Energy Economics 146 (2025) 108516

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Vulnerability of energy firms to climate risk: Does fintech development help?☆

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ARTICLE INFO

Keywords:
Climate risk
Extreme weather
Fintech development
Energy enterprise
Dividends

ABSTRACT

Energy firms, given their importance to overall economic activity, are increasingly seen as sources of systemic risk. Considering the relation of climate-change risk to energy sources, it is sensible to consider energy firms as vulnerable to climate-change. We investigate whether fintech development bolsters energy firms (valuations and dividends) as these firms face greater climate risk. Using an international sample of listed energy firms from 2016 to 2023 (2379 (1972) firm-year observations for our firm value model) and ordinary least squares regression, we find that fintech development cushions the adverse impact of climate risk on energy firm values and dividends. Findings are robust to firm fixed effects and generalized method of moments models, additional control variables, and alternative measurements of value and dividends. Our results suggest that Fintechs may act as a channel for energy firms to withstand the negative repercussions of climate change, thereby supporting the efforts of regulators to promote Fintechs. Moreover, when confronted with high climate risk, our results suggest that managers could utilize Fintechs to increase firm value and dividends.

1. Introduction

As a result of climate change, events such as extreme rainfall, severe heatwaves and unusually high/low temperatures are adversely affecting businesses, through adversely impacting production, destroying assets, and obstructing communication (Pankratz et al., 2023). Empirical evidence suggests that greater climate change risk deprecates firm value (Huang et al., 2018; He et al., 2024), with concomitant adverse impacts on dividends (Chen et al., 2023; Huang et al., 2018). With expected increases in the frequency and severity of extreme weather events (Benincasa et al., 2024), lessening vulnerability to climate risks is paramount for firms (Zhao and Lin, 2025). Climate change risk is of special concern for the energy sector (Shinwari et al., 2024), given that this sector is central to the overall economic health of a country (Lu et al., 2019; Ren et al., 2025), as well as being vulnerable to changing regulations and other transition risks, and being often highly centralized and so subject to systemic risks.

With an increase in availability of internet and individuals preferring speed and convenience, there has been a rapid growth in financial technology (Fintechs) over recent years (Abbasi et al., 2021; Li and Fu, 2022; Xu and Lin, 2024). Regulators, too, are showing increasing support towards development of Fintechs in the form of, for example, innovation hubs and regulatory sandboxes (Alaassar et al., 2021). Moreover, Fintechs are helping previously unbanked population to gain access to funds, thereby furthering firm growth and survival, which may be especially critical in emerging economies given their relatively unequal distribution of wealth and poor standard of living (Azmeh, 2025). Fintechs embodying innovative combinations of finance and technology, utilizes big data and algorithms to ascertain credit risk of firms, thereby facilitating access to finance (Lee and Shin, 2018). While traditional lenders such as banks may be reluctant to lend to firms affected by extreme weather events, fintechs may incorporate digital procedures to incorporate factors into credit assessment, layoff loan risk, and achieve broader social and geographic reach to borrowers of firms, thereby enabling firms with greater access to finance at the time of adverse climate events. This will contribute to firm value and increase

☆ This article is part of a Special issue entitled: 'Financial Innovation' published in Energy Economics.

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https://doi.org/10.1016/j.eneco.2025.108516
Received 30 September 2024; Received in revised form 2 April 2025; Accepted 13 April 2025
Available online 22 April 2025

the dividends of firms (Fu et al., 2024). Fintechs also offer a wide variety of services that facilitate operational efficiency (Abbasi et al., 2021). Insurance fintech incorporates big data from satellites, radar and ground stations and artificial intelligence to enable advanced modeling of climate risk (Hart, 2022). This helps firms withstand weather-related shocks that are increasingly unpredictable (Lin and Kwon, 2020).

While literature supports that fintech is of broad help to firms, in this paper we fill a research gap by investigating a more specific question: does the development of fintech at the country-level facilitate the financial and operational sturdiness of systemically important energy firms? Utilzing technology adoption theory which suggests that firms adopt technologies based on their perceived benefits stemming from implementing them in the operations (Bekkering et al., 2009) we find for a sample of systemically important energy firms from 51 countries (2016–2023) that society-wide fintech development positively moderate the association between climate risk and energy-firm values and dividends. Our findings are robust to fixed effects model and generalized method of moments (GMM). Moreover, results are robust to alternative specifications of determining firm value and dividends and to inclusion of further control variables. Analysis also reveals that fintech development is positively associated with higher energy-firm cash levels. We also evidence that our identified positive impact of fintech development on energy firm values is not due to a signaling effect from a positive impact on dividends.

