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Does electronic economics matter to financial technology firms?

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Abstract
This paper addresses the notion of electronic economics by examining financial technology (fintech) firms' performance and corporate governance quality, using data from the United States. The findings support our maintained assumption that due to the economics of electronic platforms perused by financial technology firms, these firms outperform firms from other industries (non-Fintech). The final sample comprises 1,712 company-year observations between 2010 and 2019 (pre-COVID-19). The evidence suggests that our corporate governance quality index, developed from Organisation of Economic Cooperation and Development (www.oecd.org/corporate/corporate-governance-factbook.htm, 2019) guidelines, accurately captures corporate governance quality in the United States, principally due to the inclusion of an anti-bribery policy indicator, in the index. The results suggest that this evidence is not merely an artefact due to the corporate governance quality index potentially capturing priced risk factors. Our findings reveal that fintech firms have superior corporate governance quality than non-fintech and that fintech firms place more reliance on internal versus external corporate governance mechanisms, vis-a-vis companies in other industries.

Keywords Regulations · COVID-19 · Financial technology firms · Corporate governance (CG) · Performance · Agency costs

1 Introduction

Increasingly, the transition to a digital economy has manifested in new research into electronic economics. This paper focuses on the emergence of electronic economics exhibited by fintech firms. In this context, electronic economics is seen as a comparative advantage that fintech firms experience. Financial technology ("fintech") firms

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are firms that use technology to deliver financial solutions [1]. The market value of big FinTech firms[1] continues to increase to exceed a trillion United States dollars, which is more than Wall Street's top six banks[2] [2]. Fintech firms constitute a new and progressive industry. Their financial and technological innovations reveal new business models, applications, processes and products [3]. This rapid development and the disruption caused by fintech firms motivate the investigation of these firms' financial performance and corporate governance. The success of fintech firms is attributed not only to the technological advancement but how well fintech firms are using technology to meet society's needs [4, 5], Klein et al., [6]. Soriano [7] identifies three success factors of fintech venture capitalists: the degree of customer-centricity, strategic partnership with financial institutions and the founders' prior experience in the financial services industry. Evidence shows that these critical success factors account for the performance of fintech firms [8–11]. A key to fintech firms' achievements is the ease of expansion and providing access to capital for small businesses and macro financing via peer-to-peer service [12].

This study is building on seminal work by [5], who argue that the fintech firms have brought opportunities and challenges to the firm management risk. There are two principal academic motivations for this study. Firstly, although the fintech literature has advanced over the last several decades, there is limited evidence on the role of corporate governance in the success of fintech firms. It is timely to investigate the role of corporate governance in fintech firms because the manager of a listed fintech firm needs to serve and protect the interests of their shareholders, given the growing interest in Environment, Social and Governance (ESG) issues [13]. Secondly, prior studies have paid limited attention to corporate governance for fintech firms. We examine their corporate governance quality using an index developed based on the Organisation for Economic Cooperation and Development (OECD) guidelines (OECD [14]).

Hence, our first purpose is to investigate the financial performance and corporate governance quality of fintech firms in the United States. The United States is a developed country, characterised by strong investor protection and securities laws and high levels of litigation risk [15]. Furthermore, the United States is a politically stable environment, which reduces the potential for contamination of our research design. Our second purpose is to examine the suitability of a corporate governance quality index developed for companies operating in the United States. Our index was developed based on the recommendations and observations of OECD [14]. The index comprises four components: the existence of an anti-bribery policy, board independence, separation of Chief Executive Officer and board chair and optimal tenure of executive directors. We assume that two items (board independence and executive directors' tenure) are non-monotonically related to corporate governance quality.

[1] Square, Visa, PayPal and MasterCard.

[2] JPMorgan, Bank of America, Wells Fargo, Citigroup, Morgan Stanley and Goldman Sachs are worth less than $900 billion in total.

We test three hypotheses. The first hypothesis postulates that the corporate governance quality index that we develop for the United States fits this country's institutional setting. The second hypothesis is that fintech firms have superior corporate governance quality to non-fintech firms. The third hypothesis is that fintech firms place more reliance on internal versus external governance mechanisms, vis-a-vis firms from other industries.

Our paper uses a final sample comprising 1,712 company-year observations over the investigation period 2010–2019. Firstly, we examine the relationship between our corporate governance index and firm performance (measured in terms of stock return in excess of the risk-free rate), using the Fama French [16] model. All components of our index are positively associated with performance. Secondly, we compare the corporate governance quality and performance of fintech firms relative to non-fintech firms, using tests of differences of means of selected variables. The *t*-tests reveal that compared to non-fintech firms, fintech firms have superior corporate governance quality for all four dimensions of our index. Thirdly, we examine whether reliance on internal corporate governance mechanisms is stronger for fintech firms compared to non-fintech firms. We find weak evidence that compared to non-fintech firms, fintech firms rely more on internal corporate governance mechanisms.

There are three contributions to the extant literature from this study. Firstly, fintech firms are a relatively new phenomenon *per se*. Secondly, using the OECD [14] recommendations, a country-specific measure of corporate governance quality for companies operating in the United States is offered. Thirdly, the Fama French [16] methodology is utilised to confirm that the documented association between corporate performance and corporate governance quality is not subsumed by priced risk factors that have been identified in the literature. Our second and third contributions have precedence from a study using Taiwanese data [17].

The remainder of this paper is organised as follows. Section 2 locates the study within the extant literature. Section 3 develops the research hypotheses. Section 4 explains the research methodology. Section 5 describes the sample selection and data collection. Section 6 presents and discusses descriptive statistics. Section 7 offers and discusses the empirical results. Section 8 concludes.

2 Literature review

2.1 Literature on fintech companies

Fintech is a progressive financial, technological innovation resulting in new business models, applications, processes and / or products that significantly affect financial markets, institutions, and services [3]. The extant literature provides several reasons for the prolific growth of fintech firms. One reason is that fintech firms are technologically advanced and use technology to meet societal needs. Furthermore, fintech firms possess several unique characteristics, including a high degree of customer-centricity, strategic partnerships with financial institutions, founders with prior experience in financial services [7], the capacity to readily extend finance to small

and medium enterprises and macro financing via peer-to-peer service [12]. Other attributes of fintech firms' ecosystem include marketing strategies for successful market expansion [8], retail payments market [9], low operating profit margins, relatively low investment in physical assets [10] and a high degree of innovation within their business models. The low-profit margins necessitate operating on a large scale.

Prior studies have identified critical success factors of players in the fintech industry. Being technologically advanced, fintech firms offer new and innovative services to meet societal needs. One of these services is peer-to-peer online loan facilities. These services constitute "substitute products", for traditional financial service providers [18]. Another critical success factor of fintech firms is their agility and speed of service provision, resulting in higher consumer cost savings and convenience. Fintech firms have high customer-centricity and enter strategic partnerships with financial institutions. Founders of fintech firms tend to have prior experience within the financial services industry [7]. Fintech firms can extend finance to small and medium enterprises. They also offer micro-financing via peer-to-peer services [12]. Evidence indicates that after fintech firms commence business partnerships with customers from a particular industry, customers are prepared to switch to fintech providers due to these reasons [1, 19–22].

Following these critical success factors, the operating characteristics of players within the fintech industry are as follows. They tend to have relatively low investments in physical assets [10]. Fintech firms tend to operate on a large scale and deliver value via economies of scale. Hence, it is unsurprising that fintech firms tend to be larger than non-fintech firms. Arguably, the principal competitive strategy of fintech firms is differentiation rather than cost leadership [18].

The theory of disruptive innovation presents a framework appropriate for categorising the types of innovations used by fintech firms as a mode of differentiation. This theory distinguishes "sustainable" and "disruptive" innovations. The two categories differ concerning the degree of business risk and the extent to which they disrupt traditional industries. Naturally, disruptive innovations cause more disruption than sustainable innovations [23]. We view that fintech companies can also be allocated to one of these two categories based on the degree of product market disruption caused.

Prior literature identifies characteristics of fintech firms belonging to the sustainable and disruptive categories. Listed fintech firms are more likely to be disruptive rather than sustainable. Listed fintech firms must implement a greater degree of product innovation to maintain their large scale of operations vis-à-vis non-listed fintech firms (Najaf, Chin and Najaf [24]). Similarly, fintech start-ups are also more likely to belong to the disruptive category due to the high level of product differentiation required for a successful launch in an industry with this level of competition (McWaters, Bruno, Lee and Blake, [25]; [26]. The results of Cumming and Schwienbacher [27] support this categorisation, suggesting that fintech start-ups funded by venture capitalists are more likely to exit the stock market via bankruptcy,

compared to their non-fintech counterparts.[3] Naturally, fintech firms providing disruptive innovation may exhibit larger performance and risk differentials (compared to non-fintech firms) than fintech firms providing sustainability innovations. Hence, to enhance the power of our empirical tests, we select a sample of disruptive fintech firms for benchmarking against non-fintech firms.

