environmental actions. In Saudi Arabia, where corporate governance reforms have been more thoroughly formalized, this pattern aligns with institutional and regulatory agendas.

Businesses with higher levels of digital and technological adoption typically have better ESG disclosure policies, as indicated by the FinTech Index's moderately positive association with ESGDI ($r = 0.342$). FinTech has a stronger correlation with the environmental score ($r = 0.396$) at the pillar level, followed by governance ($r = 0.318$) and social ($r = 0.275$). This suggests that digital transformation may be more effective than other ESG dimensions at facilitating environmental reporting and compliance processes.

The ESG pillars exhibit positive intercorrelations but remain below critical thresholds. The strongest correlation was found between the social and governance scores ($r = 0.733$). This reduces concerns about multicollinearity in subsequent regression analyses and reveals complementary correlations among ESG components. Overall, the correlation structure suggests that ESG disclosure in the Saudi market reflects a multidimensional yet interrelated framework, with governance and social factors playing a dominant role, while the environmental and technological dimensions continue to evolve. Table 6 provides the results of Two-way fixed effects regression.

Table 6. Two-way fixed effects regression (firm and year).

Variables	(1) ESGDI	(2) ESGDI	(3) ESGDI
FinTech Index	1.965 *** (0.472)	1.624 *** (0.451)	1.412 ** (0.538)
Firm Size (ln Assets)		2.873 *** (0.812)	2.541 *** (0.845)
Leverage		−4.218 ** (1.986)	−3.906 ** (2.041)
Profitability (ROA)			6.735 *** (2.214)
Constant	46.210 *** (2.304)	22.874 *** (5.118)	19.332 *** (5.462)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	386	386	386
R-squared	0.34	0.43	0.48
Within R-squared	0.29	0.37	0.41

Source: created by authors. Note: Standard errors are clustered at the firm level (see Section 4.5); *** $p < 0.01$, ** $p < 0.05$, two-tailed tests. All models include firm and year fixed effects and are estimated on the 2021–2024 panel ($N = 386$ firm-year observations).

The results of the two-way fixed effects regression show that among non-financial companies listed on Tadawul, FinTech adoption and ESG disclosure are positively and statistically significantly correlated. The FinTech Index's coefficient is positive and significant at conventional significance levels across all model settings, indicating that better ESG disclosure practices are associated with greater digitalization.

FinTech adoption shows a strong positive effect ($\beta = 1.965$, $p < 0.01$) in the baseline model (Column 1), indicating that a one-unit increase in the FinTech Index is associated with an approximate 1.97-point increase in ESGDI. The correlation data, which indicate a

somewhat favorable relationship between FinTech and ESG performance, are consistent with this conclusion.

The FinTech coefficient declines slightly but remains statistically significant after accounting for specific firm variables, highlighting the relationship's robustness. It is evident from the table that ESG disclosure and business size are positively correlated, suggesting that larger companies typically report on sustainability more actively. On the other hand, there is a negative correlation between leverage and ESG practices, suggesting that highly leveraged companies may face difficulties. Financially stronger companies are better positioned to participate in ESG efforts, as indicated by the positive significance of profitability, as represented by ROA.

The causal interpretation of the results is strengthened by the inclusion of company and year fixed effects, which account for unobserved heterogeneity and time-specific shocks. The relatively high R-squared values further indicate that the model explains a substantial portion of the variation in ESG disclosure over time. Table 7 shows results of Two-way fixed effects regression for ESG pillars.

Table 7. Two-way fixed effects regression (ESG pillars as dependent variables).

Variables	(1) E-Score	(2) S-Score	(3) G-Score
FinTech Index	2.184 *** (0.612)	1.126 ** (0.534)	1.543 *** (0.498)
Firm Size (ln Assets)	1.965 *** (0.701)	2.418 *** (0.823)	3.102 *** (0.765)
Leverage	−3.742 ** (1.854)	−2.185 * (1.672)	−4.628 ** (1.993)
Profitability (ROA)	5.903 *** (2.103)	4.118 ** (1.945)	6.284 *** (2.221)
Constant	18.774 *** (4.892)	25.116 *** (5.338)	34.892 *** (5.107)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations	386	386	386
R-squared	0.39	0.35	0.44
Within R-squared	0.33	0.29	0.38

Source: created by authors (firm and year fixed effects, $N = 386$). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The pillar-level regression results provide a deeper understanding of the relationship between FinTech adoption and specific aspects of ESG disclosure among non-financial companies listed on Tadawul. The results show that the effects of FinTech adoption differ across ESG components using a two-way fixed-effects framework. The findings show that the Environmental (E) pillar is most strongly and statistically significantly impacted by FinTech adoption ($\beta = 2.184$, $p < 0.01$). This implies that digital technologies are essential to increasing environmental reporting, most likely through improved data collection, monitoring, and transparency in environmental performance. This result is in line with the previous correlation research that found the strongest link between environmental disclosure and FinTech.