Given the recent exponential growth in Fintechs and recent concerns towards climate change issues, there is scant literature examining the nexus of Fintechs-climate risk-corporate outcomes. As a result, this study contributes to the extant literature in several ways. First, we contribute to the stream of literature investigating the impact of extreme weather events on corporate outcomes (such as Pankratz et al., 2023) by assessing whether Fintechs play a role in mitigating the impact of climate change in energy firms. Second, this study contributes to Fintech literature. In contrast to prior literature evidencing positive impact of Fintechs in terms of firm efficiency (Abbasi et al., 2021), environmental performance (Wang et al., 2024) and innovation (Kong et al., 2020; Liu et al., 2023), we investigate whether Fintechs affect the link between climate change and firm outcomes. Third, we contribute to the studies assessing determinants of firm value and dividend. Whereas studies such as Li et al. (2024) and Gregory (2022) (Zhu and Hou (2022) and Balachandran and Nguyen (2018)) analyse the impact of climate risk and firm value (dividends), we offer novel contribution to this strand of literature by investigating the impact of Fintechs on firm value and dividend when firms are confronted with high climate risk.

2. Methodology

We focus on all listed energy firms available on Thomson Reuters from 2016 to 2023, covering 51 countries. We included energy firms from all countries for which data was available on Eikon database. We utilize the industry classification of Thomson Reuters to determine energy firms. We collect fintech data from Crunchbase. We obtain firm value, dividend, corporate governance and financial characteristics from Thomson Reuters Eikon. Country-level climate risk is proxied by the Global Climate Physical Risk Index (GCPI) (Guo et al., 2024). This index measures the frequency of extreme weather events and is calculated by incorporating four components which include extreme rainfall, extreme high temperature, extreme low temperature and extreme drought (Guo et al., 2024). After incorporating missing data, our sample consists of 2379 (1972) firm-year observations.

Our two dependent variables are specifically firm-level log of the total market capitalization and dividend per share (Abdolmohammadi, 2005; Ofori-Sasu et al., 2017). Our main independent variable involves an interaction term between country climate risk and fintechs. We measure country-level fintech development as the ratio of fintechs in a country to total fintechs in the world (Laidroo et al., 2021). Whereas studies such as Abbasi et al. (2021) utilize number of Fintechs in a country, we argue that our measure of proportion of country's Fintechs to total Fintechs in the world captures the country's relative contribution towards global Fintech landscape, thereby more appropriately encompassing Fintech development.

We include several control variables. We consider that better performing firms (return on equity) and more growing firms (ratio of market value of equity to book value of equity) are likely to be in a better position in terms of ability to increase firm value and dividend (Abbasi et al., 2021; Danbolt et al., 2011). Further, given their large resources, large firms (log of total assets) are expected to be positively associated with firm value and dividends (Likitwongkajon and Vithessonthi, 2020). Additionally, higher leverage (ratio of debt to assets) suggests greater financial capacity to allocate investments to increase firm value and to provide higher dividend (Ammann et al., 2011).

We also consider governance and pro-social controls. The presence of a CSR committee (1 if there is a CSR committee in a firm, otherwise 0) has been associated with an increase in firm value and higher dividend, as a separate CSR committee suggests greater consideration for environmental issues, with concomitant regard by investors (Albitar et al., 2024), allowing greater capacity to pay higher dividends (Salah and Amar, 2022). Additionally, an independent board (percentage of independent directors) resonates with higher monitoring of executive directors, resulting in greater firm value and higher dividends (Sharma, 2011). Further, female directors (percentage of female directors) have been identified as having a greater tendency to consider the interests of various stakeholders, which may translate into higher monitoring of board, resulting in a positive association with both firm value and dividends (Gull et al., 2018). Lastly, we control for year and industry effects. Variable definitions are presented in Table 1.

The following ordinary least squares regression (OLS) models are adopted to test our research questions:

$$\text{Firm value}_{i,t} = B_0 + B_1\ \text{Fintech}_{c,t}{}^{*}\ \text{Climate risk}_{c,t} + B_2\ \text{Fintechs}_{c,t} + B_3\ \text{Climate risk}_{c,t} + B_{4-n}\ \text{Control variables}_{i,t} + \text{Country effects} + \text{Year effects} + \varepsilon \tag{1}$$

$$\text{Dividend}_{i,t} = B_0 + B_1\ \text{Fintech}_{c,t}{}^{*}\ \text{Climate risk}_{c,t} + B_2\ \text{Fintech}_{c,t} + B_3\ \text{Climate risk}_{c,t} + B_{4-n}\ \text{Control variables}_{i,t} + \text{Country effects} + \text{Year effects} + \varepsilon \tag{2}$$

Table 1
Variable definitions.