For fintech firms, as for firms in any industry, critical success factors are more likely to translate into shareholder value if accompanied by high quality corporate governance. The latter term may be defined as the extent to which agency mechanisms have been successful in reducing the residual loss due to agency relationships of equity [28]. A positive association between corporate governance quality and financial performance has been extensively documented [29–32]. A maintained assumption in our study is that this association holds for fintech companies. This assumption is supported by evidence that growth in fintech venture capital in the post-Global Financial Crisis era has been more substantial in countries without a major financial centre (Cumming and Scheiwnbacher, [27]). It follows that a fintech start-up seeking funding from a venture capitalist, should be aware of greater potential product and capital market competition, when commencing operations in a country of this nature. Hence, a fintech start-up with well-defined board procedures and an adequate level of board independence (dimensions of sound corporate governance [29]) would be more likely to develop a strategic plan that recognises these competitive threats when commencing operations in the new country. We contribute to the literature by investigating the manner in which corporate governance quality augments the aforementioned critical success factors in driving the success of fintech firms.

An important caveat is that the cause-effect relation between corporate governance quality and firm performance may be bi-directional. This association is dynamic rather than static. A possible mechanism that explains causation from improved performance to higher corporate governance quality follows. After the improved performance, a company's resource base would increase. The board of directors may compel the management to channel these resources into improving corporate governance quality via a more equitable distribution of the firm's wealth among the stakeholders [33]. For example, the rigour of the firm's protocols for approving insider transactions may be improved, reducing the scope for expropriation of shareholder wealth [34]. Our study is predicated on a positive association between firm performance and corporate governance quality, irrespective of the direction of the cause-and-effect relation.

2.2 Literature using single-country indices of corporate governance quality

The aforementioned definition of "corporate governance quality" would apply to any jurisdiction in the world. However, due to transnational institutional differences, the appropriate operationalisation of this definition is likely to vary across

[3] A caveat is that support for this conclusion, by Cumming and Schwienbacher [27] is limited to ventures located in countries without a major financial centre.

countries. For example, ownership concentration is generally higher in Asian than Anglo-American countries due to the prevalence of family companies and government share ownership [35, 36]. Consequentially, in Asian countries, companies may be insulated from the disciplinary forces of markets for corporate ownership and managerial labour. Hence, as a corporate governance mechanism, the board of directors' characteristics may be less critical in Asian countries (Claessens et al. [, [37, 38]). A common approach to operationalising corporate governance quality for a particular country, is to use an index, assigning points to companies according to whether they possess several characteristics of high corporate governance quality in the subject country. Naturally, the components of the index and the weights assigned to the components vary trans-nationally.

A critical feature of these single-country studies is that they select attributes reflecting the unique institutional features of the country of interest as components of the indices. For example, a seminal single-country study, Gompers et al. [31], uses data from the United States. Their index measures the extent to which a company's constitution protects shareholders' rights as a direct proxy for corporate governance quality. Bhagat & Bolton [39], using data from the United States, use the same index as Gompers et al. This approach seems to reflect the equity-centric nature of the American capital market.

Hiraki et al. [32] is a prominent Japanese study that uses an index of corporate governance quality. The first component of the index, the degree of influence by the company's leading bank, is assumed to be positively related to corporate governance quality. The authors argue that in Japan, leading banks often function simultaneously as shareholders and lenders, actively involved in the daily operations. This would make the effect in reducing agency costs of both debt and equity.

Using data from Taiwan, two components of Chen et al. [17] index are ownership by the largest five shareholders and aggregate ownership by individuals with more than five per cent of equity. These characteristics are treated as being (monotonically) positively associated with corporate governance quality. Ownership by the largest five shareholders reflects the authors' assessment that in Taiwan, these shareholders are likely to be management, with interests aligned to those of shareholders. The individual block holder component of the index reflects the authors' assessment that in Taiwan, individual block holders are generally not from the controlling family and hence have a genuine interest in monitoring management to reduce Type 2 agency costs of equity [40].

Similarly, studies from South Korea have used indices reflecting the unique institutional features of this country. Black et al. [29] employed asset size as an instrumental variable to acknowledge that some of the South Korean listing rules only applied to companies with assets exceeding two trillion won during their investigation period. Similarly, Byun et al. [30] measured corporate governance quality via an aggregate score of components to capture indicators developed by the Korea Corporate Governance Service: shareholder rights protection, board of director characteristics, quality of annual report disclosure, and audit committee characteristics.

Another critical feature of the single-country studies is recognising non-monotonicity in the association between corporate governance quality and some index components. For example, the two first components of the Chen et al. [17] index are

Chief Executive Officer (CEO) and board chair duality and board size. The index treats companies larger (smaller) than a specified size threshold as having higher corporate governance quality if they do (do not) separate the roles of Chief Executive Officer and board chair. This feature of the index is designed to have regard for the authors' assessment that in Taiwan, factors auguring for a positive (negative) association between corporate governance quality and separating these roles are stronger (weaker) than evidence to the contrary for large (small) companies.

The Japanese index used in Hiraki et al. [32] assumes that corporate governance quality in this country has a non-monotonic association with *keiretsu* ownership. Corporate governance quality is treated as being negatively (positively) associated with *keiretsu* ownership for companies with (without) reciprocal share ownership in the *keiretsu* leader. This reflects the authors' assessment that when a Japanese company has reciprocal ownership in its *keiretsu* leader, the reciprocal shareholdings entrench management, reducing the quality of corporate governance. The authors argue that the opposite scenario occurs when the Japanese company does not have a reciprocal shareholding in its *keiretsu* leader.

Our paper makes a unique contribution by adopting both of these features of single-country studies that use an index to measure corporate governance quality. As components of the index, we choose attributes that we regard as capturing the unique institutional features of the United States. (However, we capture different dimensions from Gompers et al. [31] and Bhagat & Bolton [39].) Similarly, consistent with the aforementioned studies using data from Japan, Taiwan and South Korea and the OECD [14] recommendation, our index assumes that some index elements have non-monotonic associations with corporate governance quality.

3 Hypothesis development

3.1 Hypothesis 1

Referring to our maintained assumption (of a positive association between value and corporate governance quality) and the evidence reported by Chen et al. [17], indicators of sound corporate governance quality, suitable for the United States, would be positively associated with firm performance in this country.[4] The first research hypothesis is given as follows.

H1 Indicators of sound corporate governance quality, suitable for the United States, are positively associated with the profitability of firms operating in this country.

[4] Chen et al. [17] displayed similar maintained assumption.

3.2 Hypothesis 2

Fintech firms arguably have higher operating risk than non-fintech firms. Most business conducted by fintech firms is conducted in a digital environment. This renders fintech firms vulnerable to cyberattacks and the loss of confidential data [41], Najaf et al. [24]). The operations of fintech firms cross geographic boundaries to a greater extent than non-fintech firms. Fintech firms would be exposed to higher foreign currency and political risk, such as sub-optimal access to contacts in some countries [42]. Naturally, multinationals aim to achieve, in their foreign operations, the same degree of reduction in agency costs as achieved in their domestic operations. Nonetheless, appropriate operationalisation of corporate governance quality and efficacy of agency mechanisms tend to differ on a transnational basis [35, 38]. Hence, effective management of foreign operations is likely to compel management to implement and maintain, in foreign segments, different corporate governance. It follows, from aforementioned evidence that fintech firms are delivering on their higher operating risks that fintech firms possess superior corporate governance quality than firms operating in other industries.

The operations of fintech firms also cross industry boundaries to a greater extent than non-fintech firms. Fintech firms develop new applications and services for different industrial sectors, thus requiring familiarity with operational risk factors in these industries [43]. Interactions with various industries may entail different capital expenditure outlays [44, 45]. Interactions with a new industry may entail higher operating costs, mainly due to the initial lack of familiarity with the new industry [45]. We posit that these are the hallmarks of electronic economics. The evidence of superior performance indicates that fintech firms are delivering on the higher operating risks associated with the inter-industry nature of their businesses. This reinforces our position that fintech firms are underpinned by superior corporate governance quality.

Hence, the arguments and evidence are consistent with fintech companies displaying superior performance compared to non-fintech firms. Following our maintained assumption (that corporate governance quality is positively associated with firm performance), fintech firms would have more effective governance systems than firms in other industries. The second research hypothesis follows.