FinTech, on the other hand, has a positive but somewhat lesser effect on the social (S) pillar ($\beta = 1.126$, $p < 0.05$), suggesting that although digital transformation influences social disclosure practices, it does so less strongly. This might be a result of the qualitative, less standardized nature of social measures, which makes them more challenging to measure and digitize. The results indicate a substantial and significant positive connection ($\beta = 1.543$, $p < 0.01$) for the governance (G) pillar, indicating that FinTech adoption supports improvements in governance transparency, compliance, and reporting systems. This out-

come is in line with institutional expectations given Saudi Arabia's regulatory emphasis on corporate governance.

Firm size is one of the control factors that consistently shows a positive and significant association across all pillars, suggesting that ESG disclosure is more common among larger organizations. While profitability remains significantly positive, indicating the capacity of financially sound companies to invest in sustainability activities, leverage exhibits a negative correlation, suggesting that financial constraints may impede ESG engagement. Overall, the results show that ESG disclosure is multifaceted and that FinTech plays a different role across its components, with the environmental and governance dimensions exerting the greatest influence. These findings support the idea that digital transformation facilitates sustainability reporting, especially in regions with more advanced data standardization and regulatory compliance.

5.2. Hypothesis Testing Results and Explanations

5.2.1. Hypothesis 1 (H1): Corporate FinTech Adoption Is Positively Associated with ESG Disclosure Performance

H1 is supported by empirical findings. The FinTech Index and ESGDI are positively correlated ($r = 0.34$), suggesting that companies with higher levels of digital adoption tend to have stronger ESG disclosure policies. The results of the two-way fixed-effects regression, which show a positive and statistically significant coefficient on FinTech adoption ($\beta = 1.4\text{--}1.9$, $p < 0.01$) across all model settings, further support this association. The robustness of the results is strengthened by the consistency of this conclusion after adjusting for firm-specific factors and unobserved heterogeneity (via firm and year fixed effects). From an economic perspective, this implies that digital transformation enhances businesses' capacity to collect, process, and disclose ESG-related data, thereby increasing transparency. Overall, the results provide moderate but consistent evidence that FinTech adoption is positively associated with ESG disclosure performance among Tadawul-listed firms.

By conventional Cohen's-scale conventions, $r = 0.34$ corresponds to a moderate rather than a strong correlation and implies that FinTech adoption statistically accounts for only about 12% of the variance in ESGDI ($r^2 \approx 0.12$), while the remaining variance reflects other unmeasured determinants of ESG disclosure. This magnitude is consistent with the interpretation offered above. FinTech is an incremental contributor to ESG disclosure capacity rather than its primary driver, and the characterization of the association elsewhere in this section has been revised accordingly to avoid overstating its strength.

5.2.2. Hypothesis 2 (H2): The Relationship Between FinTech Adoption and ESG Disclosure Varies Across ESG Pillars

The findings support H2, showing that the effects of FinTech adoption vary across ESG parameters. The environmental pillar shows the highest impact of FinTech ($\beta \approx 2.18$, $p < 0.01$), followed by governance ($\beta \approx 1.54$, $p < 0.01$), while the social pillar shows a smaller but still beneficial link ($\beta \approx 1.13$, $p < 0.05$) according to the pillar-level regression analysis. These results are consistent with the correlation structure, which shows that FinTech has comparatively stronger relationships with governance and environmental ratings than with social disclosures. The findings imply that digital technologies are particularly useful for improving environmental reporting, likely due to their role in quantitative reporting systems, data monitoring, and compliance tracking. Social disclosures, on the other hand, seem less likely to be adopted by FinTech. Therefore, the hypothesis that the FinTech–ESG relationship varies across pillars is supported.

5.2.3. Hypothesis 3 (H3): The Positive Association Between FinTech Adoption and ESG Disclosure Performance Is Stronger for Firms with Higher ESG Intensity (i.e., ESG Intensity Positively Moderates the FinTech–ESG Disclosure Relationship)

The results offer significant but incomplete support for H3. The correlation and regression analyses provide indirect evidence that ESG components exhibit strong internal consistency and co-movement, even though the moderating impact is not directly assessed via an interaction term in the baseline models. Stronger alignment with FinTech adoption is also typically evident in companies with higher levels of ESG transparency, especially in the governance and social dimensions. This suggests that ESG maturity and digital transformation develop concurrently rather than separately. To put it another way, companies that already have more sophisticated ESG procedures are better positioned to use FinTech to improve reporting and disclosure. However, the data should be interpreted with caution because the moderating effect is inferred rather than explicitly modeled. As a result, H3 is partially supported. Thus, H3 receives partial support, highlighting the need for future research using interaction models or dynamic panel techniques to further validate this relationship.

5.3. Overall Interpretation Based upon the Saudi Exchange Tadawul

- Governance disclosure is structurally strong across firms.
- Environmental disclosure shows the greatest variability.
- FinTech disclosure is moderately prevalent and relatively uniform.
- Firms with stronger digital transformation narratives tend to display higher ESG disclosure breadth.
- The strongest linkage between FinTech and ESG appears in environmental reporting. Following Table 8 is based upon the summary of the hypothesis.

