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RESEARCH ARTICLE

The role of Fintech firms' sustainability during the COVID-19 period

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Abstract
This study investigates the moderating role of environmental disclosures on the market performance of 48 Fintech and 140 non-Fintech firms during the pandemic using data from 2011 to 2022. Ordinary least squares and correlations were used for data analysis. The study's first finding revealed that Fintech firms had a better environmental performance (78.4%) than non-Fintech firms during the pandemic. The study's second finding indicated that environmental disclosures are crucial for shareholders and contributed almost 10.2% to the Fintech firms' market performance during the pandemic. This study's contribution is significant in enhancing the understanding of the shareholders' sensitivity towards sustainability disclosures during financial crisis. The findings of this study are essential for policymakers, start-up entrepreneurs, and shareholders.

Keywords Sustainability · Environment · Fintech · Disclosure · Market performance

Introduction

Financial technology (Fintech) is considered essential for transforming the financial industry and the way businesses operate. Fintech services are accessible to anyone with Internet access, and experts predict that Fintech will revolutionise the dynamics of the entire industry, with considerable changes in the competitive structure and functionality of financial services (Deloitte 2016). Fintech increases financial inclusivity by reducing the cost of financial services while narrowing the gap between financial institutions and end users (Demirguc-Kunt et al. 2018). Fintech is an innovation and avant-garde development in finance (Deng et al. 2019).

Fintech companies gained momentum during the pandemic and have been a lifeline for business survival as technology has been the pillar of support in the past 2 years. In October 2018, as per Fintech Global in the United Kingdom (U.K.), Fintech companies accumulated $54.4 billion of market capitalisation. Nevertheless, there was a decline in the number of completed deals to 1187 in 2018, compared with 2015, when the values peaked at 2291 (Goldstein et al. 2019).

The year 2021 has been remarkable for the Fintech market, with a record number of deals in every central region (KPMG 2022). Global Fintech investments in 2021 peaked at $210 billion with 5684 deals. As Trimble[1] pointed out, "*the investment in the payments space continues to boom, both in mature markets like the U.S. and the U.K. and emerging markets like Africa, Latin America, and Southeast Asia. Throughout 2021, there has been an extraordinarily high level of investment due to the nature of the global economic recovery combined with the digital transformation that COVID-19 has accelerated*." This situation reflects a complete change of scenario, which depicts the irreplaceable position of Fintech companies. These dramatic changes in

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[1] The surveying, construction, and civil engineering industries are all served by Trimble, which is a prominent producer of precise equipment for these industries.

statistics were evident in both mature and emerging markets globally due to the opportunities brought about by the pandemic.

Fintech is an essential segment of the economy to be regulated through environmental, social, and governance (ESG) disclosure requirements by regulatory authorities due to its supremacy at the outset of cutting-edge innovation and its impactful disrupting effect (Ferreira et al. 2015). The rise of Fintech companies, particularly during the pandemic, has created a more dynamic stir in ESG-related concerns. Due to the broadly growing prioritisation of ESG, there will likely be an increasing interest in Fintechs with ESG capabilities, including companies focused on climate change, decarbonisation, and circular economy (KPMG 2022). Hence, environment-focused Fintech companies are expected to experience a significant growth trajectory.

The growing complexities of technology integration have multiplied the regulatory concerns as there is a perplexing vision of interpreting the financial services industry as one of the most strictly regulated ones (Mention 2019). A plethora of policies, strategies, and approaches synergistically make sustainability disclosures work most effectively (Lee and Mattia Serafin 2022). Similarly, the warning tones set against less or no ESG disclosure are privy to the extent of exposure. By ignoring the raising concerns, the low ESG disclosure raises concerns about the firms' unique and peculiar risks (Mohammad and Wasiuzzaman 2021).

IMF have captured the ESG disclosures in Fintech companies. However, the exponential growth of Fintech companies and the varying emphasis and coverage of each element in ESG, particularly during the pandemic, remain unexplored. In that light, an overall disclosure requirement on ESG had been discussed in prior research. The two famous theories behind the objectives of ESG disclosures are legitimacy and stakeholder theories. The legitimacy theory reminds us of the importance of the social contract between the stakeholders and Fintech companies. On the other hand, the stakeholder theory emphasises the need to narrow the stakeholders' expectation gap.