Variable	Definition	Source
FirmValue	Log of total market capitalization	Eikon
Dividend	Dividend per share	Eikon
Fintech development	Ratio of fintechs in a country to total fintechs in the world	Crunchbase
ClimateRisk	An index incorporating extreme rainfall, extreme high temperature, extreme low temperature and extreme drought in a country	Guo et al. (2024)
CSRcom	1 if there is a CSR committee ina firm otherwise 0	Eikon
IndBoard	Percentage of independent directors	Eikon
FemaleBoard	Percentage of female directors	Eikon
FirmGrow	Ratio of market value of equity to book value of equity	Eikon
ROE	Return on equity	Eikon
Leverage	Log of the proportion of debt to assets	Eikon
FirmSize	Log of total assets	Eikon
BoardSize	Number of board members	Eikon
BoardDirectorships	Average additional board seats held by board members	Eikon
QuickRatio	Ratio of current assets minus inventory to current liabilities	Eikon
Cash	Log of total cash balance	Eikon

In the above models, the subscripts i, t and c represent firm, time and country respectively. To address multicollinearity concerns, we mean center Fintechs and climate risk variables before creating interaction terms. Standard errors are clustered at firm level to consider serial correlation and heteroscedasticity.

3. Results and analysis

Table 2 reports descriptive statistics. The high standard deviation of our interaction term implies varying levels of country's fintech development and climate risk. As country-specific factors may affect Fintech startups and level of climate risk (Abbasi et al., 2021), such large variation in our sample from 51 countries could be expected. The mean value of female directors is 17.12, which shows the need to deploy policies to enhance gender diversity, while the average value of independent directors is 62.50, which reflects corporate governance regulations stipulating greater presence of independent directors. The mean value of CSR committee is 0.67 which reflects that firms are under increasing pressure to mitigate their impact on climate change.

Table 3 presents our baseline regression results. Columns 1 and 2 of Table 3 show results without incorporating fintechs and the interaction term (the impact of climate risk on firm value and dividend). Results show an insignificant link between climate risk and either firm value or dividends, in contrast to Chen et al. (2023) and Huang et al. (2018). However, Columns 3 and 4 of Table 3 present our main findings related to our research questions. Column 3 reports a positive moderating impact of fintech development on the relation between climate risk and firm value. This suggests that Fintechs may help reduce climate risk, which in turn enhances firm value. Fintechs, due to their big data technology, enhance availability of funds when firms face heightened climate risk, thereby increasing firm value. Column 4 of Table 3 reports results consistent with fintech development having a positive moderating association between climate risk and dividends, implying that Fintechs may mitigate climate risk and thereby leading to an increase in dividends. Fintechs help save operating expenses and have the potential to earn higher investment returns due to automated operations and robo-investment advisory with advanced big data technology respectively (Abbasi et al., 2021; Lee and Shin, 2018). This results in greater availability of cash resources to be able to pay dividends at the time of high climate risk. Our findings align with studies such as Wu (2024) and Tao et al. (2022), which evidence that Fintechs curtail climate risk. We, therefore, offer further insights by substantiating that such mitigation effect translates into a positive impact on corporate outcomes in terms of firm value and dividends.

In relation to our control variables, we find that firm performance, firm growth, leverage and firm size are positively and significantly related to firm value and dividends, consistent with our expectations. Additionally, female directors are positively associated in the firm value model, consistent with expectations. CSR committee and board independence variables are insignificant, which suggests that they may be affected by specific characteristics of CSR committee and independent directors wherein positive aspects (such as greater experience) may have been mitigated by negative characteristics (such as limited meetings).