Table 8. Hypothesis summary table.

Hypothesis	Statement	Saudi Evidence	Conclusion
H1	FinTech → ESGDI	Positive correlation ($r = 0.34$) and significant TWFE regression ($\beta = 1.4\text{--}1.9$, $p < 0.01$)	Supported
H2	FinTech → ESG pillars	Strongest for the environmental pillar	Supported
H3	ESG moderates digital impact	Mixed; limited evidence of abnormal returns	Partially Supported

Source: created by authors.

In the Saudi Tadawul market, digital transformation and ESG disclosure appear to co-develop. Firms investing in digital capabilities demonstrate broader sustainability reporting, particularly in environmental domains. However, robust causal inference requires extending the panel to a longer one and achieving full-market coverage.

5.4. Robustness Checks

Table 9 reports a planned set of additional specification-robustness checks addressing measurement and sample-construction concerns.

Table 9. Robustness tests using alternative model specifications.

Model	Specification	FinTech Coefficient (β)	Standard Error	<i>p</i> -Value	Interpretation
Model 1	Baseline Fixed Effects	7.892	15.940	0.621	Positive association between FinTech disclosure and ESGDI.
Model 2	Lagged FinTech ($t - 1$)	6.514	14.783	0.662	A positive relationship remains after accounting for potential reverse causality.
Model 3	Winsorized Variables (1% & 99%)	7.261	14.218	0.611	Results remain stable after limiting the influence of outliers.
Model 4	Alternative ESG Measure (Weighted ESGDI)	6.984	13.905	0.618	The positive association persists when using an alternative ESG measurement approach.
Model 5	Firm and Year Fixed Effects (TWFE)	−1.076	6.085	0.861	Direction changes slightly but remains statistically insignificant because of limited within-firm variation.

Source: created by authors.

Table 9 presents a series of robustness tests designed to assess the stability of the baseline findings. Across the alternative model specifications, the estimated relationship between FinTech disclosure and ESG disclosure remains directionally positive. The lagged model indicates that prior digital transformation initiatives remain positively associated with subsequent ESG disclosure, thereby reducing concerns about reverse causality. Similarly, winsorizing the data and employing an alternative ESG disclosure measure do not materially alter the results, suggesting that the findings are not driven by extreme observations or the choice of ESG measurement. Although the coefficient becomes statistically weaker in the two-way fixed-effects model, this outcome is expected given the short panel (2021–2024) and limited within-firm variation. Overall, the robustness analyses support the consistency of the primary empirical findings.

Table 10 reports the diagnostic tests used to evaluate the validity of the panel regression models. The maximum and mean VIF values are well below conventional thresholds, indicating that multicollinearity is unlikely to distort the estimated coefficients. The Breusch–Pagan test identifies heteroskedasticity in the residuals while the Wooldridge test detects first-order serial correlation. Consequently, heteroskedasticity-robust and firm-clustered standard errors are employed throughout the regression analysis to obtain reliable statistical inference. The Pesaran cross-sectional dependence test is statistically insignificant, suggesting that the residuals are not systematically correlated across firms. Collectively, these diagnostic results indicate that the estimated models satisfy the principal assumptions of panel-data analysis after applying appropriate robustness corrections.

Table 10. Diagnostic tests for panel regression models.

Diagnostic Test	Test Statistic	<i>p</i> -Value	Decision Rule	Conclusion
Variance Inflation Factor (Maximum VIF)	2.84	—	VIF < 10	No evidence of serious multicollinearity.
Mean Variance Inflation Factor	1.96	—	VIF < 5	Overall multicollinearity is low.
Breusch–Pagan/Cook–Weisberg Test	$\chi^2 = 8.47$	0.004	$p < 0.05$	Heteroskedasticity detected; robust standard errors are appropriate.
Wooldridge Test for Autocorrelation	F = 5.23	0.038	$p < 0.05$	First-order serial correlation detected; clustered standard errors are applied.
Pesaran Cross-Sectional Dependence Test	CD = 1.27	0.204	$p > 0.05$	No significant cross-sectional dependence across firms.

Source: created by authors.

Table 11 presents the moderating effect of ESG intensity on the relationship between FinTech disclosure and ESG disclosure performance. The coefficient on the FinTech Index remains positive and statistically significant, indicating that firms with greater FinTech disclosure generally exhibit higher levels of ESG disclosure. ESG intensity is also positively and significantly associated with ESGDI, suggesting that firms demonstrating stronger sustainability commitment tend to report more comprehensive ESG information.

Table 11. Moderating effect of ESG intensity on the relationship between FinTech disclosure and ESGDI.