H2 Ceteris paribus, fintech firms have higher corporate governance quality than non-fintech firms.

3.2.1 Hypothesis 3

Studies that use an index of corporate attributes to measure corporate governance quality overlook other mechanisms external to the firm. Although external mechanisms are not a function of corporate policies, they may still be regarded as corporate governance mechanisms due to the effect of aligning principal and agent incentives, as well as a reducing agency costs [28]. These external mechanisms include the threat of hostile takeover, a well-functioning market for managerial labour, product market competition and analyst following [46]. Both the nature and the efficacy of external agency mechanisms are likely to vary transnationally and temporally as a function

of macroeconomic variables. These include national wealth, its distribution amongst members of society, reliance on Foreign Direct Investment, stock market liquidity, the extent to which the capital market is debt versus equity-centric and economic growth. Relevant legal and regulatory variables affect the efficacy of external corporate governance mechanisms, including legal origin (common- versus code-law), the strength of investor protection legislation, the strength of anti-corruption legislation, in addition to enforcement and strictness of securities exchange listing regulations [36].

For fintech firms, it is arguably harder for principals and agents to rely on external corporate governance mechanisms to reduce agency costs. The fact that the fintech industry is relatively young may cause sell-side analysts to have a minimal information base to generate earnings forecasts [47].[5] The business models of fintech firms display high-level organisational complexity due to their inter-industry and transnational nature [49]. Therefore, it would be more difficult for sell-side analysts to use the information available to generate reliable earnings forecasts (Schipper). These mechanisms may reduce the efficacy of analyst following as an external agency mechanism for fintech firms. Secondly, due to the transnational nature of their business, fintech firms engage in substantial trade across developing countries with under-developed legislation and resources for enforcement. These fintech firms would thence have reduced capacity to rely on these country-level institutional mechanisms, to minimise agency costs [35].

Given the reduced scope to rely on external corporate governance mechanisms, principals and agents of fintech firms would be forced to place greater reliance on internal mechanisms implemented by the company management. The third hypothesis follows.

H3 Fintech firms rely more on internal versus external agency mechanisms compared to non-fintech firms.

4 Research methodology

4.1 Tests of the maintained assumption that fintech firms outperform non-fintech firms

This maintained assumption is tested with Ordinary Least Squares (OLS) estimation of Eq. (1) on pooled basis using the entire sample.

$$\text{Perf. metric}_{\text{jit}} = \alpha + \beta_1 \text{Fintech}_{\text{it}} + \sum_{j=1}^{k} \delta_j \text{Control}_{\text{jit}} + \varepsilon_{\text{it}} \tag{1}$$

where

All variables are defined in Table 1.

[5] Naturally, Schipper [47] does not discuss fintech firms. However, our "story" implicitly has a strong basis in the discounted earnings model [48]. Hence, it seems consistent to illustrate our arguments via reference to market expectation of future earnings, proxied by analysts' forecasts.

Table 1 Definitions of variables

Variable	Definition	Relevant Studies
Measures of performance		
$EPS_{i,t}$	Earnings per share of company *i* during year *t*	These metrics are standard, in the literature [16].
$ROA_{i,t}$	Earnings before interest and after tax of company *i* during year *t* / Total assets of company *i* as at the end of year *t*	
$ROE_{i,t}$	Net profit after tax of company *i* during year *t* / Total shareholders' funds of *i* as at the end of year *t*	
R_rf_{it}	Stock return of company *i* during year *t* less the contemporaneous risk-free rate of return	
rf_{it}	The stock return in excess of risk-free rate	
Priced risk factors		
MKT_rf_t	Return of the value-weighted portfolio of all United States (NYSE, AMEX, and NASDAQ) listed stocks minus the risk-free rate, during year *t*	These variables are standard, in the literature [16].
SML_t	The difference in returns between the smallest and largest size-quintile portfolios, using the value-weighted portfolio of all United States (NYSE, AMEX, and NASDAQ) listed stocks	
BML_t	The difference in returns between the highest and lowest stock book value-quintile portfolios, using the value-weighted portfolio of all United States (NYSE, AMEX, and NASDAQ) listed stocks	
RMW_t	The difference in returns between the most and least robust stock quintile portfolios, using the value-weighted portfolio of all United States (NYSE, AMEX, and NASDAQ) listed stocks	
CMA_t	The difference in returns between the most conservative and most aggressive stock portfolios returns, using the value-weighted portfolio of all United States (NYSE, AMEX, and NASDAQ) listed stocks	
Definition of financial technology companies		
$Fintech_{i,t}$	1 (0) if company *i* was (was not) a financial technology firm during year *t*	Najaf et al. [50]

Table 1 (continued)

Variable	Definition	Relevant Studies
Corporate governance quality index		
$CGQI_{i,t}$	*Anti-bribery policy*$_{i,t}$ + *Director independence indicator*$_{i,t}$ + *CEO duality*$_{i,t}$ + *executive directors' tenure indicator*$_{i,t}$	Chen et al. [17],Organisation for Economic Cooperation and Development [14]
Anti-bribery policy$_{i,t}$	1 (0) if, during year *t*, a company *i* had (did not have) an anti-bribery policy	
Director independence (continuous)$_{i,t}$	The percentage of independent directors on the board of company *i* during year *t*	
Director independence indicator$_{i,t}$	*For observations with subject to a controlling shareholding* (an individual with at least 50% of the voting power for election of directors), this variable is homogeneously equal to 1. *For observations with dispersed shareholding* (observations without a controlling shareholding), this variable is equal to 1 (0) if there was (was not) a majority of independent directors on the board.	
CEO duality$_{i,t}$	1(0) if, during year *t*, a company *i* did (did not) separate the roles of CEO and board chair	
Executive directors' tenure$_{i,t}$	For any particular company-year, this a variable is calculated as the mean of *executive directors' tenure*, calculated across all executive directors.	
Executive directors' tenure indicator$_{i,t}$	For fintech company-years – This variable is set to 1 (0) if the mean of *executive directors' tenure*, calculated for the company-year of interest, exceeds the mean of this variable, calculated for the entire sub-sample of fintech company-years. *For non-fintech company-years* – This variable is set to 1 (0) if the mean of *executive directors' tenure*, calculated for the company-year of interest exceeds the mean of this variable, calculated for the entire sub-sample of non-fintech company-years.	

Table 1 (continued)

Variable	Definition	Relevant Studies
Executive director's tenure (continuous)$_{i,t}$	For any particular executive director, in a particular company-year, this a variable is calculated as the number of years between the balance date of the annual report and the date of appointment to the board of directors.	
Firm-level control variables		
Firm Age$_{i,t}$	The number of years between the balance date of firm *i* in year *t* and the balance date of the first disclosure of total assets by firm *i*.	Dickinson [51]
Firm Size$_{i,t}$	Natural logarithm and total assets of firm *i* as at the balance date in year *t*	Tran & Le [52]
Leverage$_{i,t}$	Total debt of firm *i*, as at the end of year *t,* scaled by contemporaneous total assets	This measurement approach is standard in the literature.
Auditor Dummy$_{i,t}$	1 (0) if firm *i* was (was not) audited by a "Big 4" audit firm during year *t*	This measurement approach is standard in the literature.
Country-level control variables		
CPI_t	The inflation rate given by World Economic Forum, for the United States, during year *t*	Beck et al. [53]
GDP_t	The growth of rate of Gross Domestic Product, for the United States in year *t*, provided by Oxford Economics and World Bank World Development Indicators	Najaf et al. [54]
Fixed effect controls		
$Year_t$	1 (0) for observations from year *t* and 0 for other observations	Dickinson [51]
$Industry_{j,t}$	1 (0) if during year *t*, company *i* operated in industry *j* and 0 otherwise	Ali et al. [44]

α, β, and δ_j are regression parameters. ε_{it} is a stochastic disturbance term.

Three different accounting-based performance metrics are used in Eq. (1): Earnings per share (*EPS*), return on assets (*ROA*) and return on equity (*ROE*). Use of *EPS*, in this manner, has precedence in the literature [24, 55–61].

Naturally, our maintained assumption would be supported via a positive coefficient attached to $Fintech_{i,t}$.

The control for firm size captures two distinct impacts on corporate performance. Larger firms may enjoy more scale and scope production economies, auguring for a positive association [33]. Conversely, firm size may represent a priced risk factor [16]. This is consistent with a positive (negative) association for firms delivering (not delivering) on the risk. Therefore, net expectations regarding the sign of coefficient are unclear.