3.1. Endogeneity

Out of concern that omitted variable bias may drive our results, we employ endogeneity testing. We utilize fixed effects to account for time-invariant firm-specific unobserved heterogeneity (Bevan and Danbolt, 2004). Additionally, we employ generalized method of moments (GMM) testing, which considers both time-varying and time-unvarying firm related unobserved heterogeneity (thereby, addressing multiple endogenous concerns simultaneously) (Dong and Li, 2022). Even though instrumental variables (IVs) can be used to address the endogeneity problem, GMM estimation is more efficient and popular to do so (Worrall and Kovandzic, 2010). In a related study, Worrall (2008) added that GMM nests several estimations (OLS, 2SLS, IV) within a single framework. In addition, our diagnostic tests suggest suitability of applying GMM to our study, as AR (2) and Hansen J test are insignificant, consistent with the absence of second-order autocorrelation. This indicates validity of instruments (Wintoki et al., 2012). Our results, reported in Columns 1 and 2 of Table 4, suggest that our main findings

Table 2
Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
FirmValue	21.41	2.00	14.91	28.39
Dividend	0.64	1.50	0.00	27.03
Fintech* ClimateRisk	−7.22	68.74	−696.49	215.21
CSRcom	0.67	0.47	0.00	1.00
IndBoard	62.50	24.17	0.00	100.00
FemaleBoard	17.12	13.41	0.00	66.67
FirmGrow	0.64	103.07	−1000.62	4460.14
ROE	0.04	1.19	−25.47	38.35
Leverage	2.92	3.63	−8.49	19.01
FirmSize	18.36	3.01	4.09	26.65

Sources: Authors' calculation.

Table 3
Main regression results.

Variable	Firm Value	Dividend	Firm Value	Dividend
ClimateRisk	−0.000	0.012		
	(−0.004)	(1.086)		
Fintech * ClimateRisk			0.127***	0.392**
			(2.736)	(2.062)
Fintech			15.122*	2.596
			(1.753)	(0.207)
ClimateRisk			2.377***	7.364**
			(2.743)	(2.064)
CSRcom	0.155	0.042	0.153	0.044
	(1.596)	(0.411)	(1.576)	(0.430)
IndBoard	0.002	0.001	0.002	0.001
	(0.890)	(0.343)	(0.856)	(0.327)
FemaleBoard	0.014***	0.006	0.014***	0.006
	(3.881)	(0.923)	(3.909)	(0.925)
FirmGrow	0.001***	0.000***	0.001***	0.000***
	(4.886)	(3.086)	(4.860)	(3.207)
ROE	0.098**	0.041*	0.098**	0.041*
	(2.273)	(1.651)	(2.285)	(1.684)
Leverage	0.710***	0.192***	0.708***	0.192***
	(25.757)	(6.039)	(25.628)	(5.995)
FirmSize	0.707***	0.199***	0.705***	0.200***
	(21.642)	(5.013)	(21.558)	(4.997)
Constant	5.833***	−4.982***	289.791*	43.942
	(7.837)	(−5.988)	(1.789)	(0.186)
Observations	2379	1972	2379	1972
Country effects	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
R^2	0.777	0.271	0.271	0.272
F-test	1.0e+12***	9.6e+06***	2.1e+09***	7.2e+09***

Table 1 defines the variables. Standard errors are clustered at firm-level. t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4
Endogeneity testing.

	Fixed effects		GMM	
	Firm value	Dividend	Firm value	Dividend
One-year lagged FirmValue			0.744***	
			(8.658)	
One-year lagged Dividend				0.552***
				(4.246)
Fintech * ClimateRisk	0.055*	0.343*	0.102**	0.302**
	(1.857)	(1.937)	(2.178)	(1.983)
Fintech	11.724*	−8.281	0.607**	1.081**
	(1.934)	(−0.760)	(1.778)	(2.128)
ClimateRisk	1.044*	6.430*	1.913**	5.676**
	(1.875)	(1.937)	(2.185)	(1.985)
CSRcom	0.035	−0.113	−0.011	0.078
	(0.534)	(−0.910)	(−0.064)	(0.683)
IndBoard	−0.003	0.003	−0.005	0.002
	(−1.414)	(1.171)	(−1.316)	(1.052)
FemaleBoard	−0.002	0.003	0.012*	0.002
	(−0.560)	(0.536)	(2.030)	(0.528)
FirmGrow	0.000***	0.000	0.001	0.000
	(9.530)	(0.310)	(0.907)	(0.109)
ROE	0.045	−0.061	0.206	0.253
	(1.332)	(−1.357)	(1.624)	(1.662)
Leverage	0.212***	0.297**	0.194**	0.089*
	(3.505)	(1.986)	(2.451)	(1.813)
FirmSize	0.197***	0.295**	0.195**	0.075
	(2.988)	(2.049)	(2.328)	(1.202)
Constant	236.273**	−160.435	12.838**	18.550*
	(2.091)	(−0.785)	(1.980)	(1.929)
Observations	2379	1972	2180	1684
Year effects	YES	YES	YES	YES
R^2	0.238	0.045	–	–
F-test	30.33***	5.15***	–	–
Hansen J test	–	–	0.537	0.285
AR (2) test	–	–	0.392	0.164

Table 1 defines the variables. Standard errors are clustered at firm-level. t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5
Robustness testing.