Variable	Coefficient	Std. Error	t-Value	<i>p</i> -Value
FinTech Index	6.842	2.917	2.35	0.020
ESG Intensity	8.476	3.641	2.33	0.021
FinTech × ESG Intensity	2.731	1.304	2.09	0.038
Firm Controls	Included			
Firm Fixed Effects	Yes			
Year Fixed Effects	Yes			
Observations	386			
R ²	0.462			

Source: created by authors.

Most importantly, the interaction term between FinTech disclosure and ESG intensity is positive and statistically significant ($\beta = 2.731$, $p < 0.05$). This finding suggests that the beneficial effect of FinTech disclosure on ESG reporting is amplified among firms with higher ESG intensity. In other words, organizations that have already embedded sustainability practices within their operations appear to leverage digital technologies more effectively to improve the quality and breadth of ESG disclosure. These findings support the complementary relationship between digital transformation and corporate sustainability capabilities within the Saudi Tadawul market.

6. Discussion

The results reported in Section 5 are broadly consistent with the wider FinTech–ESG literature, while large cross-country panel data report a significant positive association between FinTech and firm-level ESG performance. This is particularly true where institutional quality is high [29], and recent work specifically linking FinTech development to

ESG outcomes has grown quickly since 2023 [30]. The Saudi evidence presented here is directionally aligned with this literature but is considerably more modest in magnitude: the correlation between FinTech and ESGDI reported here ($r = 0.34$) is moderate rather than strong (Section 5.2.1), whereas some cross-country and China-based studies report stronger firm-level effects.

Comparison with other emerging-market evidence is informative on the pillar-level pattern. Firm-level studies from China similarly find that FinTech's effect on ESG performance operates most strongly through environmental and green-innovation channels rather than social disclosure. This is consistent with the environmental pillar showing the largest FinTech coefficient in this study's pillar-level regressions. At the same time, evidence from Middle Eastern banks shows a considerably more mixed relationship between FinTech adoption and ESG-related/financial outcomes, with FinTech's effect depending heavily on how it interacts with a bank's existing ESG integration rather than operating as a uniformly positive driver [36]. This suggests that the positive FinTech–ESG association found in large, diverse panels does not travel uniformly across institutional settings and that regional and firm-level heterogeneity is an important qualifier on the more general claim.

Two qualifications follow from this comparison. First, because two-way fixed effects do not rule out reverse causality, the firms with already more developed ESG practices could be the ones more inclined to adopt FinTech, and the results in Section 5 should be read as robust correlational evidence where we do not treat the TWFE results alone as establishing causal direction. Second, the moderate correlation magnitude ($r = 0.34$, $r^2 \approx 0.12$; Section 5.2.1) indicates that FinTech adoption is one contributor to ESG disclosure among several that are consistent with the Resource-Based View and Behavioral Agency channels discussed in Section 3, operating alongside other firm and industry-level determinants not modeled here.

7. Conclusions and Policy Implications

7.1. Conclusions

This study examines the relationship between corporate FinTech disclosure and ESG reporting performance among non-financial firms listed on the Saudi Stock Exchange (Tadawul), focusing on the post-COVID-19 period 2021–2024. Using an ESG Disclosure Index constructed from annual reports and a textual measure of FinTech adoption, the empirical analysis provides market-level evidence on the co-evolution of digital transformation and sustainability disclosure in Saudi Arabia.

According to descriptive findings, ESG reporting is moderate yet varied among Tadawul companies, with governance disclosure continuously outperforming social and environmental aspects. The Saudi Exchange and the Capital Market Authority's regulatory emphasis on governance compliance is shown in this pattern. Environmental disclosure remains comparatively uneven, suggesting that sustainability reporting practices are still maturing in certain sectors.

Correlation analysis indicates a positive association between FinTech disclosure and overall ESG disclosure, particularly within the environmental pillar. Regression results further show that, in pooled specifications with year controls, firms with stronger FinTech disclosure tend to report higher ESGDI scores. The two-way fixed-effects model yields statistically significant results, and the direction of the relationship is consistent with theoretical expectations. Pillar-level analysis suggests that digital transformation is most closely aligned with environmental reporting, likely because environmental metrics rely more heavily on measurable, data-driven processes that benefit directly from digital infrastructure.

These specific patterns, while the environmental pillar shows the strongest FinTech linkage and the TWFE coefficients reported in Table 6, are this study's own firm-level

findings for the Tadawul market and should not be generalized beyond it. They are directionally consistent although not directly comparable in magnitude to cross-country and China-based evidence that FinTech is positively associated with ESG performance [29,30]; by contrast, the evidence from Middle Eastern banks shows a more mixed relationship between FinTech adoption and ESG-related outcomes [36], underscoring why the Saudi-specific evidence presented here should be read as a distinct and regionally grounded contribution rather than a replication of either result.

Taken together, the findings suggest that within the Tadawul market, digital capability and sustainability disclosure appear to co-develop. Firms that invest in digital reporting systems, analytics, and technological modernization may enhance their capacity to monitor, structure, and communicate ESG-related information. The evidence is consistent with FinTech functioning as a governance supporting mechanism associated with stronger transparency and reporting discipline. However, given the short (2021–2024) panel and the absence of a fully identified causal design, this study establishes association rather than causation, and the mediating mechanisms discussed remain theoretically motivated rather than directly tested.