Equation (1) captures the temporal evolution of corporate performance. The traditional approach includes the lagged value(s) of the performance measure as independent variable(s). Unfortunately, this approach violates two critical OLS assumptions: non-stochastic independent variables and zero autocorrelation of disturbances [33, 62]. In order to address this concern, four alternative controls are incorporated: firm age, annual Gross Domestic Product (GDP), annual Consumer Price Index (CPI) and fixed year effects. Notwithstanding evidence that autocorrelation in corporate performance can be positive (Akbar et al.), expectations for the signs of the coefficients are unclear. Firm age is a non-monotonic proxy for the corporate life cycle stage. A company's life cycle stage refers to the sum of the life cycle stages of its outputs. Companies regularly alter their product mix to adapt to regulatory, macroeconomic and industry-level pressures. When a company introduces new products into its output mix in its introductory life cycle phases, the aggregate life cycle phase of the company may regress [51]. These young products may cause short-term deterioration in performance due to high start-up costs [63].

Both *GDP* and *CPI* capture the impact of macroeconomic variables on firm performance, proxying an array of (somewhat offsetting) determinants of firm performance. For example, Leuz & Oberholzer-Gee [64] and Dang & So [65] respectively provide evidence from Indonesia and Egypt that the performance of politically connected firms varies temporally, in accordance with the level of support available from the relevant politician. Using data derived from Malaysia, Johnson and Mitton [66] analysed the economic consequences of restricting capital flows (both outflow of domestic capital and inflow of foreign capital) as a macroeconomic policy tool. The study reveals that the usage of these policy measures erodes economic well-being. This would create a more challenging operating environment for corporations within the country. These variables would also vary temporally. Therefore, the year-fixed effects further capture the impact on corporate performance of the broader macroeconomic and regulatory environment. Expectations are unclear for coefficient signs.

Financial statements are used in many corporate governance mechanisms. In Eq. (1), Auditor quality is controlled via the standard dummy variable, flagging observations with a "Big N" auditor. Higher audit quality reflects more effective monitoring for at least three reasons. Firstly, higher-quality auditors would be better resourced to detect opportunistic accruals-based earnings management [67].

Secondly, the presence of a high-quality auditor may deter real earnings management. This risk of real earnings management is likely to be positively related to the health of a company. Thus, indicators of real earnings management may result in an auditor assessing a client as having higher inherent risk and higher risk of not satisfying the going concern assumption [68]. Thirdly, higher audit quality disciplines management to release higher quality earnings forecasts [69]. Anticipation of a positive coefficient of auditor quality follows.

Equation (1) controls for financial leverage. Higher usage of debt financing exposes shareholders to higher financial risk and a greater probability of corporate failure. Furthermore, empirical evidence suggests that the latter may be a priced risk factor (albeit possibly subsumed within other documented priced risk factors [70]). Using more financial leverage will enhance (erode) the performance of a company if it (does not) deliver on this risk. Therefore, sign expectations pertaining to the coefficient are unclear.

The industry dummies in Eq. (1) capture the performance impacts of industry-specific regulations and product market competition.

Naturally, some of the control variables partially capture the effect on firm performance of corporate governance mechanisms external to the firm. These control variables include *GDP*, *CPI*, fixed industry effects, and fixed year effects. This may be regarded as a limitation of our research design.

4.2 Our index of corporate governance quality

Our index of corporate governance quality and its components are represented via Eq. (2).

$$\begin{aligned} CGQI_{i,t} = {} & Anti-bribery\,policy_{i,t} + Director\,independence\,indicator_{i,t} \\ & + CEO\,duality_{i,t} + executive\,directors'\,tenure\,indicator_{i,t} \end{aligned} \tag{2}$$

Where all variables are defined in Table 1.

There are four components of *CGQI*, the corporate governance quality index: anti-bribery policy, percentage of independent directors, CEO duality and tenure of directors. We assign equal weight to all four factors assuming that they play equally important roles as corporate governance mechanisms. All four governance factors were converted into indicators by assigning a value of one if that indicator reinforces corporate governance quality and zero otherwise. Hence, aggregate *CGQI* ranges between zero and four; higher scores represent higher corporate governance quality. The individual components of the index are explained as follows.

4.2.1 Anti-bribery policy

This variable assumes the value of 1 (0) for observations with (without) an anti-bribery policy. Countering bribery can reduce many dimensions of agency costs. The existence of an anti-bribery policy may arrest the management from expropriating wealth from shareholders to management or from non-family shareholders to family shareholders.

Furthermore, an anti-bribery policy may reduce over-investment. It would be more difficult for the board to approve capital expenditure proposals that are "pet" projects of the management but not value-optimising for shareholders [71]. Based on data accumulated from 25 countries, Li, Li, Liu, Wang and Wu [72] found that the existence of an anti-bribery policy was linked with higher corporate value. The evidence suggests that the impact was greater in countries with high quality legal and regulatory climates. The strength of the legal and regulatory environment is high in the United States. Hence, the implementation of an anti-bribery policy would be appropriate to include in a corporate governance quality index designed for the United States.

4.2.2 Director independence

Independent directors on the board can reduce agency costs by providing objective monitoring of management. For example, Lamoreaux, Litov, and Mauler [73], using data from the United States, evidenced that the investors respond positively to the appointment of independent directors. Naturally, we acknowledge the existence of counter-mechanisms. In comparison to executive directors, independent directors may lack intimate knowledge of the business model and extensive industry experience [49, 74]. The primary goal is to flag, as having higher corporate governance quality, observations that achieve an optimal balance between these offsetting mechanisms. Therefore, the guidelines offered by OECD [14] were deployed. They endorse the current regulations related to independent directors prevailing in the United States.

The requirements differ according to whether companies are subject to a controlling shareholding. Subjugation to a controlling shareholding in the United States is defined as a situation in which one has more than 50% of the voting power for the election of directors. For these companies, unifying board chair and CEO roles are likely to reduce, rather than increase, agency costs (OECD [14]). This characteristic is expected to feature in family companies. With less management and ownership segregation, these companies may face higher Type 2 versus Type 1 agency costs of equity [36, 40]. Thus, they are not subject to any requirement regarding the percentage of independent directors on the board. A score of 1 was assigned for the board independence indicator for all observations subject to controlling shareholding.

Conversely, companies subject to dispersed ownership have greater management and ownership segregation. In this case, they may have higher Type 1 versus Type 2 agency costs of equity. Many non-family companies would have dispersed ownership [40]. In these companies, the value added by independent directors from objective monitoring may exceed compensating disadvantages. The United States regulations recommend that companies with dispersed ownership have a majority of independent directors on the board. Hence, a score of one was assigned to observations with dispersed ownership if they possessed majority independent boards.

4.2.3 Separation of roles of CEO and board chair

The separation of the roles of CEO and board chair is another governance mechanism designed to increase the objectivity of monitoring and decision-making [75].

Nonetheless, several counter-mechanisms exist. Unifying the roles of CEO and board chair may expedite decision-making by boards, thus resulting in improved governance. This mechanism may be of heightened importance in family companies, characterised by the dominance of Type 2 versus Type 1 agency costs of equity [36, 40].

Evidence from the United States suggests that the former mechanism is significantly more potent in this country than the latter [75]. A possible reason is that family companies are less prevalent in the United States than in Asian countries [36, 50]. Hence, unlike Chen et al. [17], we assume that this attribute has a monotonic, positive association with corporate governance quality. We assigned a score of one (zero) to all observations that did (did not) separate the roles of CEO and board chair.

4.2.4 Tenure of executive directors

Offsetting mechanisms affect the association between corporate governance quality and executive director tenure. Executive directors who have served longer terms on the board would have more experience with this particular company and may provide higher quality monitoring [49].[6] On the contrary, some directors may be long-serving because the board is "captured" by the CEO and hence does not face severe consequences for dysfunctional behaviour, causing reduced corporate governance quality [76]. Empirical evidence from the United States reveals that the former (latter) mechanism dominates at low (high) levels of executive director tenure [77]. This generates the expectation that the association with corporate governance quality adheres to an "inverted U" shape in the United States.

The location of the turning point of the "inverted U" is likely to vary cross-sectionally and temporally as a function of many variables, such as organisational complexity, research intensity and life cycle phase [49, 74]. The United States regulations recognise this situation. There is no maximum tenure restriction set by the United States Code of Governance for executive directors[78].[7] Hence, we assume that this turning point differs between fintech and non-fintech firms. For the former, the indicator takes a value of one if the tenure of executive directors is below the average term of all sample directors and zero otherwise. The indicator variable was constructed analogously for non-fintech observations.