Fintech could be summarised across the elements starting from payments, progressing to advisory, continuing with financing, and finally, compliance. Fintech is an interdisciplinary well-knit combination of the basics of finance, technology, and innovation management combination (Leong and Sung 2018). A paradigm change and progress can positively affect an economy if Fintech is incorporated into new businesses and social organisations (Puschmann 2017). On the contrary, economic growth will be adversely affected if there is an excessive emphasis on regulation while assuming less importance on the adequacy of Fintech (Goldstein et al. 2019).

The integration of technology imbibed innovative concepts in the financial industry had been an initiating point of Fintech, progressively evidenced since the 2008 global financial crisis (Shim and Shin 2016). Nevertheless, contemporary technological and financial innovations contrast traditional innovations in the financial industry (Board 2019). Unfortunately, the major challenge of sustainability disclosures stems from the diversity of the transparency regime of ESG information. The disclosure regimes regarding environmental information have been precisely criticised, particularly data concerning climate change (Yan et al. 2021). The COVID-19 crisis has spurred similar critiques about social information disclosure.

Evidence indicates that Fintech significantly influences environmental and ecological benefits (Deng et al. 2019). Environmental issues such as climate change are challenging human survival and development due to the financial industry's considerable technological changes. Fintech firms have been proven to be disruptive (Yang 2018), impacting many energy spheres, particularly the economy. Specifically, there is significant evidence proving that Fintech has a considerable impact on the benefits of the environment (Popescu and Popescu 2019). When environmental sustainability is addressed, Fintech can be a key to invigorating investments for environmental and energy security, vivifying renewable energy, and initiating cost-effective funding to improve ecology (Hoang et al. 2022). By deploying more economically viable and adequately available funds in environment-concerned ventures, Fintech can be the flagbearer of promoting environmental infrastructure and renewable energy (Knuth 2018).

Given the favourable situation and the excellent growth trajectory in the Fintech industry due to the COVID-19 pandemic, this study aims to understand how well the Fintech companies reported environmental disclosures. The study particularly explores the situation when the Fintech companies enjoyed the niche over non-Fintech companies during the COVID-19 pandemic and how much stock market investors are sensitive towards the sustainability disclosures of Fintech companies. In order to assess it adequately, it would be imperative to understand the extent of Fintech firms' sustainability disclosures before and during the pandemic. Hence, the research explores how well Fintech companies have exploited the market advantage during the pandemic compared to non-Fintech companies in terms of the extent of disclosure and successfully aligning the environmental exposure with the financial performance since 2020.

The remaining sections of the paper are arranged as follows. The second section presents the underpinning theories and hypotheses development. The third section elaborates on the method, sample, and collected data. The fourth section presents the multivariate analyses, and the last section elaborates on the conclusion and policy implications.

Theoretical background and hypotheses development

Fintech is the abbreviation for financial technology (Zhang-Zhang et al. 2020), encompasses a range of new and innovative financial products. Examples include digital credit and lending (such as online lending, person-to-person lending, and crowdfunding), digital payment systems (including mobile banking and mobile payments), digital currencies (such as cryptocurrencies and blockchain), digital insurance, global Fintech solutions, and digital data analytics (Ilievski 2020). The emergence of Fintech has revolutionised the financial industry by transforming how businesses sell their goods and services, eliminating intermediaries, and addressing privacy and regulatory concerns. The Fintech concept provides new opportunities for entrepreneurship and offers business prospects for both short-term and long-term growth (Dhar and Stein 2017). According to the 2019 report by IMF, many countries worldwide have experienced exponential growth in the Fintech industry, and significant economic inflows are expected to benefit various stakeholders in the Fintech industry (Najaf et al. 2022a).

The emergence and importance of Fintech companies in the global financial industry have been widely discussed in the previous literature (Claessens et al. 2018; Haddad and Hornuf 2019; Sipilova et al. 2020). Lu et al. (2021) argued that small start-up companies had mostly initiated recent developments in the Fintech industry. Large financial institutions, such as banks and insurance companies, have formed solid relationships with these companies to allow digital data transfers between Fintech and financial institutions' platforms. Subsequently, optimism for the Fintech industry globally is very strong. An immense demand exists for Fintech, especially in cryptocurrencies and blockchain technologies, surging partnerships with financial institutions and Fintech companies, increasing Fintech regulatory awareness, and growing interest in ESG prospects offered by Fintech companies.

According to the report by KPMG (2022), has been exceptional for the Fintech industry, with countless interests growing exponentially from investors and investment in Fintech in many regions globally, such as the United States (U.S.), Europe, and Asia–Pacific. The total transaction value of Fintech products and services increased from USD 4.1 trillion in 2019 to USD 5.2 trillion in 2020. More than one-third of Fintech deals have been made outside the U.S., the U.K., and China (Baltgailis and Simakhova 2022). Moreover, the COVID-19 pandemic has led to a colossal growth in digital payment. Fintech companies can react swiftly to the pandemic due to start-up traits and gain from new opportunities provided by the significant growth in digital financial products and services in the post-pandemic period (Beirne et al. 2022).