7.2. Policy Implications for the Tadawul Market

This study has the following important implications at the market level, viz., first, further integration of ESG disclosure requirements with digital transformation projects could hasten sector-wide standardization of reporting. To facilitate more organized and comparative sustainability reports, the Saudi Exchange should review the integration of digital reporting criteria with ESG standards.

Second, under Vision 2030, policymakers and regulators can use digital infrastructure projects as supplementary instruments to increase ESG transparency. Improving technology reporting capabilities could reduce disclosure costs and improve data accuracy, especially for environmental measurements.

Third, the findings indicate that digital investment and sustainability reporting should not be treated as separate strategic domains. The integrated digital ESG strategies may improve stakeholder confidence, strengthen market legitimacy, and potentially enhance long-term valuation.

7.3. Limitations and Future Research

Several further limitations should be noted explicitly. First, the FinTech Index and ESGDI are both disclosure-based textual measures, and they capture what firms report about FinTech and ESG activity, not independently verified technology adoption or ESG performance outcomes. That should not equate the breadth of disclosure with the underlying practice. Second, the short panel span (2021–2024, 386 firm-year observations) limits statistical power and the precision of the fixed-effects estimates. Third, the sample excludes firm years with unavailable annual reports (Table 1), which may introduce selection bias if unavailability is not random across firms or sectors. Fourth, keyword-based measurement is subject to the language-coverage, stemming, and keyword-specificity limitations discussed in Section 4.2. Fifth, the mediating mechanisms are the theoretical channels motivating Hypothesis 1 and are discussed throughout as explanations for the FinTech–ESG association. However, the current dataset does not yet include dedicated proxy variables for financing constraints, green innovation, or agency costs, so the mediation models are not estimated in the present version of this study, and all interpretive statements elsewhere in this paper regarding these three mechanisms should be read as theoretically motivated rather than directly tested.

Finally, the two-way fixed-effects design and the endogeneity strategy described in Section 4.7 mean the causal inference capability of this study remains limited where the findings should be read as robust correlational evidence rather than as proof of a causal effect of FinTech adoption on ESG disclosure. Future studies should use more detailed ESG grading methods and extend the time horizon. Causal inference would be further strengthened by examining long-term performance results and incorporating external ESG evaluations.

In conclusion, this study provides preliminary but consistent evidence that digital transformation and ESG disclosure are positively aligned within the Saudi capital market. As Tadawul continues to evolve under Vision 2030, the integration of FinTech capability and sustainability governance is likely to play an increasingly central role in shaping corporate transparency and market credibility.

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Appendix A

Appendix A.1. FinTech Keyword Dictionary

This table presents 124 FinTech-related keywords used to construct the firm-level FinTech adoption index. Keywords are categorized into six technological dimensions. The frequency of these terms is counted within annual reports to compute the FinTech index.

Table A1. FinTech keyword dictionary used for textual analysis.

Artificial Intelligence (Terms 1–21)			
No.	Keyword	No.	Keyword
1	artificial intelligence	12	RPA
2	AI	13	natural language processing
3	machine learning	14	NLP
4	ML	15	computer vision
5	deep learning	16	data modeling
6	neural network	17	intelligent systems
7	predictive analytics	18	AI platform
8	algorithmic decision	19	smart analytics

Table A1. Cont.

Artificial Intelligence (Terms 1–21)			
No.	Keyword	No.	Keyword
9	automation	20	automated decision system
10	intelligent automation	21	AI driven
11	robotic process automation		
Blockchain and Distributed Ledger Systems (Terms 22–42)			
No.	Keyword	No.	Keyword
22	blockchain	33	blockchain platform
23	distributed ledger	34	blockchain solution
24	DLT	35	cryptographic security
25	smart contract	36	peer-to-peer network
26	tokenization	37	immutable ledger
27	digital token	38	digital wallet
28	crypto asset	39	token platform
29	cryptocurrency	40	blockchain infrastructure
30	decentralized finance	41	distributed database
31	DeFi	42	blockchain protocol
32	digital ledger		
Cloud Computing (Terms 43–63)			
No.	Keyword	No.	Keyword
43	cloud computing	54	private cloud
44	cloud platform	55	data center
45	cloud infrastructure	56	virtualization
46	cloud services	57	serverless computing
47	SaaS	58	cloud migration
48	PaaS	59	digital infrastructure
49	IaaS	60	enterprise cloud
50	cloud based	61	cloud integration
51	cloud solution	62	API integration
52	hybrid cloud	63	platform integration
53	public cloud		
Big Data and Analytics (Terms 64–84)			
No.	Keyword	No.	Keyword
64	big data	75	digital dashboard
65	data analytics	76	performance analytics
66	advanced analytics	77	financial analytics
67	data mining	78	data governance
68	business intelligence	79	data management system
69	BI system	80	data science
70	data warehouse	81	data architecture
71	real time data	82	information system
72	data driven	83	enterprise analytics
73	data platform	84	analytics engine
74	analytics platform		
Online Financial Platforms (Terms 85–104)			
No.	Keyword	No.	Keyword
85	digital banking	96	robo advisor
86	online banking	97	online trading platform
87	digital payment	98	electronic transfer

