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DOES GREEN FINANCE SUPPORT TO REDUCE THE INVESTMENT SENSITIVITY OF ENVIRONMENTAL FIRMS?

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Abstract. This study aims to examine the financing cash flow sensitivity into the firm investment of Environment Sensitive Firms (ESFs). To improve the robustness of our analysis, we implement cluster regression to analyze the 300- firms listed on Shenzhen Stock Exchange. The findings of this study indicate that high-ESFs have more financing cash flow volatility in firm investment than low-ESFs. The firms can reduce this volatility by integrating green finance with their financing cash flows. Green finance helps to implement sustainable investment practices and reduces investment volatility by providing the solution to societal issues. It also assists to generate stable cash flows, lower investment risk, and a better governance structure.

Keywords: environment sensitive firms, investment sensitivity, green finance, risk absorbing capacity, financial constraints.

JEL Classification: D22, F64, F65, G11.

Introduction

A growing literature in corporate finance suggests that the integration of green finance is an essential ingredient of the efficient allocation of capital. Efficient allocation of capital is an important role in economic growth and firm value (Lamperti et al., 2021). Globally, the modern financial framework and associated financial institutions integrate green finance to improve the optimal allocation of capital for long-term sustainability (Devika & Shankar, 2022). Green finance can be used to finance investment projects in environmental, social, economic, climate change mitigation, energy, and reduction of carbon emissions in the en-

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vironment (Ferraz & Coutinho, 2019). Licastro and Sergi (2021) explain that Environment Sensitive Firms (ESFs) focus to mobilize green finance for sustainable investment and socially acceptable projects.

Integration of green finance with firm financing decisions assists investors to evaluate the overall performance of a firm rather than only financial performance (Cho et al., 2019). Access to green finance is examined by comparing how financing through green finance affects the sensitivity of firms' investment and cash flow decisions, particularly on the firm green finance cash flow sensitivity to investment projects (Shad et al., 2019). This approach is unique in the existing literature on cash flow sensitivity, which only focuses to examine the investment cash flow volatility. While, investment through green finance is defined as a firm feeling of responsibility to contribute to social welfare, and sustainable investment for the development of stakeholders (Barnett, 2007).

Tang and Zhang (2020) find that green finance firms have better governance structures, more cautious about the environment, and implement sustainable investment policies for all stakeholders. Galanti et al. (2022) report that the integration of green finance with firm financing decisions is positively related to their investment decisions, which have been explained as an interpretation of firm access to the capital market. We argue that prior literature by Hovakimian and Hovakimian (2009), Mohamed et al. (2014), and Lin et al. (2021) focus only on the single equation models, by examining exclusively on the investment cash flow sensitivity, but neglecting the green finance cash flow sensitivity that reduces the firm cash flow volatility into the investment decisions.

To the best of our literature review, this study is the first to examine the integration of green finance with firm financing choices to examine the financing cash flows sensitivity on firm long-term investment. Further, the findings of this study support the arguments of swapping the green finance with traditional source of finance in the light of trade-off and pecking order hypothesizes to enhance the value of firm. Additionally, we start the new debate by introducing ethical and social behavior of firms with respect of societal well-beings, which leads to lower investment volatility and better value. Moreover, Ding et al. (2021) examining the investment cash flow volatility framework, we evaluate the source and usage of funds to gain a critical viewpoint on the importance of green finance into firm investment.

This study focuses on Chinese firms to examine the effect of green finance on firm investment. Chinese firms are important for green finance research since Chinese companies are enduring to implement the Paris agreement for the reduction of carbon emissions and struggle to reduce global warming to 1.5 °C (Zhao et al., 2022). In China, financing through green bonds has increased dramatically in the recent past as on December 31, 2021, Chinese companies issued US$270 billion in green bonds for sustainable investments (Chen & Zhao, 2021).

In 2021, Chinese President Xi Jinping's speech to United Nations General Assembly announced that his country will bring a major reduction in carbon emissions before 2030 and carbon free emission country before 2060. It is forecasted that US$-450–550 billion require annually to support environmental friendly projects (Höhne et al., 2021). The Chinese government's 11th five-year plan (2006-11) was focused on increasing the share of non-fuel energy for the industrial sector, increasing 15% annually investment in the environmental

sector, and environment investment touched 1.34% of GDP by 2009 (Brødsgaard, 2005).