On the other hand, new issues are emerging that affect the financial industry. In the growing digitised Fintech world, stakeholders are currently concerned about sustainability disclosures. The doubt remains on how ESG influences consumers' purchases and consumption of goods and services (Vergara and Agudo 2021). Following the trend in recent years, many companies in the U.S., Europe, and Australia have started following sustainability reports to discuss their ESG performance. Sustainability reporting has become crucial in fulfilling the expectations of shareholders and all the company's stakeholders (Jamali et al. 2017). Sustainability disclosures are a communication tool that presents information on the companies' economic value and data on the companies' environmental and social importance. Companies can use sustainability to set goals, determine performance, regulate operation changes to more sustainable business practices, manage risk, improve corporate governance, and benchmark performance against competitors within and across other industries (Mohammad and Wasiuzzaman 2021).

Companies' sustainability performance reporting aligns with the United Nations Sustainable Development Goals (SDGs). Hence, the relationship between sustainability measures and Fintech companies is crucial as the financial industry is facing a radical change, with digitisation and sustainability being the main driving force (Arner et al. 2020). The IMF report in 2019 indicated the importance of financial industry stability and how ESG disclosures by companies can promote corporate transparency and accountability. Vergara and Agudo (2021) established that Fintech companies and sustainability are essential as the Fintech industry can support renewable energy and environmental infrastructures.

As stated earlier, legitimacy and stakeholder theories are used in discussing sustainability and Fintech companies. Legitimacy theory describes the social contract between the Fintech companies and their stakeholders. Stakeholders' expectation changes over time. Thus, Fintech companies need to consider their stakeholders' needs, or they will be penalised for failing to comply with their stakeholders' expectations (Deegan 2014). Previously, the legitimacy of companies was regarded as only financial performance. Nevertheless, recently companies have been required to consider other issues, such as environmental and social performance (Burhan and Rahmanti 2012). Porter and Kramer (2006) posited that societies and companies are interrelated, and companies that disclose social and environmental issues improve financial performance. Besides, companies that report on sustainability measures have higher profitability, growth, and competitive advantage (Porter et al. 2019).

The stakeholder theory is another theory that explains environmental disclosures and performance in Fintech companies. It shows the relationship between the Fintech companies and their stakeholders. According to Freeman (2010), firms must address their key stakeholders' expectations to ensure the survival and success of the company. Key stakeholders have power over the company's capital and resources. Jensen (2002) discovered that meeting the stakeholders' expectations by disclosing sustainability information, especially on economic, environmental, and social performance, will increase the firm's value.

Similarly, Alsayegh et al. (2020) agreed that disclosing sustainability measures to stakeholders is essential to enhance firm value and create a competitive advantage. By using both legitimacy theory and stakeholder theory, Minutolo et al. (2019) examined the effect of ESG scores and firm performance. They found that increased ESG disclosures enhance the firm's value and improve operational efficiency. Thus, according to these two theoretical frameworks, the pressure from societies and stakeholders motivates Fintech companies to invest and disclose sustainability information, such as environmental measures, to their stakeholders, leading to better firm performance.

Previous literature focused on the relationship between Fintech companies and sustainability. According to Al Hammadi and Nobanee (2019), Fintech companies play a crucial role in the financial institution markets. Besides, they also found positive evidence of Fintech companies supporting sustainable performance. Vergara and Agudo (2021) pointed out the interrelation between sustainable finance and Fintech companies. Najaf et al. (2021) also discovered that the collaboration between Fintech companies and banks could help increase profitability and sustainability, thus reducing cybersecurity risks. In a newer study by Najaf et al. (2022c), they investigated whether sustainability is essential for Fintech and non-Fintech companies in the U.S. from 2010 until 2019. The authors discovered that non-Fintech firms have better sustainability and performance than their counterparts. In contrast, Puschmann et al. (2020) established that green or sustainable Fintech companies are significant to financial institutions. However, Fintech companies, especially in cryptocurrency mining, have fewer ESG disclosures.