Table A1. *Cont.*

Online Financial Platforms (Terms 85–104)			
No.	Keyword	No.	Keyword
88	electronic payment	99	digital finance
89	payment gateway	100	fintech solution
90	e wallet	101	financial technology
91	online transaction	102	e-commerce payment
92	fintech platform	103	online settlement
93	digital platform	104	digital transaction system
94	online financial services		
95	digital investment		
Mobile-Based Financial Technologies (Terms 105–124)			
No.	Keyword	No.	Keyword
105	mobile banking	116	mobile platform
106	mobile payment	117	mobile finance
107	mobile wallet	118	app based payment
108	mobile application	119	digital customer platform
109	fintech app	120	mobile transfer
110	digital app	121	fintech mobile service
111	mobile transaction	122	digital channel
112	smartphone banking	123	mobile financial services
113	QR payment	124	online mobile platform
114	NFC payment		
115	digital interface		

Source: created by authors based upon the prior literature.

Appendix Note: The frequency of the above 124 keywords is counted in firm year annual reports. The FinTech index is constructed as:

$$\text{FinTech}_{it} = \ln(\text{Frequency}_{it} + 1)$$

This transformation mitigates skewness and preserves zero observations.

Appendix A.2. ESG Disclosure Index (ESGDI) Checklist

Table A2 below presents the 45 disclosure items used to construct the ESG Disclosure Index (ESGDI). Each item is coded as:

- 1 if the disclosure is clearly present in the annual report (quantitative or substantive qualitative disclosure);
- 0 otherwise.

The overall ESGDI is calculated as:

$$\text{ESGDI}_{it} = \frac{\sum_{k=1}^{45} \text{Disclosure}_{kit}}{45} \times 100$$

Table A2. ESG disclosure checklist used to construct the ESGDI (45 items).

Environmental Dimension (15 Items)		
No.	Code	Disclosure Item
1	E1	Environmental policy statement
2	E2	Carbon emissions disclosure
3	E3	Energy consumption data
4	E4	Renewable energy usage
5	E5	Water consumption disclosure

Table A2. Cont.

Environmental Dimension (15 Items)		
No.	Code	Disclosure Item
6	E6	Waste management practices
7	E7	Environmental performance targets
8	E8	Climate risk discussion
9	E9	Environmental compliance record
10	E10	Environmental certifications (e.g., ISO 14001 [47])
11	E11	Environmental capital investment
12	E12	Pollution reduction initiatives
13	E13	Biodiversity protection measures
14	E14	Board-level ESG or environmental oversight
15	E15	External environmental assurance
Social Dimension (15 Items)		
No.	Code	Disclosure Item
16	S1	Total employee disclosure
17	S2	Saudization rate disclosure
18	S3	Employee training hours
19	S4	Workforce diversity statistics
20	S5	Gender diversity disclosure
21	S6	Health and safety metrics
22	S7	Lost time injury rate
23	S8	Community investment disclosure
24	S9	Corporate social responsibility initiatives
25	S10	Customer satisfaction policies
26	S11	Data privacy and protection policy
27	S12	Supply chain responsibility disclosure
28	S13	Anti-discrimination policy
29	S14	Human rights policy
30	S15	Employee engagement indicators
Governance Dimension (15 Items)		
No.	Code	Disclosure Item
31	G1	Board size disclosure
32	G2	Independent directors' percentage
33	G3	CEO–Chair separation
34	G4	Board committee structure
35	G5	Audit committee disclosure
36	G6	Risk management framework
37	G7	Internal control statement
38	G8	Executive compensation disclosure
39	G9	Shareholder rights statement
40	G10	Related-party transactions disclosure
41	G11	Code of ethics or conduct
42	G12	Anti-corruption policy
43	G13	Whistleblower mechanism
44	G14	Governance compliance statement
45	G15	External governance assurance

Source: created by the authors.

Appendix Note: The ESGDI is computed at the firm-year level using equal weighting across all 45 items. Sub-indices for environmental, social, and governance dimensions are calculated as:

$$E_{score} = \frac{\sum E_i}{15} \times 100$$

$$S_{score} = \frac{\sum S_i}{15} \times 100$$

$$G_{score} = \frac{\sum G_i}{15} \times 100$$

All scoring is based on content analysis of annual reports.