	Additional controls		Alternative measure	
	FirmValue	Dividend	FirmValue	Dividend
Fintech * ClimateRisk	0.116**	0.406**	0.127***	0.646*
	(2.534)	(1.999)	(2.736)	(1.809)
Fintech	17.818**	2.879	15.122*	35.628
	(2.143)	(0.211)	(1.753)	(0.685)
ClimateRisk	2.183**	7.618**	2.377***	12.021*
	(2.550)	(2.001)	(2.743)	(1.797)
CSRcom	0.045	0.068	0.153	0.303
	(0.507)	(0.593)	(1.576)	(0.481)
IndBoard	−0.002***	0.001	0.002	−0.019
	(−0.802)	(0.277)	(0.860)	(−0.930)
FemaleBoard	0.014***	0.005	0.014***	0.055**
	(4.772)	(0.840)	(3.909)	(2.420)
FirmGrow	0.000***	0.000**	0.001***	0.001
	(5.060)	(2.044)	(4.860)	(0.990)
ROE	0.077**	0.036	0.098**	0.475**
	(2.109)	(1.583)	(2.285)	(2.115)
Leverage	0.608***	0.213***	0.708***	1.287***
	(21.059)	(4.939)	(25.628)	(7.588)
FirmSize	0.606***	0.220***	−0.295***	2.200***
	(18.970)	(4.183)	(−9.000)	(11.797)
BoardSize	0.057***	−0.012		
	(3.711)	(−0.656)		
BoardDirectorships	0.181***	−0.181**		
	(3.177)	(−2.033)		
BoardTenure	0.006	−0.008		
	(0.555)	(−0.472)		
QuickRatio	0.051***	0.014**		
	(5.799)	(2.108)		
Cash	0.168***	0.039		
	(7.067)	(1.098)		
Constant	338.873**	48.236	289.791*	626.995
	(2.170)	(0.188)	(1.789)	(0.642)
Observations	2217	1838	2379	1908
Industry effects	YES	YES	YES	YES
Year effects	YES	YES	YES	YES
R^2	0.834	0.256	0.928	0.383
F-test	1.1e+09***	1.9e+10***	1.7e+07***	2.5e+07***

Table 1 defines the variables. Columns 1 and 2 include further control variables, while Columns 3 and 4 utilize different measures to ascertain firm value (log of ratio of market capitalization to assets) and dividends (log of total dividends). Standard errors are clustered at firm-level. t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

persist with our fixed effects model, while Columns 3 and 4 of Table 4 report that the findings are consistent with our GMM model. Overall, our findings are robust to endogenous concerns.

3.2. Robustness tests

As a robustness check, we include other corporate governance variables and further financial characteristics namely, board size (number of board members), additional directorships of the board (average multiple directorships of board members), board tenure (average tenure of board members), quick ratio (ratio of current assets minus inventory to current liabilities) and cash balance (log of the total cash balance)) in our main models. Findings (Columns 1 and 2 of Table 5) are robust to inclusion of further control variables.

Second, we measure firm value and dividends alternatively. In this case, firm value is the log of the ratio of market capitalization to total assets (Bai et al., 2016), while dividend is the log of total dividends (Lee et al., 2023). Our findings (Columns 3 and 4 of Table 5) show that the main findings are robust to alternative specifications of firm value and dividends.

3.3. Path analysis (Fig. 1)

3.3.1. Dividend and firm value

As per signaling theory, higher dividends signal market participants about the high potential of a firm, resulting in increases in firm values. Given our findings that fintech development positively moderates the link between climate risk and firm value, it may be possible that this finding may stem from our result that fintech development increase dividends at the time of high climate risk.