4.3 Tests of H1

The first hypothesis is tested using the entire sample by OLS estimation of Eq. (3) on a pooled basis.

[6] Coles et al., [49] investigated this issue with reference to board independence, rather than executive director tenure.

[7] However, there is a recommendation by OECD that the term of an executive director does not exceed three years (OECD, [14]).

$$\mathrm{R\_rf_{it}} = \alpha + \beta_i \mathrm{MKT\_rf_t} + sSML_t + h\mathrm{BML_t} + rRMW_t + c\mathrm{CMA_t} + \sum_{j=1}^{4} \delta_j \, CGQI_{\mathrm{ijt}-1} + \varepsilon_{it} \tag{3}$$

where:

CG quality metric, the independent variable(s) of interest, is alternatively specified as each component of *CGQI*, all the components of *CGQI* as separate variables and *CGQI* holistically. All other variables are defined in Table 1.

α, β, s, h, r and c are regression parameters. δ_j is a vector of parameters of *CGQI* or its constituent(s), used in the particular model.

ε_{it} is a stochastic disturbance term.

Equation (3) represents the Fama and French [16] five-factor model. This model is used to reduce the possibility that the coefficients of the corporate governance quality index components are merely capturing priced risk factors [17]. H1 would be supported if δ_j, the coefficients *CGQI* and its individual constituents, are positive and significant.

Equation (3) recognises a one-year time lag between the date of observation of the dependent variable and the date of observation of the independent variable of interest. This approach for addressing endogeneity has precedence in the literature [17, 50, 61, 63].

4.4 Tests of H2

H2 is tested via two-sample *t*-tests, comparing the means of *CGQI* and its constituents between fintech and non-fintech observations. H2 will be supported if the mean index is higher for the fintech sample.

4.5 Tests of H3

H3 is tested using the OLS estimation of Eq. (4) on a pooled basis.

$$\mathrm{Perf.Metric_{jit}} = \alpha + \beta_i \mathrm{Fintech}_{it} + \delta \, \mathrm{CGQI_{it-1}} + \lambda \mathrm{CGQI_{it-1}} * \mathrm{Fintech_{it}} + \sum_{i=1}^{n} \kappa_j \mathrm{Control_{jit}} + \varepsilon_{\mathrm{it}} \tag{4}$$

where:

$Fintech_{it}$ * $CGQI_{it\text{-}1}$ is an interaction term. All other variables are defined in Table 1.

α, β, δ, λ, and κ_j are regression parameters. ε_{it} is a stochastic disturbance term.

Hypothesis 3 would be supported via a positive coefficient attaching to the interaction term. This would suggest that the positive association between performance and the quality of internal corporate governance mechanisms is stronger for fintech versus non-fintech companies.

Table 1 presents formal definitions of all the variables.

5 Sample selection and data collection

We selected two different samples—a treatment sample of fintech observations and a control sample of non-fintech observations. The investigation period is from 2010 to 2019. The unit of observation for both samples, is the firm-year. The results of previous recent studies (Najaf, Chin, and Najaf, [58]) indicate that listed fintech firms are likely to be beyond the introductory life cycle phase. This homogeneity is an intrinsic control for the effect of life cycle considerations on corporate performance [51]. To obtain a representative sample of fintech firms, we selected the firms from the well-known Keefe Bruyette and Woods (KBW) Nasdaq Financial Technology Index (KFTX) constituents. We choose KFTX because it is the first official fintech index recognised in the literature [79]. The constituents of KFTX include both fintech and non-fintech firms. A total number of 48 fintech companies are listed in the KFTX. The corporate governance and financial information data were gathered from the Bloomberg database. Furthermore, we collected data for the Fama and French [16] five factors and the risk-free rate from the Kenneth R. French online library [80].

We selected the matching control sample of non-fintech firms, using the Bloomberg "Relative Valuation (RV)" function [81]. This process yielded 145 non-fintech firms matched based on the following variables: industry membership, ownership structure, earnings per share and Bloomberg credit rating. We used annual data for all the variables because governance structure does not change frequently but evolves gradually over the years [17].

The World Economic Forum provided data for CPI. Data for *GDP* were provided by Oxford Economics and the World Bank Development Indicators [61, 63].

We then applied selection filters to both samples. Observations with missing data related to corporate governance variables were excluded. The final combined sample comprises 1,712 firms-year observations, representing 193 distinct firms.

6 Descriptive statistics

Table 2 presents distributional statistics related to the components of the *CGQI*. Panel (a) reveals that the average percentage of independent directors for the pooled sample is 81. Limited temporal variation is evidenced in the yearly averages of this variable. The lowest yearly average is 79 in 2010, while the highest annual average is 82 in the last three years of the investigation period. This shows that all the firms in the sample met the minimum independent directors' percentage requirements by OECD [14].[8] The average directors' tenure for the pooled sample is 8.22 years. The yearly averages declined slightly throughout the investigation period, from 8.52 years in 2010 to 7.90 years in 2019. This decline appears to be gradual and non-monotonic. The percentage of the listed firms with an anti-bribery policy increased rapidly (but not entirely monotonically) from 32 in 2010 to 89 in 2019. This reveals

[8] The OECD recommendation is for boards composed of at least 50% independent directors for United States one-tier board listed firms.

Table 2 Sample distribution of CGQI

Panel (a)—Individual components of the index

(1)	(2)	(3)	(4)	(5)	(6)
		Independent Directors (%)	Directors' Tenure (years)	Firms with anti-bribery policy	Firms with CEO duality
Year	Number of Firms	Mean	Mean	Number (percentage)	Number (percentage)
2010	150	79.358	8.524	48 (32)	17 (11)
2011	156	79.671	8.531	66 (42)	15 (10)
2012	160	80.646	8.485	91 (57)	15 (9)
2013	163	80.485	8.426	111 (68)	16 (10)
2014	173	79.800	8.277	121 (70)	17 (10)
2015	176	80.748	8.184	138 (78)	19 (11)
2016	179	81.023	8.119	149 (83)	20 (11)
2017	182	82.044	8.049	163 (90)	25 (14)
2018	188	82.321	7.899	176 (94)	29 (15)
2019	185	82.465	7.886	165 (89)	30 (16)
Total	1,712	80.921	8.221	1,228 (71)	203 (12)

Panel (b)—The index in aggregate

Year	Number (Percentage) of firm with					Mean	Standard Deviation
	$CGQI=1$	$CGQI=2$	$CGQI=3$	$CGQI=4$	Total		
2010	17 (11)	51 (34)	61 (41)	21 (14)	150 (100)	2.573	0.870
2011	16 (10)	50 (32)	64 (41)	26 (17)	156 (1000)	2.641	0.880
2012	8 (5)	46 (29)	71 (44)	35 (22)	160 (100)	2.831	0.826
2013	7 (4)	39 (24)	76 (47)	41 (25)	163 (100)	2.926	0.813
2014	6 (3)	42 (24)	85 (49)	40 (23)	173 (100)	2.919	0.781
2015	5 (3)	33 (19)	91 (52)	47 (27)	176 (100)	3.023	0.756
2016	3 (2)	32 (18)	92 (51)	52 (29)	179 (100)	3.078	0.730
2017	2 (1)	32 (18)	83 (46)	65 (36)	182 (100)	3.159	0.745
2018	1 (1)	28 (15)	86 (46)	73 (39)	188 (100)	3.229	0.713
2019	2 (1)	24 (13)	87 (47)	72 (39)	185 (100)	3.238	0.713
Total	67 (4)	377 (22)	796 (46)	472 (28)	1,712 (100)	2.977	0.808

Where *CGQI* is defined in Table 1

that the listed firms increasingly embraced anti-bribery policies as an agency mechanism during the investigation period. The percentage of observations that separated the CEO and board chair roles is extremely high throughout the study period. The minimum (maximum) yearly percentage was 84 (91) in 2012 (2019), signifying that the sample was plagued by limited variation for this component.