Consistently, the Chinese government's 12th Five-Year Plan (2011-15) included environmental goals like cutting carbon emission per unit by 17% of GDP; reducing fuel energy consumption per unit by 16% of GDP, and accelerating forest coverage up to 21.66 of vacant land (Xue et al., 2014). In 2015, Party Central Committee and State Council have released the "Green Finance Integrated Reform Plan" to protect the environment and sustainable economic growth. In 2017 Government also allocated US$52.1 billion to reduce carbon emissions and protect the environment (Zhang et al., 2020). The study comprises of the following structure. The introduction provides research topic and highlights the novel research question. Section 1 explains the underlying theories and literature review on integration of green finance with ESG disclosures on firm performance leading to development of four hypotheses. Section 2 model explanation, data collection and measurement of variables. Section 3 consists of various empirical analysis, hypothesis testing and discussion of results. The last Section provides the conclusion, managerial implication, future research and limitations of this study.

1. Literature review and hypothesis development

Corporate literature has extensively studied that firm financing cash flows sensitivity to its investment as an important determinant of firm value. For instance, Moyen (2004) examines that firm investment plays a significant role to redesign the optimal allocation of capital and its economic growth. Beyond the investment cash flow sensitivity, Brusov et al. (2012) illustrate that firm ways of financing investment projects can influence the efficient allocation of capital and cash flow volatility. Moreover, this association between usage and source of funds are more pronouncedly influenced by green finance. For instance, Lamperti et al. (2021) show that the impact of capital structure on firm investment growth is stronger in industries that recently move to green finance to finance their investment projects. The trade-off theory of capital structure deeply explain the benefits of leverage by designing the optimal capital structure (Mun & Jang, 2015). Similarly, Pecking and Modigliani and Miller theories also highlight the benefits and sensitivity of leverage to finance the investment. The ESFs reduce this sensitivity of leverage by financing through green finance and allocate the optimal level of capital structure. Green finance also reduces the asymmetric cost of capital and spare funds for transactions and speculative motives of cash holding.

Based on these findings, we integrate green finance with the firm capital structure to examine the cash flow sensitivity of the firm long-term investment. We hypothesize that firm green finance with firm capital structure affects the firm financing position, which in turn may become visible in firm investment and financing cash flow sensitivity (Hovakimian & Hovakimian, 2009). The integration of green finance with capital structure facilitates to finance externally at a reasonable cost especially when a firm shortfalls in cash flows (Chen & Zhao, 2021). Since, green finance fill the shortfall in cash flow and also provides the funds to meet the transaction motives of cash holding. To examine the effect of green finance on financing cash flows into investment behavior, we analyze the firms' financing cash flow sensitivity into investment across the different environment-sensitive industries. In doing

this, we examine the (1) sensitivity of financing-cash flow into firm investment (2) sensitivity of green finance into the firm investment (3) integration of green finance with the capital structure of the firm investment.

To narrow down this debate through which firm financing cash flow volatility toward the firm's investment activities, we divided the sample into numerous subgroups. First, we compare the high and low environment sensitivity firms. Building on the existing findings, the difference in firms financing cash flow sensitivity to investment depends upon the firm ability to finance externally (Ding et al., 2021; Moyen, 2004). Higher environment-sensitive firms may transmit more financing cash flow sensitivity into investment (Lin et al., 2021). Similarly, lower environment-sensitive firms should thus be associated with lower financing cash flow sensitivity into the investment (Han et al., 2022). Hence, the higher environment sensitivity firms have lower benefits of leverage by trading-off the traditional source of finance under the trade-off and pecking order hypotheses to maximize the value of firm. This sensitivity also demands for hoarding cash to meet the transaction and precautionary motives of cash holding. Therefore, we propose our first two hypotheses

Hypothesis I: In higher-ESFs, financing cash-flow sensitivity into a firm's investment is higher than in the lower-ESFs.

Further, the high-ESFs are more cautious about the stakeholders' reaction to the firm long-term investment as compared to the lower-ESFs (Tang & Zhang, 2020). Hence, high-ESFs firms reduce the financing cash flows volatility into firm investment by switching the traditional source of financing with green financing (Devika & Shankar, 2022). Here, the application of trade-off and pecking order theory support to get the more benefits of leverage by trading-off traditional source of financing with green finance to reduce the investment sensitivity.