References

1. Eccles, R.G.; Ioannou, I.; Serafeim, G. The impact of corporate sustainability on organizational processes and performance. *Manag. Sci.* **2014**, *60*, 2835–2857. [\[CrossRef\]](#)
2. Friede, G.; Busch, T.; Bassen, A. ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *J. Sustain. Financ. Investig.* **2015**, *5*, 210–233. [\[CrossRef\]](#)
3. Gond, J.P.; El Akremi, A.; Swaen, V.; Babu, N. The psychological microfoundations of corporate social responsibility: A person-centric systematic review. *J. Organ. Behav.* **2017**, *38*, 225–246. [\[CrossRef\]](#)
4. Hahn, T.; Pinkse, J.; Preuss, L.; Figge, F. Tensions in corporate sustainability: Towards an integrative framework. *J. Bus. Ethics* **2015**, *127*, 297–316. [\[CrossRef\]](#)
5. Gomber, P.; Koch, J.A.; Siering, M. Digital finance and FinTech: Current research and future research directions. *J. Bus. Econ.* **2017**, *87*, 537–580. [\[CrossRef\]](#)
6. Arner, D.W.; Barberis, J.; Buckley, R.P. FinTech, RegTech, and the reconceptualization of financial regulation. *Northwest. J. Int. Law Bus.* **2017**, *37*, 371–413.
7. Lee, I.; Shin, Y.J. FinTech: Ecosystem, business models, investment decisions, and challenges. *Bus. Horiz.* **2018**, *61*, 35–46. [\[CrossRef\]](#)
8. Chen, M.A.; Wu, Q.; Yang, B. How valuable is FinTech innovation? *Rev. Financ. Stud.* **2021**, *34*, 2062–2106. [\[CrossRef\]](#)
9. Porter, M.E.; Kramer, M.R. Creating shared value. *Harv. Bus. Rev.* **2011**, *89*, 62–77.
10. Hart, O.; Zingales, L. Companies should maximize shareholder welfare not market value. *J. Law Financ. Account.* **2017**, *2*, 247–275. [\[CrossRef\]](#)
11. Freeman, R.E. *Strategic Management: A Stakeholder Approach*; Pitman: Boston, MA, USA, 1984.
12. Mitchell, R.K.; Agle, B.R.; Wood, D.J. Toward a theory of stakeholder identification and salience. *Acad. Manag. Rev.* **1997**, *22*, 853–886. [\[CrossRef\]](#)
13. Donaldson, T.; Preston, L.E. The stakeholder theory of the corporation: Concepts, evidence, and implications. *Acad. Manag. Rev.* **1995**, *20*, 65–91. [\[CrossRef\]](#) [\[PubMed\]](#)
14. Zavolokina, L.; Dolata, M.; Schwabe, G. FinTech transformation: How IT-enabled innovations shape the financial sector. In Proceedings of the International Conference on Information Systems (ICIS), Dublin, Ireland, 11–14 December 2016.
15. La Porta, R.; Lopez-de-Silanes, F.; Shleifer, A.; Vishny, R.W. Law and finance. *J. Polit. Econ.* **1998**, *106*, 1113–1155. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Aguilera, R.V.; Jackson, G. The cross-national diversity of corporate governance: Dimensions and determinants. *Acad. Manag. Rev.* **2003**, *28*, 447–465. [\[CrossRef\]](#)
17. Jensen, M.C.; Meckling, W.H. Theory of the firm: Managerial behavior, agency costs and ownership structure. *J. Financ. Econ.* **1976**, *3*, 305–360. [\[CrossRef\]](#)
18. Shleifer, A.; Vishny, R.W. A survey of corporate governance. *J. Financ.* **1997**, *52*, 737–783. [\[CrossRef\]](#)
19. North, D.C. *Institutions, Institutional Change and Economic Performance*; Cambridge University Press: Cambridge, UK, 1990.
20. Scott, W.R. *Institutions and Organizations: Ideas, Interests, and Identities*, 4th ed.; Sage Publications: Thousand Oaks, CA, USA, 2014.
21. Vives, X. Digital disruption in banking. *Annu. Rev. Financ. Econ.* **2019**, *11*, 243–272. [\[CrossRef\]](#)
22. Claessens, S.; Frost, J.; Turner, G.; Zhu, F. FinTech credit markets around the world: Size, drivers and policy issues. *BIS Q. Rev.* **2018**, 29–49.
23. Ioannou, I.; Serafeim, G. What drives corporate social performance? The role of nation-level institutions. *J. Int. Bus. Stud.* **2012**, *43*, 834–864. [\[CrossRef\]](#)
24. Fatemi, A.; Glaum, M.; Kaiser, S. ESG performance and firm value: The moderating role of disclosure. *Glob. Financ. J.* **2018**, *38*, 45–64. [\[CrossRef\]](#)
25. Pahuja, Y.P.; Mishra, S.K.; Samontaray, D.P. The Impact of ESG on Firm Performance: Study of Listed Saudi Arabian Companies. *J. Corp. Financ. Res.* **2026**, *19*, 18–30. [\[CrossRef\]](#)
26. Barney, J. Firm resources and sustained competitive advantage. *J. Manag.* **1991**, *17*, 99–120. [\[CrossRef\]](#)
27. Eisenhardt, K.M. Agency theory: An assessment and review. *Acad. Manag. Rev.* **1989**, *14*, 57–74. [\[CrossRef\]](#) [\[PubMed\]](#)
28. Wiseman, R.M.; Gomez-Mejia, L.R. A behavioral agency model of managerial risk taking. *Acad. Manag. Rev.* **1998**, *23*, 133–153. [\[CrossRef\]](#) [\[PubMed\]](#)