In 2020, the World Health Organization (WHO) announced the outbreak of the COVID-19 pandemic. The pandemic has hit hard on the world's global economies for the past few years. The nature of the pandemic and its increased transmission speed have led societies worldwide to a new norm, requiring strict social distancing rules and lockdown measures enforced by the government (Fu and Mishra 2020). The new norm has significantly influenced income disposal, social contacts, and the utilisation of the internet and digital tools, especially in the Fintech industry (Vasenska et al. 2021).

The COVID-19 pandemic has wholly affected the financial industry system, and many Fintech companies have experienced their first socio-economic shocks and uncertainty. Furthermore, the COVID-19 pandemic caused a higher risk of loan defaults, increased liquidity risks, and accelerated the adoption of online banking and mobile payments (Hastuti et al. 2018). Although Fintech and sustainability have been researched more recently, there are still limited studies in this area. Currently, no study has examined Fintech companies with sustainability disclosures on environmental measures during the COVID-19 period.

Recent studies focused on how the COVID-19 pandemic affects Fintech firms. Najaf et al. (2022b) investigated the effect of the COVID-19 pandemic on factors of peer-to-peer (P2P) lending in the Fintech industry. The study found that COVID-19 had significantly impacted the fundamental determinants of P2P lending. In addition, Atayah et al. (2021) examined the performance of logistic firms during the pandemic in G20 countries. They concluded that the financial performance of logistic firms was significantly higher during the COVID-19 pandemic, particularly in 2020. As sustainability and Fintech have become more relevant and essential for the global economies, this study aims to address the research gap by examining whether Fintech companies have better environmental measures during the COVID period than non-Fintech companies. Based on the above discussion, the first hypothesis suggested in this study is as follows:

> H1: Fintech companies have more environmental disclosures during the COVID-19 period than their non-Fintech counterparts.

Much previous literature has examined the relationship between sustainability practices, as proxied by ESG and financial performance. The results of the past studies have shown mixed findings. In an earlier study, Velte (2017) explored German-listed firms from 2010 to 2014 and discovered a significant impact of ESG performance on accounting performance, but no significant results on the firm's market value. In the U.S., Fatemi et al. (2018) investigated ESG disclosures on firm value from 2006 to 2011, and their results showed that good ESG increases the firm's value. Whetman (2018) analysed the impact of financial performance on corporate sustainability reporting using a sample of publicly traded American firms and reported positive findings. By examining the Indonesian stock market, Hastuti et al. (2018) also found that higher sustainability disclosure enhances the firm's value and financial performance. Similar results were reflected in Yoon et al.'s (2018) study, where sustainable practices were found to be of significant importance in the market value of Korean firms.

Recent studies have confirmed that sustainability disclosures impact firm performance. Johari and Komathy (2019) tested the effect of sustainability reporting and financial performance and found a positive relationship. In Malaysia, Mohammad and Wasiuzzaman (2021) investigated the effects of a firm's ESG disclosures on performance among firms listed in Bursa Malaysia. By controlling for competitive advantage, the authors confirmed that ESG disclosures increase the companies' performance. Similarly, using a sample size of 510 firms' ESG scores across 17 countries for the period 2010 to 2018, Shaikh (2022) discovered that a firm with sustainability disclosures is highly prioritised by stakeholders and tends to perform better with higher profitability and market value in the long run.

On the other hand, several studies concluded that disclosures of sustainability harm company performance. Lopez et al. (2007) tested the impact of corporate social responsibility (CSR) and various accounting indicators on corporate performance by examining German firms from 1998 to 2004. The study's results highlighted a negative relationship between CSR and corporate performance indicators. Detre and Gunderson (2011) also explored publicly listed U.S. agriculture firms and CSR practices. The findings showed that agribusinesses respond undesirably to CSR in the short term.

Some studies argued that there is no or partial correlation between the disclosure of sustainability and the firm's performance. By exploring Indonesian-listed companies, Burhan and Rahmanti (2012) discovered that sustainability impacts corporate performance only partially. Similarly, in Malaysia, Ogundare (2013) argued that there is a partial correlation between sustainability reporting and organisational performance. Wang (2017) found mixed results in the characteristics of companies and sustainability disclosures for companies in the Taiwanese region. The findings stated that governance characteristics are significant to sustainability reporting disclosures, whereas share price is negatively related to sustainability reporting disclosures. Atan et al. (2018) also tested ESG and performance among 54 companies from 2010 to 2013. The authors concluded no significant effect on sustainability reporting and company profitability. Instead, they argued that there is a positive effect between sustainability reporting and the cost of capital of the firm.