Hypothesis 2: ESFs reduce the financing cash flow sensitivity into investment by integrating green finance with firm capital structure.

Further, we spilled the sample based on the risk-absorbing capacity of ESFs. Lemmon and Zender (2010) explain, that a firm's capital structure consisting of equity and debt is in a better position to absorb the risk than the firm merely debt financing or equity finance for long-term investment. Barclay and Smith Jr (1995) explain that prioritizing equity financing over debt financing tends to be adjoined with stable cash flows, greater risk absorbing capacity, and lower investment sensitivity. Lee and Wang (2021) explain the firms have lower market risk are in a better position to design an efficient allocation of capital and reduce the investment cash flow volatility. Recently, Xu et al. (2022) show that firms integrate green finance with traditional source of financing to reduce the market risk and optimal allocation of capital. Trading-off green finance with traditional financing is really application of trade-off and pecking order hypotheses in context of risk and return. The ESFs are consistently effort to increase the risk-absorbing capacity of firm by trading-off the green finance with traditional source of financing (Pang et al., 2022). Therefore, we expect the variation in financing cash flow sensitivity toward the investment is differ depend upon the risk absorbing capacity of a firm.

Hypothesis 3: Integration of green finance with financing risk absorbing capacity of a firm has lower sensitivity on firm investment than the traditional source of financing.

Debate in the research community is still ongoing on how firm financial constrained can be measured properly, we argue that variation in firms' access to finance externally must be represented in financing cash flow volatility. Lee and Wang (2021) find that firm financing cost influence the firms to finance external market. Brusov et al. (2012) argue that firms' restrictions to access external markets transmit more financing cash flow volatility into a firm investment because such firms have limited access to the equity and debt market to reduce the financing shortfalls (Gartner et al., 2012). Therefore, financing cash flow sensitivity is higher in the firms have lower access to the external market than the firms that have easily approach to financing externally. The pecking order theory proposes that financial constraints firms choose the internal source of financing to reduce the asymmetric cost of capital. However, if internal cash flows are insufficient than approach the external financing. The green finance reduces the asymmetric cost of finance externally and spares internal funds to meet the transactions and speculative motives of cash holding.

Hypothesis 4: Integration of Green finance with firm financing cash flows transmits the lower sensitivity of financing cost toward the firm investment.

2. Data and methodology

Most proceeding research studies use regression as a statistical tool in analyzing the cash flow volatility toward the investment but it fails to explain how to eliminate correlation errors and unbiased omission due to errors of omission in regression estimation (Gartner et al., 2012). The breusch-Pagan test has been applied to check the heteroskedasticity in our estimation and find it positive analysis. For the endogeneity test, we apply a two-stage regression analysis and find no endogeneity errors exist in our model.

Multicollinearity is tested by using the Variance Inflation Factor (VIF) and VIF find below 10, indicating multicollinearity problem does not exist in our analysis. In observing statistical error, we find the residual errors for a given firm should be correlated across years and across time, hence we find the cause of dependency in the dataset. If a firm effect exists in analysis, clustering the firm can create unbiased residual errors (Petersen, 2008). When clustering by the firm and year, the residual error is estimated based on two dimensions of within-cluster correlations. Hence, for controlling both firm and year effects, we cluster the dataset based on industry and time effects. To examine the cash flow sensitivity toward the investment, we formulate the following econometric model with green finance.

1. Without integration effect

$$\frac{I_{it}}{K} = C + \beta_1 Q_{it} + \frac{\beta_2 CF_{it}}{K} + \frac{\beta_3 GF_{it}}{K} + \beta_4 Beta_{it} + \beta_5 FC_{it} + \beta_6 Liq_{it} + \beta_7 LEV_{it} + \mu_{it} + \eta_i + \varepsilon_{it}.$$

2. Integration of green finance with financing cash flows

$$I_{it} / K = C + \beta_1 Q_{it} + \beta_2 CF_{it} / K + \beta_3 GF_{it} / K + \beta_4 (Q_{it} \times GF_{it} / K) + \beta_5 Beta_{it} + \beta_6 FC_{it} + \beta_7 Liq_{it} + \beta_8 LEV_{it} + \mu_{it} + \eta_i + \varepsilon_{it}.$$