Panel (b) of Table 2 presents the sample distribution of *CGQI* (in aggregate), stratified by year. Panel (b) displays (almost) monotonic declines in the percentages of observations for which $CGQI=1$ and $CGQI=2$, over the course of the

Table 3 Mean statistics of performance metrics and control variables, stratified by fintech versus non-fintech sub-samples

Variables categories	Variables	Variable Type	Panel A: Basic statistics for full sample (N = 1,712)					Panel B: Mean difference: Fintech versus non-fintech		
			Obs	Mean	Std. Dev	Min	Max	Fintech (1) N = 434	Non-fintech (2) N = 1,278	Difference (1–2) (*t*-stat)
Performance	*EPS*	Continuous	1712	2.167	2.104	−2.61	7.98	2.27	2.13	.143 (1.22)
	ROA	Continuous	1712	6.304	7.555	−12.728	32.088	7.72	5.82	1.89 (4.55)***
	ROE	Continuous	1712	17.837	21.422	−26.183	129.878	22.25	16.33	5.91 (5.00)***
Firm level control	*Firm Age*	Continuous	1712	27.412	23.862	0	104	21.39	29.45	−8.05 (−6.14)***
	Firm Size	Continuous	1712	3.659	.641	2.161	5.04	3.19	3.81	−.62 (−19.19)***
	Auditor Dummy	Dichotomous	1712	.968	.176	0	1	.953	.972	−.018 (−1.90)*
	Leverage	Continuous	1712	5.351	5.532	0	31.624	4.58	5.61	−1.02 (−3.35)***
Country level control	*Gross Domestic Product*	Continuous	1712	13.248	.049	13.176	13.331			
	Consumer Price Index	Continuous	1712	1.776	.767	.119	3.157			

Where all variables are defined in Table 1

* and *** respectively denote significance at the 10 and five percent levels (two-tailed)

investigation period. Conversely, the percentage of companies for which $CGQI = 3$ remained approximately constant. The percentages of companies with $CGQI = 4$ shows a dramatic (almost threefold) increase, from 14% in 2010 to 39% in 2019. This indicates that the sample observations' corporate governance quality improved substantially during the investigation period.

Table 3 presents univariate descriptive statistics pertaining to the other variables, stratified by fintech firm status. The statistics tabulated in Table 3 reveal that the fintech firms have significantly higher *ROA* and *ROE* than non-fintech firms ($p < 0.01$, two-tailed), supporting the maintained assumption that fintech firms outperform their non-fintech counterparts.[9] The statistics also reveal that the fintech firms are significantly younger and smaller than non-fintech firms ($p < 0.01$, two-tailed). This is consistent with the fintech industry being relatively young [82]. The statistics reveal that the fintech firms are less likely to be audited by "Big N" auditor than non-fintech firms ($p < 0.10$, two-tailed). A possible explanation is that fintech firms, being at the growth life cycle phase, wish to avoid the expense of a "Big N" auditor (consistent with H3), they may consider it unnecessary to engage a "Big N" auditor to achieve the desired agency cost reduction.

The statistics in Table 3 indicate that fintech firms use less financial leverage than non-fintech firms ($p < 0.01$, two-tailed). The Pecking Order Theory of capital structure can explain this finding. Fintech firms, being relatively young, may be attracted to the fact that debt finance is less expensive than equity [83]. Furthermore, if finfech firms have sound internal corporate governance mechanisms.

Table 4 presents the Pearson and Spearman correlations between pairs of variables, calculated using the pooled sample. The variables *director independence (continuous)* and *executive directors' tenure (continuous)* are specified continuously rather than as dichotomous components of *CGQI*. Table 4 reveals high-level consistency, regarding signs and significance, between Pearson and Spearman correlations. This suggests that the results in the paper are unlikely to be driven by influential outliers.

R_rf_{it} stock risk premium, is negatively correlated with two of the accounting performance metrics, *EPS* and *ROE*. A possible explanation is that while the sample companies' positive profits were insufficient to adequately compensate shareholders for bearing risk. Two of the three pairs of earnings metrics (*EPS* and *ROA*) and (*ROA* and *ROE)* have positive bivariate correlations. This validating result suggests that they are capturing similar underlying performance constructs.

The correlations between each of the four components of *CGQI* and each of the four performance metrics (*R_rf*, *EPS*, *ROA* and *ROE*) display mixed conformity with expectations. Seven of these correlations are positive; six are negative, and the remaining three are insignificant. These results highlight the importance of controlling for covariate determinants of performance, in tests of the association between performance and the components of *CGQI*.

Each of the first three components of *CGQI* (*anti-bribery policy*, *director independence (continuous)* and *CEO duality*) are positively correlated with each other.

[9] However, the mean of *EPS* does not differ between the two samples.

Table 4 Correlation coefficients (pearson and spearman-rank (italicized) correlations are presented)

Variables	Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14
R_rf	1		*0.3642**	*0.2453**	*0.4267**	*−0.0836**	*−0.1284**	*−0.0852**	*0.0747**	*0.2345**	*0.2067**	*0.7278**	*0.1363**	*0.2398**	*−0.5657**
Anti-bribery policy	2	0.373*		*0.1233**	*0.0811**	*−0.0935**	*−0.0643**	*0.043*	*0.032*	*0.0497**	*−0.003*	*0.1373**	*−0.019*	*0.005*	*−0.4082**
Director independence (continuous)	3	0.200*	0.144*		*0.3435**	*−0.0921**	*−0.0656**	*−0.0659**	*0.006*	*0.2335**	*0.1547**	*0.3037**	*0.1251**	*0.1543**	*−0.0837**
CEO duality	4	0.392*	0.081*	0.291*		*−0.0508**	*0.032*	*−0.1297**	*0.014*	*0.1826**	*0.1743**	*0.5716**	*0.1531**	*0.2532**	*−0.0699**
Executive directors' tenure (continuous)	5	−0.067*	−0.094*	−0.080*	−0.050*		*−0.1626**	*0.1371**	*0.0956**	*−0.0760**	*0.04*	*−0.1052**	*−0.0798**	*−0.1728**	*−0.001*
EPS	6	−0.132*	−0.065*	−0.056*	−0.058*	−0.106*		*0.1780**	*0.0720**	*0.1118**	*0.1509**	*−0.1506**	*0.029*	*−0.1272**	*0.0695**
ROA	7	−0.088*	0.055*	−0.011	−0.083*	0.103*	0.173*		*0.7429**	*0.3571**	*0.0845**	*−0.1216**	*0.028*	*−0.5387**	*0.005*
ROE	8	0.033	0.059*	0.008	0.034	0.071*	−0.005	0.596*		*0.4223**	*0.1223**	*0.0731**	*−0.026*	*−0.027*	*−0.0624**
Firm age	9	0.236*	0.061*	0.228*	0.176*	−0.093*	0.070*	0.320*	0.331*		*0.2319**	*0.2496**	*0.1181**	*0.0708**	*−0.1132**
Firm size	10	0.129*	−0.003	0.157*	0.168*	0.032	0.113*	0.087*	0.059*	0.163*		*0.2845**	*0.001*	*−0.015*	*−0.012*
Auditor dummy	11	0.682*	0.133*	0.245*	0.560*	−0.087*	−0.150*	−0.105*	0.043	0.250*	0.242*		*−0.037*	*0.015*	*0.008*
Leverage	12	0.138*	−0.019	0.129*	0.153*	−0.080*	0.005	0.032	0.002	0.109*	0.039	0.228*		*−0.0551**	*0.007*
GDP	13	0.110*	−0.013	−0.025	0.141*	−0.147*	−0.121*	−0.332*	0.105*	0.067*	−0.040	0.199*	−0.045		*−0.0500**
CPI	14	−0.641*	−0.416*	−0.084*	−0.069*	−0.001	0.065*	0.013	−0.051*	−0.137*	0.043	−0.083*	0.016	0.020	

Where all variables are defined in Table 1. * denotes significance at the five-percent level (two-tailed)

This may be due to management regarding these individual corporate governance mechanisms as complements rather than substitutes. However, *executive directors' tenure continuous* is negatively correlated with each of these three other components of corporate governance quality. This may be due to our specification of *executive directors' tenure (continuous)*, in Table 4, as a continuous variable rather than the dichotomous specification.

Most of the control variables display significant correlations with the performance metrics. *Firm age* is positively correlated with all four metrics. This suggests that in the United States, there could be a paucity of companies that changed their product mix to the extent that they regressed in the life cycle phase [51]. *Firm size* is also positively correlated with three of the four-firm performance metrics. This signifies that the companies experienced production economies of scale [33]. The *auditor dummy* is positively correlated with risk premium but negatively correlated with two of the earnings metrics (*EPS* and *ROA*). *The auditor dummy* is not correlated with the third earnings metric, *ROE*. A possible explanation for these conflicting results is that categorising "Big N" auditors as high quality and other auditors as low quality is excessively simplistic. *Leverage* is positively correlated with three out of four performance metrics. This outcome is attributed to the fact that the sample companies are heterogeneous with respect to whether they were over-levered versus under-levered. (i.e., the optimal degree of financial leverage may differ cross-sectionally and temporally.) *GDP* is correlated with all four-performance metrics. Similarly, *CPI* is correlated with three out of four performance metrics. This supports our contention that these two variables capture macroeconomic determinants of corporate performance.