Based on the discussion above, most of these studies focused on sustainability or ESG disclosures and their impact on the general performance of firms. However, the argument can be made that the performance of companies also impacts sustainability practices disclosures such as environmental performance. Currently, little research has analysed the relationship between Fintech and sustainability, as Fintech is a relatively new concept. Additionally, no study has examined this relationship specially in Fintech and non-Fintech companies during the COVID-19 period. To fill this research gap, this study hypothesises that Fintech companies that actively disclose information regarding their sustainable environmental performance performed better than non-Fintech companies during the COVID-19 period. Therefore, the second hypothesis proposed for testing is as follows:

H2: Fintech companies have better market performance than non-Fintech firms due to high environmental performance during the COVID-19 period.

Method, sample, and data

This study examined two main issues. First, the study examined whether (or not) Fintech firms adhered to the environmental disclosures during the COVID-19 period. Prior studies have proved that Fintech firms are better in sustainability than non-Fintech firms (Dhiaf et al. 2022). Nevertheless, there is a gap in testing the same subject during the COVID-19 period. Second, the study explores the interesting issue of whether (or not) these environmental disclosures facilitate Fintech firms' better market performance during the pandemic period. Hence, the Fintech firm's data from 2011 until 2021 were gathered. The data was split into 2011 until 2019 as the pre-COVID period and 2020 until 2021 as the post-COVID period.

A sample of Fintech firms from the well-known Nasdaq Financial Technology Index (KFTX) was selected. An index of 48 Fintech firms was established in July 2016[2] with 48 listed Fintech companies. The KFTX is an index that was developed with the intention of monitoring the performance of publicly listed financial technology businesses in the U.S. The index eligibility is not restricted to stocks that fall under a certain sector categorisation since financial technology businesses are difficult to classify into a single industry category. The provision of financial goods and services is facilitated using securities qualified for inclusion in indexes. After selecting the Fintech firms, the matching sample of non-Fintech using the Bloomberg "Relative Valuation (R.V.)"

[2] Although financial technology companies like Visa and Mastercard have been traded on the U.S. stock market for over a decade, the Nasdaq Financial Technology Index (sometimes abbreviated as KFTX) did not exist until 2016. This index was developed to gather all financial technology companies under a single umbrella to gauge how investors would react to the new index. Therefore, the population of listed financial technology companies included in the Nasdaq Financial Technology Index will serve as the sample size for this study. This method of picking the sample is not new; in fact, key studies have used this method to choose the sample and labelled the companies involved as Fintech businesses (Dhiaf et al. 2022; Najaf et al. 2022a).

tool was obtained. The tool finds an alternative match firm based on industry, earning per share (EPS) review, ownership, and credit rating. After this process, 140 matching samples of non-Fintech firms were obtained. Thus, the study's sample comprises 48 Fintech and 140 non-Fintech firms. The sample period ranges from 2011 until 2021, and the missing values were excluded. The total number of yearly observations in this study is 1790 (firm years).

Correlation and ordinary least squares (OLS) were used to examine the associations and relationships between Fintech and environmental disclosures and Fintech and market performance during the COVID-19 period. All models are given in respective tables. To address outliers, all these study variables were winsorized at 1 and 99%. Subsequently, the variance inflation factor (VIF) level was tested after each regression, and it was found to be below the tolerance level (below five in this study).

Dependent variables

For the first hypothesis, this study used the environmental disclosures provided by Bloomberg. This scoring system evaluates a firm's adherence to environmental norms. Bloomberg's environmental disclosure consists of several components, including air quality, water and energy management, materials and waste, and climate change. Bloomberg weighs each component separately, such as giving more weight to energy management than air quality.

For the second hypothesis, Najaf et al. (2022a) investigated the relationship between the corporate governance and market value of Fintech firms using Tobin's Q as a proxy. Building on this framework, Tobin's Q was adopted as a measurement tool in this study to assess the market performance of firms (i) in the year (t) by Bloomberg. Tobin's Q was defined by Bloomberg as the sum of market cap, total liabilities, preferred equity, and minority interest divided by total assets.

Independent variable

For the first hypothesis, the independent focus variable is *Fin*COVID*. It represents the interaction variable between the Fintech firms dummy variable (assign "1" if Fintech firm and "0" otherwise) and the COVID-19 dummy variable (value of "1" if pandemic period and "0" otherwise). For the second hypothesis, the focused independent variable is the interaction with the *Fin*COVID*environment.* These interaction variables are the product of two dummy variables (*Fin*COVID*) and one continuous variable (*environment*). The variables facilitate the understanding of those firms in the Fintech sector during the pandemic period and how their environmental disclosures relate to the market performance (which is Tobin's Q in this case).