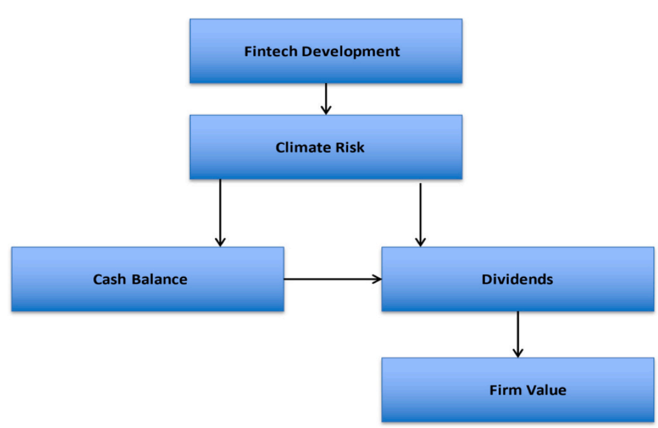

Fig. 1. Path analysis.

To investigate this possibility, we include a three-way interaction term (wherein the interaction between fintech development and climate risk is interacted with dividends) in the firm value model. Results, reported in Column 1 of Table 6, show an insignificant association of this three-way interaction term. This suggests that our positive impact of

Table 6
Path analysis.

	FirmValue	Dividend
Fintech * ClimateRisk * Dividend	0.001	
	(1.552)	
Fintech * ClimateRisk * Cash		0.001**
		(2.334)
Fintech * ClimateRisk	0.136**	0.382*
	(2.353)	(1.960)
Dividend	0.160***	
	(3.062)	
Cash		0.046
		(1.413)
Fintech	13.584	1.424
	(1.522)	(0.111)
ClimateRisk	2.340**	7.222**
	(2.268)	(1.968)
CSRcom	0.006	0.042
	(0.064)	(0.401)
IndBoard	0.003	0.001
	(1.100)	(0.250)
FemaleBoard	0.015***	0.005
	(4.023)	(0.858)
FirmGrow	0.001***	0.000**
	(4.954)	(2.460)
ROE	0.096*	0.039
	(1.789)	(1.589)
Leverage	0.688***	0.167***
	(20.030)	(4.594)
FirmSize	0.694***	0.177***
	(17.732)	(3.890)
Constant	264.167	22.223
	(1.576)	(0.092)
Observations	1972	1899
Industry effects	YES	YES
Year effects	YES	YES
R^2	0.767	0.277
F-test	57,143.13***	6.8e+09***

Table 1 defines the variables. Standard errors are clustered at firm-level. t-statistics in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

fintech development on firm value (given higher climate risk) may be driven by higher growth potential (stemming from Fintechs helping firms attain greater access to funds) rather than an increase in dividends causing a rise in firm value.

3.3.2. Cash and dividends

Given that fintech development increases the cash balance of firms, it may be argued that this greater cash balance acts as a channel through which fintech development positively affects dividends during high climate risk exposure. Consequently, we test this proposition by including a three-way interaction term wherein we interact cash balance (log of the total cash balance) with the interaction of climate risk and fintech development. Results are reported in Column 2 of Table 6. The findings show a positive and significant association for the three-way interaction term, consistent with greater cash balance promotes dividends.

4. Conclusions

Firms are clearly affected adversely by extreme weather events. (Chen et al., 2023), with energy firms increasingly seen as being systemically risky. While energy firms are vulnerable to many factors, a significant concern is climate change risk. We investigate whether fintech development positively conditions the relation between climate risk and energy firm value and dividends. Using a cross-country sample, covering 51 countries, from 2016 to 2023, we find that fintech development positively conditions the impact of climate risk on energy firm value and dividends. We reason that fintech development brings capacity to consider big data, enhanced access, broader geographic reach, improved ability to distribute risks, and improved availability of financing for energy firms.

We recommend policymakers to introduce policies supportive of Fintech startups which may include regulatory sandboxes and green Fintech startups (which specifically focus on climate finance). We also suggest regulators to improve digital infrastructure (for example, investing in high-speed internet) for Fintech startups to develop. This is especially important in the context of emerging economies given their poor institutional quality. We recommend future researchers to analyse types of Fintechs to examine whether certain Fintechs offer relatively greater resilience towards climate change. Moreover, we suggest that institutional and cultural factors are investigated to assess whether our results are contingent on country-specific variables. Further, our measure of Fintechs (ratio of country's Fintechs to global Fintechs) encompasses a limitation that it disregards the significant progress of smaller economies in terms of Fintech development which may be captured by measuring Fintech development through Fintechs per capita.

CRediT authorship contribution statement

Kaleemullah Abbasi: Writing – original draft, Investigation, Formal analysis, Data curation. **Ashraful Alam:** Methodology, Formal analysis, Data curation. **John W. Goodell:** Writing – review & editing, Validation, Supervision, Project administration. **Anna Min Du:** Writing – original draft, Validation, Conceptualization. **Noor Ahmed Brohi:** Software, Investigation.