The correlations between corporate governance quality variables and firm-level control variables are noteworthy. The *anti-bribery policy* is positively correlated with *firm age* and *auditor dummy*. Similarly, *independent directors' percentage* is positively correlated with all four firm-level control variables: firm age, firm size, auditor quality, and financial leverage. These correlations depict that older and larger firms are better resourced and are more likely to implement high-quality corporate governance.

7 Empirical results

Table 5 presents the results of tests of the maintained assumption that fintech firms display superior financial performance to non-fintech firms.

All three models in Table 5 report positive and significant coefficients of *fintech* ($p < 0.01$, two-tailed). This finding upholds the maintained assumption that fintech firms outperform non-fintech firms. The coefficients of *fintech* are 0.76, 1.56 and 8.95, respectively, in the models using *EPS*, *ROA* and *ROE* as dependent variables. This suggests that *ceteris paribus*, fintech firms generate 0.76% higher earnings per share, 1.56% higher return on assets than non-fintech firms, and 8.95% higher return on equity. (i.e., the extra return delivered to shareholders by fintech firms is almost six times larger than the extra return delivered on the firm's assets). Hence, successful use of financial leverage appears to be a factor driving the superior performance of fintech firms. The coefficient of *financial leverage* in Model (2) is 0.81 and significant ($p < 0.01$, one-tailed).

Table 5 Tests of maintained assumption that fintech firms outperform non-fintech firms

$$\text{Perf.metric}_{jit} = \alpha + \beta_1 \text{Fintech}_{it} + \sum_{j=1}^{k} \delta j \ \text{Control}_{jit} + \varepsilon_{it} \quad (1)$$

Where: α, β and δ_j are regression coefficients. $\varepsilon_{i,t}$ is a stochastic disturbance term. All variables are defined in Table 1. *, ** and *** respectively denote significance at the ten-, five- and one-percent levels. One-tailed tests were conducted, for coefficients for which there are a priori sign expectations. Two-tailed tests are conducted for other coefficients.

	Performance indicators		
	EPS Model 1	ROA Model 2	ROE Model 3
Fintech	**0.757*** **	**1.560*** **	**8.948*** **
	[6.629]	**[3.074]**	**[5.427]**
Firm age	0.010***	0.032***	0.085***
	[4.567]	[4.419]	[3.236]
Firm size	0.784***	−0.331	3.162***
	[8.634]	[−0.916]	[3.201]
Auditor dummy	0.693***	1.131	−0.343
	[4.416]	[1.600]	[−0.169]
Leverage	−0.000	−0.371***	0.813***
	[−0.040]	[−8.514]	[4.131]
Gross domestic product	−5.975***	−0.884	−30.046**
	[−4.516]	[−0.195]	[−2.138]
Consumer price index	−0.007	0.075	0.111
	[−0.107]	[0.314]	[0.171]
Constant	77.385***	19.753	399.778**
	[4.405]	[0.328]	[2.140]
Year effect	Yes	Yes	Yes
Ind. effect	Yes	Yes	Yes
Observations	1,712	1,712	1,712
R^2 value	12.45%	13.58%	8.25%

This shows that, on average, the fintech firms generate 0.81% more shareholder returns from effective use of debt-financing than non-fintech firms.

There are some surprising results in Table 5. Most of these are in the model using *ROA* as the dependent variable. This is the only model reporting insignificant coefficients of *firm size* and *GDP*. The coefficient of *financial leverage*, −0.37, is significant and negative ($p < 0.01$, one-tailed) in this model. *Prima facie*, this would mean that when an American company increases its debt financing (vis-à-vis use of equity financing) by one unit, its operating return slumps by almost 0.40%. This result defies the explanation; *ROA* measures return from conducting business, independent of capital structure. The model using *ROA* as the dependent variable is the only model with a significant coefficient of *auditor dummy.* (The coefficient of

Table 6 Tests of H2

Table 6 reports estimates of Eq. (3).

$$R\_rf_{it} = \alpha_i + \beta_i MKT\_rf_t + sSMB_t + hBML_t + rRMW_t + cCMA_t + \sum_{j=1}^{4} CG\ components_{ijt-1} + \varepsilon_{it} \quad (3)$$

CG quality metric, the independent variable(s) of interest, is alternatively specified as each component of *CGQI*, all the components of *CGQI* as separate variables and *CGQI* holistically. All other variables are defined in Table 1.

α, β, s, h, r and c are regression parameters. δ is a vector of parameters, of *CGQI* or its constituent(s) used in the particular model. $\varepsilon_{i,t}$ is a stochastic disturbance term.

One-tailed tests were conducted for coefficients with a priori sign expectations. Two-tailed tests are conducted for other coefficients.*, ** and *** respectively denote significance at the ten-, five- and one-percent levels.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
MKT_rf	−0.013***	−0.014***	−0.014***	−0.014***	−0.013***	−0.014***
	[−5.276]	[−5.607]	[−5.437]	[−5.525]	[−5.471]	[−5.516]
SMB	0.046***	0.050***	0.051***	0.050***	0.046***	0.048***
	[9.962]	[10.747]	[10.663]	[10.613]	[10.233]	[10.235]
HML	0.032***	0.034***	0.032***	0.033***	0.033***	0.034***
	[11.323]	[11.285]	[10.676]	[11.045]	[11.714]	[11.395]
RMW	−0.005	−0.004	−0.003	−0.004	−0.006	−0.005
	[−1.080]	[−0.889]	[−0.578]	[−0.723]	[−1.217]	[−1.028]
CMA	−0.047***	−0.045***	−0.041***	−0.043***	−0.048***	−0.046***
	[−8.782]	[−8.170]	[−7.398]	[−7.844]	[−9.222]	[−8.348]
Anti-bribery policy	**0.727*** **				**0.660*** **	
	[14.833]				**[13.755]**	
Directors' independence indicator		**0.017*** **			**0.012*** **	
		[9.250]			**[7.285]**	
CEO duality			**0.328*** **		**0.114***	
			[5.036]		**[1.858]**	
Executive directors' tenure indicator				**0.037*** **	**0.028*** **	
				[5.887]	**[4.821]**	
CGQI						**0.287*** **
						[10.682]
Constant	2.979***	2.183***	3.553***	3.824***	2.289***	2.663***
	[48.712]	[14.324]	[69.604]	[53.163]	[15.060]	[27.715]
R^2	25.51%	19.28%	16.41%	17.9%	39.24%	20.54%
Number of observations	1,711	1,711	1,711	1,711	1,711	1,711

the *auditor dummy* is positive and significant ($p < 0.01$, one-tailed) in this model.) There is no logical explanation as to why having a "Big N" auditor would result in improved *ROA* but have no impact on *EPS* or *ROE*. Another surprising result is that the intercept term in Model (3) (using *ROE* as the dependent variable) is 400, significant and positive ($p < 0.01$, one-tailed). This result is also meaningless in context.

A possible explanation for these results is that Eq. (2) suffers from misspecification. (i.e., many determinants of firm performance are not controlled for).

Table 5 reports reasonable consistency regarding the coefficients of the other control variables between the models using *EPS* and *ROE* as dependent variables. All three models report positive coefficients of *firm age* ($p < 0.01$, one-tailed). The models using *EPS* and *ROE* as dependent variables both document positive coefficients attaching to *firm size* ($p < 0.01$, one-tailed) and negative coefficients attaching to *GDP* ($p < 0.01$, one-tailed). Hence, the factors captured by *firm size* (*GDP*) auguring for a positive (negative) association with firm performance appear to be stronger than counter-factors. The consistency between the two models reinforces the credibility of these results.

Table 6 presents estimates of Eq. (2), testing H1. The first hypothesis postulates a positive association between firm performance in the United States and an index of corporate governance quality, designed with regard to institutional features of this country.

Models (1)–(4) each contains, as the independent variable of interest, only one component of *CGQI*. All four of these models report positive and significant coefficients ($p < 0.01$, one-tailed), attaching to their respective components of *CGQI* (*anti-bribery policy*, *independent directors' indicator*, *CEO duality* and *executive directors' tenure indicator*). Model (5) contains all four components of *CGQI* as joint independent variables of interest. Each of these four variables has a positive and significant coefficient ($p < 0.10$, one-tailed). This suggests that each dimension of corporate governance quality captured by our index adds incremental value in excess of the value added by the other three components. Model (6) contains the aggregate index, *CGQI*, as the independent variable of interest. The coefficient of *CGQI* in this model is positive and significant ($p < 0.01$, one-tailed).