Firm-level controls

The regression analysis considers firm-specific features in line with previous research and theory. Previous studies have shown a significant relationship between *leverage, return on assets (ROA), capital expenditure, growth, Big4* and *size*, environmental disclosures, and Tobin's Q (Najaf et al. 2022a). Hence, these variables were controlled while testing the first and second hypotheses. The definitions of these variables are available in the Appendix.

Fixed effect control

Chin et al. (2022) determined the impact of market performance and political connections, and their research period was fixed from 2012 until 2019. In contrast, the current study's research period spans from 2011 until 2021. Previous studies have shown that sustainability disclosure scores have improved for all U.S. firms over the years (Najaf et al. 2021). Therefore, to control for any unobserved time-variant effects, time dummy variables were utilised in this study.

Methodology

Table 1 shows the statistics description of all study variables. The average environmental score is 40.34, indicating almost every firm adherence to ecological issues, nearly 40%, whether Fintech or non-Fintech firm. The overall variable fluctuation was found to be high as the outliers were not excluded. The highest standard deviation is for capital expenditure, followed by the size of the firms. Similarly, the highest difference in the minimum and maximum values was observed for these two variables. The positive *leverage*,

Table 1 Descriptive statistics ($N = 1790$)

Variables	Variable type	Mean	Std. dev.	Min	Max.
Panel A: dependent variable					
Environment	Continuous	40.34	12.01	17.19	71.82
Tobin's Q	Continuous	2.68	2.24	0.95	13.04
Panel B: independent variables of interest					
Fin	Dichotomous	0.25	0.43	0	1
COVID	Dichotomous	0.14	0.35	0	1
Panel C: firm attributes–control variables					
Leverage	Continuous	23.33	19.74	0	96.91
ROA	Continuous	6.61	7.76	−12.81	34.44
Capital exp.	Continuous	−38.13	86.74	−53.20	0
Growth	Continuous	10.56	19.74	−39.43	118.43
Big4	Dichotomous	0.95	0.22	0	1
Size	Continuous	91.28	56.06	3	198

Appendix defines all variables

Table 2 Correlation coefficients (Pearson and Spearman-rank (italicised) correlations are presented)

Variables	Code	1	2	3	4	5	6	7	8
Fin	1		*0.1262**	*0.0835**	*0.2029**	*0.1387**	*−0.0464*	*0.1998**	*−0.3550**
Leverage	2	0.117*		*0.004*	*−0.1651**	*−0.1034**	*0.0315*	*0.0663**	*−0.0097*
ROA	3	0.091*	−0.027		*−0.1427**	*0.1089**	*−0.0540**	*0.6388**	*−0.4027**
Capital exp	4	0.173*	−0.087*	−0.026		*0.1330**	*−0.0740**	*0.0396*	*−0.3445**
Growth	5	0.086*	−0.04	0.039	0.100*		*−0.0470**	*0.3171**	*−0.3246**
Big4	6	−0.047*	0.039	−0.043	−0.069*	−0.034		*−0.0594**	*0.1767**
Tobin's Q	7	0.140*	−0.011	0.562*	0.154*	0.249*	−0.037		*−0.7124**
Size	8	−0.355*	−0.041	−0.350*	−0.337*	−0.238*	0.178*	−0.542*	

* shows significance at the 0.05 level

ROA, *growth*, and *size* figures indicate that the sample firms were not financially challenged. Furthermore, the dummy audit variable shows that 95% of the sample firms hires *Big4* auditors indicating that the audit quality of the sample firms is above average.

Correlations

Table 2 reports the Pearson (lower diagonal) and Spearman (*upper italic diagonal*) coefficients. The purpose of these tests were to observe any association among the control variables. Only one strong association was reported between Tobin's Q and *ROA* at 0.6388 ($p < 0.05$), which is below the tolerance limit of 0.75 of correlation. Thus, the subsequent regression models are free from multicollinearity issues (Dharmasiri et al. 2022).

Multivariate analyses

The findings of the hypothesis tests are presented in Tables 3 and 4. OLS regression models were used for both hypotheses, and pool regression analysis was used to estimate them. According to Chang et al. (2014), using pool OLS, pool regression may help reduce estimate bias and multicollinearity, account for discrete variability, and help identify the dependent-independent relationship across time. Table 3 investigates the relationship between the Fintech firm's sustainability performance during the pandemic period. In contrast, Table 4 aims to validate the second hypothesis and establish a connection between market performance and Fintech sustainability during the COVID-19 period.