Appendix A. Appendix 1 (List of countries in the sample)

Argentina
Australia
Austria
Belgium
Bermuda
Brazil
Canada
Chile
China
Colombia
Cyprus
Denmark
Finland
France
Germany
Greece
Hungary

(continued on next page)

(*continued*)

India
Indonesia
Ireland
Israel
Italy
Japan
Kazakhstan
Kuwait
Luxembourg
Malaysia
Mexico
Morocco
Netherlands
New Zealand
Nigeria
Norway
Pakistan
Philippines
Poland
Portugal
Qatar
Romania
Russia
Saudi Arabia
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Thailand
Turkey
United Kingdom
United States

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2025.108516.

References

Abbasi, K., Alam, A., Du, M.A., Huynh, T.L.D., 2021. FinTech, SME efficiency and national culture: evidence from OECD countries. Technol. Forecast. Soc. Chang. 163, 120454.

Abdolmohammadi, M.J., 2005. Intellectual capital disclosure and market capitalization. J. Intellect. Cap. 6 (3), 397–416.

Alaassar, A., Mention, A.L., Aas, T.H., 2021. Exploring a new incubation model for FinTechs: Regulatory sandboxes. Technovation 103, 102237.

Albitar, K., Nasrallah, N., Hussainey, K., Wang, Y., 2024. Eco-innovation and corporate waste management: the moderating role of ESG performance. Rev. Quant. Finan. Acc. 1–25.

Ammann, M., Oesch, D., Schmid, M.M., 2011. Corporate governance and firm value: international evidence. J. Empir. Financ. 18 (1), 36–55.

Azmeh, C., 2025. Bridging divides: the role of Fintech and financial inclusion in reducing poverty and inequality in developing countries. Innov. Dev. 1–20.

Bai, J., Philippon, T., Savov, A., 2016. Have financial markets become more informative? J. Financ. Econ. 122 (3), 625–654.

Balachandran, B., Nguyen, J.H., 2018. Does carbon risk matter in firm dividend policy? Evidence from a quasi-natural experiment in an imputation environment. J. Bank. Financ. 96, 249–267.

Bekkering, E., Johnston, A.C., Warkentin, M., Schmidt, M.B., 2009. An empirical assessment of technology adoption as a choice between alternatives. Inf. Resour. Manag. J. 22 (4), 23–44.

Benincasa, E., Betz, F., Gattini, L., 2024. How do firms cope with losses from extreme weather events? Finance 84, 102508.

Bevan, A.A., Danbolt, J.O., 2004. Testing for inconsistencies in the estimation of UK capital structure determinants. Appl. Financ. Econ. 14 (1), 55–66.

Chen, S., Liu, S., Zhang, J., Zhang, P., 2023. The effect of extreme rainfall on corporate financing policies. J. Econ. Behav. Organ. 216, 670–685.

Danbolt, J., Hirst, I.R., Jones, E., 2011. The growth companies puzzle: can growth opportunities measures predict firm growth? Eur. J. Financ. 17 (1), 1–25.

Dong, F., Li, Y., 2022. How does industrial convergence affect regional high-quality development? Evidence from China. J. Asia Pac. Econ. 1–34.

Fu, T., Li, Z., Qiu, Z., Tong, X., 2024. The policy gap between finance and economy: evidence from China's green finance policy. Energy Econ. 134, 107550.

Gregory, R.P., 2022. The effect of atmospheric greenhouse gases on firm value and firm size distribution. J. Clean. Prod. 358, 131751.

Gull, A.A., Nekhili, M., Nagati, H., Chtioui, T., 2018. Beyond gender diversity: how specific attributes of female directors affect earnings management. Br. Account. Rev. 50 (3), 255–274.

Guo, K., Ji, Q., Zhang, D., 2024. A dataset to measure global climate physical risk. Data Brief 54, 110502.

Hart, V., 2022. How Insurance is Adapting to Support Climate Resilience. Retrieved from. https://www.bobsguide.com/how-insurance-is-adapting-to-support-climate-resilience/.

He, F., Duan, L., Cao, Y., Wen, S., 2024. Green credit policy and corporate climate risk exposure. Energy Econ. 133, 107509.

Huang, H.H., Kerstein, J., Wang, C., 2018. The impact of climate risk on firm performance and financing choices: an international comparison. J. Int. Bus. Stud. 49, 633–656.