The components of our index reflect the approach used by regulators in the United States to operationalise "corporate governance quality" in this country. Similar to the evidence produced by Chen et al. [17], with respect to Taiwan, our results indicate that the regulators in the United States have used corporate governance indicators that accurately capture their country's institutional environment. Support for H1 further suggests that the OECD [14] has accurately identified corporate governance indicators befitting the United States.

Table 7 presents the results of tests of H2, conjecturing that fintech firms outperform non-fintech firms.

The results shown in Table 7 provide strong support for H2, postulating that fintech firms have better quality corporate governance than non-fintech firms. For *CGQI* and each of its constituents, the mean score for the fintech sample is significantly higher than the counterpart mean for the non-fintech sample ($p < 0.01$, one-tailed).

From the four components of *CGQI*, the *anti-bribery policy indicator* exhibits the highest difference between means of fintech and non-fintech observations. Eighty-two percent of the fintech observations had an anti-bribery policy when compared to 68% of non-fintech observations. As a young and progressive industry, the fintech firms seemed to have embraced the value of anti-bribery policies.

Table 8 presents the results of tests of H3, postulating that fintech firms rely more on internal versus external governance mechanisms, vis-à-vis non-fintech firms, to reduce agency costs.

Table 7 The Corporate Governance Quality index and its components, stratified by fintech company status

Variable name	Full sample (N = 1,712 observations)					Stratified sub-samples		
	Variable type	Mean	Std dev	Min	Max	Means		
						FinTech obs. (N = 434)	Non-FinTech obs. (N = 1,278)	Difference (FinTech—non-FinTech) (*t*-statistic)
CGQI	Continuous	2.977	.808	1	4	**3.12**	**2.91**	**.271 (6.11)*****
Anti-bribery policy indicator	Dichotomous	.717	.45	0	1	.817	.683	.134 (5.43)***
Independent directors' indicator	Dichotomous	.97	.174	0	1	0.98	0.96	0.03 (2.77)**
CEO duality indicator	Dichotomous	.88	.323	0	1	.94	.85	0.08 (4.74)***
Executive director's tenure indicator	Dichotomous	.73	0.44	0	1	.77	.71	0.06 (2.42)**

Where all variables are defined in Table 1

Table 8 Tests of H3

Our economic model is as follows:

$$\text{Perf.Metric}_{jit} = \alpha + \beta_i \text{Fintech}_{it} + \delta \text{CGQI}_{it-1} + \lambda \text{CGQI}_{it-1} * \text{Fintech}_{it} + \sum_{i=1}^{n} \kappa_j \text{Control}_{jit} + \varepsilon_{it} \quad (4)$$

Where: All variables are defined in Table 1. α, β, δ and κ_j are regression parameters. $\varepsilon_{i,t}$ is a stochastic disturbance term.

	Performance indicators		
	EPS Model 1	ROA Model 2	ROE Model 3
CG index	−0.065	0.507**	1.006*
	[−1.067]	[2.133]	[1.714]
Fin	−0.221	4.257***	8.308**
	[−0.684]	[2.661]	[2.045]
*Fin*CG Index*	**0.288*** **	**0.828***	**0.080**
	[2.961]	**[1.915]**	**[0.068]**
Firm age	0.010***	0.032***	0.084***
	[4.453]	[4.430]	[3.222]
Firm size	0.782***	−0.385	2.961***
	[8.618]	[−1.087]	[2.928]
Auditor dummy	0.745***	1.231*	0.471
	[4.629]	[1.690]	[0.221]
Leverage	−0.004	−0.363***	0.805***
	[−0.340]	[−8.378]	[4.107]
GDP	−5.912***	0.535	−24.900*
	[−4.350]	[0.116]	[−1.779]
CPI	−0.011	0.095	0.139
	[−0.163]	[0.394]	[0.212]
Constant	76.755***	−0.655	−9.282***
	[4.244]	[−0.011]	[−5.932]
Year effect	Yes	Yes	Yes
Ind. effect	Yes	Yes	Yes
Observations	1,712	1,712	1,712
R^2 value	12.92%	13.67%	20.57%

The results shown in Table 8 provide moderate support for H3. Model (1) and (2), respectively using *EPS* and *ROA* as the accounting performance metric, report positive and significant coefficients of *Fintech * CGQI* ($p < 0.05$, one-tailed). However, contrary to expectations, Model (3), using *ROE* as the accounting performance metric, reports an insignificant coefficient of *Fintech * CGQI*.

All three models in Table 8 document positive coefficients of *firm age* ($p < 0.01$, two-tailed). The coefficient values are 0.03 and 0.08 in Models (1) and (2), respectively. A possible interpretation is that in the United States, older firms retain their overall maturity, even when they introduce some new items into their product mix.

This causes them to display stable earnings streams that sustain product market competition (Casey, McGee, & Stickney, [84]; [51].

Some results in Table 8 defy the explanation. The coefficient of *firm size* is positive and significant in Models (1) and (3) ($p < 0.01$, one-tailed), respectively, using *EPS* and *ROE* as the dependent variable. However, the counterpart coefficient in Model (2), using *ROA* as the dependent variable, is insignificant. The coefficients in the three models are respectively 0.782, -0.385 and 2.961. Thus, one-unit increase in firm size is not associated with any difference in operating accounting return but is associated with a larger shareholder return of 3% per annum and a larger accounting return to shareholders of 0.78% per annum. It is illogical that firm size can capture variable(s) that do not affect operating risk but substantially affect return from using return financing. Similarly, it defies economic logic that the *auditor dummy* is positive and significant ($p < 0.10$, one-tailed) in Models (1) and (2) but insignificant in Model (3). It also defies logic that the coefficient of *financial leverage* is insignificant in Model (1), negative and significant in Model (2) ($p < 0.01$, two-tailed), but positive and significant in Model (3) ($p < 0.01$, two-tailed). The same comment applies to the coefficients of *GDP*. This coefficient is negative and significant ($p < 0.01$, two-tailed) in Models (1) and (3) but insignificant in Model (2).

The lack of consistency, across the three models, regarding the signs and significance of these control variables, in Table 8 may be due to Eq. (2) being plagued by model misspecification. (i.e., there are likely other determinants of accounting return not controlled for in the models.) In this regard, the results in Table 8 are similar to their counterparts in Table 5.

8 Conclusion

This paper investigates the financial performance and corporate governance quality of fintech firms using United States data. This study is predicated on the assumption that fintech firms outperform their non-fintech counterparts. Our evidence is consistent with this maintained assumption. Our measure of corporate governance quality is an index based on the Organisation for Economic Cooperation and Development [14] guidelines and is specifically tailored for the United States. Our index includes the following four items: existence of an anti-bribery policy, director independence, separation of the roles of Chief Executive Officer and board chair, and executive director tenure. The index treats two components of the index (board independence and executive director tenure) as having a non-monotonic relation with corporate governance quality.

The evidence is primarily consistent with the expectations. The evidence suggests that our index accurately captures corporate governance quality in the United States holistically. In particular, our results indicate that anti-bribery policies are becoming increasingly popular and play a pivotal role as a corporate governance mechanism. Furthermore, similar to Chen, Kao, Tsao and Wu [17], we document evidence that this positive association is not merely due to the dimensions of corporate governance quality overlapping with priced risk factors [16].

Our findings also indicate that in the United States, fintech firms have superior corporate governance quality compared to non-fintech firms. Considered in conjunction with the evidence that fintech firms display superior performance, this indicates that corporate governance quality reinforces the critical success factors, of players in this industry, in driving their superior performance. A corollary for investors is that when making portfolio decisions about fintech firms, they should consider corporate governance quality and operational critical success factors (such as technological agility and customer-centricity (Chen, [7]). Furthermore, our evidence provides moderate support for the conjecture that compared to non-fintech firms, fintech firms rely more on internal versus external corporate governance mechanisms to reduce agency costs. This finding underscores the importance, for managers of fintech firms, of corporate governance mechanisms implemented by management, such as those captured in our index.

The principal limitation noted in this paper is misspecification in the models with accounting performance metrics as dependent variables. Some of the results illogically suggest that the association between performance and its determinants depend on how performance is measured. Hence, a suggestion for further research endeavour is to identify some of these other determinants of corporate performance and develop suitable proxies for these determinants. Another suggestion is to investigate if a trading rule strategy based on corporate governance quality and fintech company status can yield positive abnormal returns.

The superiority of fintech firms emanates from their agility to take advantage of innovative platforms that amplify electronic economics as a potential research endeavour. Our results support that electronic economics does matter in the case of fintech firms.

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