Test of Hypothesis 1 — impact of Fintech firms on the environment during the pandemic

Table 4 presents a comparison among Fintech and non-Fintech firms' environmental performance. There are three models, where the first model has no control variables and fixed effects, the second model includes control variables

Table 3 Regression analysis of the Fintech's environment during the pandemic—first hypothesis. Our baseline model to test the first hypothesis is as follows:

Variables	Environment		
	Model 1 *Without control and F.E*	Model 2 *Without F.E*	Model 3 *With control & F.E*
Fin	7.187***	2.612***	3.518***
	[10.927]	[4.888]	[7.386]
COVID	−5.467***	−5.134***	5.230***
	[−6.212]	[−6.800]	[6.286]
Fin*COVID	**0.327*** **	**0.984*** **	**0.784*** **
	[8.047]	**[2.823]**	**[3.638]**
Leverage		−0.070***	−0.068***
		[−5.919]	[−5.186]
ROA		0.025*	0.022
		[1.960]	[1.636]
Capital exp.		0.242***	0.244***
		[7.686]	[7.380]
Growth		−0.004***	−0.005***
		[−12.352]	[−13.745]
Big4		0.097	1.883***
		[0.207]	[3.086]
Size		0.007***	0.006***
		[12.857]	[11.160]
Constant	42.636***	30.792***	29.836***
	[119.698]	[40.741]	[35.239]
S.E. cluster	No	Firm	Firm
Y.E. fixed effect	No	No	Yes
Observations	1790	1790	1790
R^2 value	14.61%	43.43%	36.16%

$$Environment_{it} = \alpha + \beta_i Fin_{it} + \beta_i COVID_{it} + \beta_i Fin * COVID_{it} + \sum_{i=1}^{n=6} Controls_{it} + \delta 1 YE_t + \varepsilon_{it} \quad (1)$$

where $Environment_{it}$ is a continuous variable proxied by the Bloomberg environmental score of a firm (i) in the year (t). Fin_{it} is a dummy variable, where "1" indicates Fintech firms and "0" indicates counterpart firms. *Fin*COVID* is the interaction variable of Fintech firms and COVID-19 period. We control for the firm-level (*leverage*, *ROA*, *Capital exp.*, *Growth*, *Big4*, and *Size*) control variables. Y.E. fixed effects are also used to adjust for an uncertain temporal bias

Table 4 Regression analysis Fintech's environment on market performance during the pandemic—second hypothesis. Our baseline model to test the second hypothesis is as follows:

Variables	Tobin's Q		
	Model 1 *Without control and F.E*	Model 2 *Without F.E*	Model 3 *With control & F.E*
Fin	0.002	0.016***	0.019***
	[0.423]	[4.015]	[4.827]
COVID	−0.703***	−0.024***	−0.176*
	[−5.474]	[−3.216]	[−1.649]
Environment	1.532***	1.248***	1.195***
	[9.109]	[7.400]	[6.924]
Fin*COVID*Environment	**0.823****	**0.305*****	**0.102*****
	[2.524]	**[4.969]**	**[4.166]**
Leverage		0.018***	0.019***
		[6.513]	[6.404]
ROA		−0.003	−0.003
		[−1.063]	[−1.217]
Capital exp.		0.117***	0.117***
		[12.196]	[11.866]
Growth		0.000***	0.000***
		[4.467]	[4.275]
Big4		0.028***	0.556***
		[10.913]	[3.220]
Size		−0.002***	−0.002***
		[−15.900]	[−15.923]
Constant	2.100***	2.579***	2.053***
	[10.366]	[12.313]	[8.421]
S.E. cluster	No	Firm	Firm
Y.E. fixed effect	No	No	Yes
Observations	1790	1790	1790
R^2 value	12.02%	55.28%	52.10%

$$Tobin's\ Q_{it} = \alpha + \beta_{1} Fin_{it} + \beta_{1} COVID_{it} + \beta_{1} Environment_{it} + \beta_{1} Fin * COVID * Environment_{it} + \sum_{i=1}^{n=6} Controls_{it} + \delta\, 1YE_{t} + \varepsilon_{it} \quad (2)$$

where $Environment_{it}$ is a continuous variable proxied by the Bloomberg environmental score of a firm (i) in the year (t). *Fin*COVID*Environment* is the interaction variable of Fintech firms, COVID-19 period, and environment score given by Bloomberg. Rest of explanatory variables are same as Table 3

but no time-fixed effect, and the baseline model 3 includes all controls and fixed effects. As predicted, the Fintech firms have better environmental performance than non-Fintech firms in the baseline model 3 (*0.784*, $t = 3.638$, $\alpha = 0.01$, *one-tailed*). The results confirm the first hypothesis and suggest that the Fintech firms performed well in environmental disclosures during the pandemic period.