Kong, D., Zhu, L., Yang, Z., 2020. Effects of foreign investors on energy firms' innovation: evidence from a natural experiment in China. Energy Econ. 92, 105011.

Laidroo, L., Koroleva, E., Kliber, A., Rupeika-Apoga, R., Grigaliuniene, Z., 2021. Business models of FinTechs–difference in similarity? Electron. Commer. Res. Appl. 46, 101034.

Lee, I., Shin, Y.J., 2018. Fintech: ecosystem, business models, investment decisions, and challenges. Bus. Horiz. 61 (1), 35–46.

Lee, S., Liu, B., Jung, S., Kim, B., 2023. The effect of vaccination during the COVID-19 for the restaurant industry. Int. J. Hosp. Manag. 110, 103451.

Li, S., Fu, T., 2022. Abatement technology innovation, worker productivity and firm profitability: a dynamic analysis. Energy Econ. 115, 106369.

Li, X., Luo, L., Tang, Q., 2024. Climate risk and opportunity exposure and firm value: an international investigation. Bus. Strateg. Environ. 33 (6), 5540–5562.

Likitwongkajon, N., Vithessonthi, C., 2020. Do foreign investments increase firm value and firm performance? Evidence from Japan. Res. Int. Bus. Financ. 51, 101099.

Lin, X., Kwon, W.J., 2020. Application of parametric insurance in principle-compliant and innovative ways. Risk Manag. Insur. Rev. 23 (2), 121–150.

Liu, J., Zhang, Y., Kuang, J., 2023. Fintech development and green innovation: evidence from China. Energy Policy 183, 113827.

Lu, J., Ren, L., Qiao, J., Yao, S., Strielkowski, W., Streimikis, J., 2019. Corporate social responsibility and corruption: implications for the sustainable energy sector. Sustainability 11 (15), 4128.

Ofori-Sasu, D., Abor, J.Y., Osei, A.K., 2017. Dividend policy and shareholders' value: evidence from listed companies in Ghana. Afr. Dev. Rev. 29 (2), 293–304.

Pankratz, N., Bauer, R., Derwall, J., 2023. Climate change, firm performance, and investor surprises. Manag. Sci. 69 (12), 7352–7398.

Ren, X., Wang, S., Mao, W., Gozgor, G., 2025. Greening the energy industry: an efficiency analysis of China's listed new energy companies and its market spillovers. Energy Econ. 108414.

Salah, O.B., Amar, A.B., 2022. Does corporate social responsibility affect dividend policy? Empirical evidence in the French context. J. Glob. Responsibil. 13 (3), 268–289.

Sharma, V., 2011. Independent directors and the propensity to pay dividends. Finance 17 (4), 1001–1015.

Shinwari, R., Wang, Y., Gozgor, G., Mousavi, M., 2024. Does FDI affect energy consumption in the belt and road initiative economies? The role of green technologies. Energy Econ. 132, 107409.

Tao, R., Su, C.W., Naqvi, B., Rizvi, S.K.A., 2022. Can Fintech development pave the way for a transition towards low-carbon economy: a global perspective. Technol. Forecast. Soc. Chang. 174, 121278.

Wang, C.A., Wang, L., Zhao, S., Yang, C., Albitar, K., 2024. The impact of Fintech on corporate carbon emissions: towards green and sustainable development. Bus. Strateg. 33, 5376–5396.

Wintoki, M.B., Linck, J.S., Netter, J.M., 2012. Endogeneity and the dynamics of internal corporate governance. J. Financ. Econ. 105 (3), 581–606.

Worrall, J.L., 2008. The effects of local law enforcement block grants on serious crime, *criminal*. Public Polic. 7, 325–350.

Worrall, J.L., Kovandzic, T.V., 2010. Police levels and crime rate: an instrumental variable approach. Soc. Sci. Res. 39, 506–516.

Wu, Q., 2024. From bits to emissions: how FinTech benefits climate resilience? Empir. Econ. 67 (5), 2009–2037.

Xu, B., Lin, B., 2024. Green finance, green technology innovation, and wind power development in China: evidence from spatial quantile model. Energy Econ. 132, 107463.

Zhao, H., Lin, B., 2025. Rising inequality in the European Union under stringent climate policy: internal challenges of carbon border adjustment mechanism. Energy Econ. 142, 108180.

Zhu, B., Hou, R., 2022. Carbon risk and dividend policy: evidence from China. Int. Rev. Financ. Anal. 84, 102360.