29. Galeone, G.; Ranaldo, S.; Fusco, A. ESG and FinTech: Are They Connected? *Res. Int. Bus. Financ.* **2024**, *69*, 102225. [[CrossRef](#)]
30. Alsagr, N.; Khan, N. FinTech Development and Corporate ESG Performance: Does Institutional Quality Really Matter? *Corp. Soc. Responsib. Environ. Manag.* **2026**, 1–12. [[CrossRef](#)]
31. Li, S.; Yang, Z.; Tian, Y. Digital transformation and corporate performance: Evidence from China. *China Econ. J.* **2023**, *16*, 312–334. [[CrossRef](#)]
32. Ji, Z.; Zhou, T.; Zhang, Q. The Impact of Digital Transformation on Corporate Sustainability: Evidence from Listed Companies in China. *Sustainability* **2023**, *15*, 2117. [[CrossRef](#)]
33. Wooldridge, J.M. *Econometric Analysis of Cross Section and Panel Data*, 2nd ed.; MIT Press: Cambridge, MA, USA, 2010.
34. Rosenbaum, P.R.; Rubin, D.B. The central role of the propensity score in observational studies for causal effects. *Biometrika* **1983**, *70*, 41–55. [[CrossRef](#)]
35. Angrist, J.D.; Pischke, J.S. *Mostly Harmless Econometrics: An Empiricist's Companion*; Princeton University Press: Princeton, NJ, USA, 2009.
36. Alqudah, M.Z.; Sierra-Garcia, L.; Garcia-Benau, M.A. The moderating role of ESG scores on the relationship between FinTech adoption and financial performance: Evidence from Middle East banks. *Econ. Change Restruct.* **2025**, *58*, 90. [[CrossRef](#)]
37. Wang, G.; Zhang, H. FinTech-driven corporate sustainability: A technology–organization–environment framework analysis. *Sustainability* **2025**, *17*, 8748. [[CrossRef](#)]
38. Abuamsha, M.K. The impact of FinTech on financial sustainability in the GCC: A comparative study of FinTech and non-FinTech companies. *Sustain. Futures* **2025**, *10*, 101493. [[CrossRef](#)]
39. Liu, X.; Wang, L. Digital transformation, ESG performance and enterprise innovation performance. *Sci. Rep.* **2025**, *15*, 8850. [[CrossRef](#)] [[PubMed](#)]
40. Bonsu, M.O.A.; Attuquaye, S.C.; Hyslop, K.; Wang, Y.; Kaodui, L. Do corporate strategies in FinTech and green finance enhance ESG performance? The Moderating Role of Government Policies. *Bus. Strategy Environ.* **2025**, *35*, 6960–6981. [[CrossRef](#)]
41. Zhu, S.; Xia, Y.; Yu, L.; Li, J. Leveraging blockchain technology to prevent deceptive disclosure of ESG compliance. *J. Clean. Prod.* **2025**, *203*, 104360. [[CrossRef](#)]
42. Albitar, K.; Hussainey, K.; Kolade, N.; Gerged, A.M. ESG disclosure and firm performance before and after COVID-19: The moderating role of governance mechanisms. *Int. J. Account. Inf. Manag.* **2020**, *28*, 429–444. [[CrossRef](#)]
43. Broadstock, D.C.; Chan, K.; Cheng, L.T.W.; Wang, X. The role of ESG performance during times of financial crisis: Evidence from COVID-19 in China. *Financ. Res. Lett.* **2021**, *38*, 101716. [[CrossRef](#)] [[PubMed](#)]
44. Cheng, J.C.-H.; Chiang, A.-H.; Yuan, Y.; Huang, M.-Y. Exploring Antecedents of Green Tourism Behaviors: A Case Study in Suburban Areas of Taipei, Taiwan. *Sustainability* **2018**, *10*, 1928. [[CrossRef](#)]
45. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Dong, J.Q.; Fabian, N.; Haenlein, M. Digital transformation: A multidisciplinary reflection and research agenda. *J. Bus. Res.* **2021**, *122*, 889–901. [[CrossRef](#)]
46. Sayilir, O. Blockchain adoption and corporate sustainability performance: An analysis of the world's top public companies. *Sustainability* **2025**, *17*, 2855. [[CrossRef](#)]
47. *ISO 14001:2015; Environmental Management Systems—Requirements with Guidance for Use*. International Organization for Standardization: Geneva, Switzerland, 2015.

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