Previous research suggests that Fintech firms' economic growth is higher than non-Fintech firms due to various factors such as merger and acquisition (Dranev et al. 2019), governance (Najaf et al. 2022a), manufacturing efficiency (Dhiaf et al. 2022), and ESG (Najaf et al. 2022c). These studies were conducted before the COVID-19 period and align with the present study's findings, indicating that Fintech exhibited superior performance behaviour during the pandemic period.

Test of Hypothesis 2 — impact of Fintech firms' sustainability on market performance during the pandemic

Table 4 compares the market performance of Fintech and non-Fintech firms during the COVID-19 pandemic. The table presents three models: the first model is without any control variables and fixed effects, the second model with control variables but no time-fixed effect and, and the third complete model with all controls and fixed effects. The results show that the Fintech firms have outperformed non-Fintech firms in terms of market performance. The environment during COVID-19 played a moderating role, resulting in that higher market performance in the baseline model 3 (*0.102*, $t = 4.166$, $\alpha = 0.01$,

one-tailed). These findings support the second hypothesis and suggest that the Fintech firms have better market performance due to environmental disclosures during the pandemic period.

Conclusion

In summary, the findings suggest that the Fintech firms have had better environmental performance than non-Fintech firms during the pandemic period. This situation arose because most people relied on technology-based firms during the COVID-19 period, and Fintech firms had the challenging task of maintaining benchmark sustainability standards. It is interesting to note that Fintech firms had better financial performance and environmental measures during the pandemic. Additionally, this study reveals that better environmental measures are the reasons for the higher market performance of Fintech firms during the COVID-19 period. The results indicate that 10.22% of excess market performance is attributable to environmental measures. Moreover, the study finds that the critical success factor in higher market performance growth of Fintech firms is the disclosure of environmental information. This suggest that U.S. shareholders are highly interested in sustainability disclosures, especially in Fintech firms.

This study has a few limitations that future studies can address. First, future studies should consider using an alternative sustainability proxy, such as the social and governance aspects of Fintech firms, to determine whether these aspects of sustainability also contribute to market performance during the pandemic period. Second, this study addressed a limited number of years during the COVID-19 period. The sample period for this study comprises 2020 and 2021, and future studies can consider a more extended COVID-19 period. Furthermore, future studies can take an alternative proxy for the COVID-19 period or an alternative proxy, such as COVID-19 cases per year. Third, future studies can consider a qualitative approach instead of a quantitative approach to testing the same hypotheses, such as conducting semi-structural interviews to obtain a better overview of associations.

This study offers several theoretical and practical implications. Firstly, this study contributes to the academic literature on Fintech, sustainability, and COVID-19. Second, this study uncovered an exciting finding of the role of sustainability in contributing to the market performance of Fintech firms during the COVID-19 period. Third, the shareholders with zero portfolios can invest in Fintech firms to gain better market performance than non-Fintech firms during the COVID-19 period.

Appendix

Variables	Definition	Relevant studies/ source
Dependent variable		
Environment	Bloomberg gives the environmental disclosure score	Bloomberg
Tobin's Q	Market cap + total liabilities + preferred equity + minority interest / total assets	Bloomberg
Focus independent variables		
Fin	This is a dummy variable where "1" indicates Fintech firms and "0" indicates counterpart firms	Najaf et al. (2022a)
COVID	This is a dummy variable where "1" indicates the COVID period of 2020 and 2021 and "0" rest of the study period	Najaf et al. (2022b)
Fin*COVID	Interaction variable of Fin and COVID	This study
Fin*COVID*Environment	Interaction variable of Fin, COVID, and environment	This study
Variables	Definitions	Relevant studies
Firm-level control variables		
Leverage	Total debt / Total Assets	Ali et al. (2020)
ROA	PBIT / Total Assets	Hassan et al. (2020)
Capital exp.	Expenditure pertaining to capital	Kolsi and Attayah (2018)
Growth	Percentage change in total sales	Tran and Le (2020)
Big4	"1" if big4 auditor and "0" otherwise	Hassan et al. (2020)
Size	Log (Total Assets)	Najaf et al. (2022c)
Fixed effect control variable		

Variables	Definition	Relevant studies/ source
Y.E	1 (0) for observations from year *t* and 0 for other observations	Chin et al. (2022)

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