3. Integration of green finance with firm systematic risk

$$\frac{I_{it}}{K} = C + \beta_1 Q_{it} + \frac{\beta_2 CF_{it}}{K} + \beta_3 GF_{it} \frac{}{} \frac{}{K} + \beta_4 Beta_{it} + \beta_5 \left(\frac{GF_{it}}{K} \times Beta_{it} \right) +$$

$$\beta_6 FC_{it} + \beta_7 Liq_{it} + \beta_8 LEV_{it} \ \mu_{it} \ + \eta_i + \varepsilon_{it}.$$

4. Integration of green finance with firm financing cost

$$\frac{I_{it}}{K} = C + \beta_1 Q_{it} + \frac{\beta_2 CF_{it}}{K} + \beta_3 GF_{it} \frac{}{} \frac{}{K} + \beta_4 Beta_{it} + \beta_5 FC_{it} +$$

$$\beta_6 \left(\frac{GF_{it}}{K} \times FC_{it} \right) + \beta_7 Liq_{it} + \beta_8 LEV_{it} + \mu_{it} \ + \eta_i + \varepsilon_{it}.$$

Thomson Reuters DataStream has been used to collect the data of dependent and independent variables from 2015–2021. Based on the prior research on firm investment cash volatility, we calculate the firm investment in fixed assets by (I). It is used as a dependent variable and represents the firm capital expenditure. K is used for capital stock at begging of the period. In prior research Q is used standard model of investment, we depart the traditional Q-model of investment and we add the Green Finance GF_{it}. A novel model has been obtained that is more rational to capture the financing – cash flows sensitivity toward the investment. Q is the ratio of market value of capital to its replacement cost and uses as proxy for firm growth opportunity. CF is the ratio of Earnings Before Interest, Tax, Depreciation and Amortization (EBITD&A) divided by total assets, GF denotes the green bond issued by a firm i at time period t to invest in environmental friendly projects divided by total assets, Beta represent the systematic risk by following the theory of capital asset pricing model to measure the risk absorbing capacity of a firm. The higher the systematic risk, lower the risk absorbing capacity of a firm. FC denotes for firm financing cost calculated by using the weighted average cost of capital. Liq represents the liquidity measuring as a current assets divided by current liability.

Table 1. Descriptive statistics

Variable	Description	Mean	Median	Std.	Min	Max	N
I	Investment in fixed assets	0.453	0.543	0.441	0.199	1.351	1225
Tobin's Q	The ratio of market value of capital to its replacement cost	1.233	0.871	0.654	0.081	3.74	1225
CF	Earning + Dep+ other CF	0.120	0.045	0.754	0.001	0.287	1225
GF	Green bonds / total assets	0.042	0.021	0.051	0.000	0.075	1225
Beta	Systematic risk	1.233	1.040	0.564	0.561	1.876	1225
FC	Financing cost	0.241	0.155	0.096	0.099	0.443	1225
Liquidity	Current asset/current liabilities	1.360	1.110	0.642	0.652	1.982	1225
LEV	Firm long-term debt/ Total Assets	0.411	0.275	0.221	0.170	0.782	1225

This study uses the Thomson Reuters Eikon to collect the rating of each company regarding the application of environment disclosures on firm performance. The Eikon rating the company's profile from 0 to 100 based on the environmental performance score. The sample includes the firms that participate in environmental performance score. The top 50% of firms that attain a high environmental score are included in the list of lower environment sensitive firms and the lower 50% of firms are included in the list of higher environment sensitive firms. There are 175 after excluding the firms having incomplete observations from the most environmentally sensitive industries like Oil & Gas Extraction, Mining (Except Oil & Gas), Automobiles, Energy, Plastic, Chemical, Furniture, Food Manufacturing, Textile Companies, Wood Product Manufacturing, and Tobacco. The sample of the study consists of 1225-year observations from 2015 to 2021. Table 1 shows the variables and numbers of observations use in this study to analyze the investment volatility.

3. Results and discussion

3.1. Correlation analysis

In Table 2 upper part of the triangle shows the correlation among the variables of the high-ESFs and the lower part shows the correlation among the variables of the low-ESFs. In high-ESFs, Tobin's Q (0.043), and CF (0.421) develop a significant positive correlation with Investment-I (Brusov et al., 2012). It guides that high-ESFs firm, internal cash flows and financing-cash flows sensitivity are highly correlated with long-term investment-I (Galanti et al., 2022). The significant positive correlation between GF and I (0.354) indicates that the firm funds the projects with green finance and also influences the managers to design the long-term investment policy (Devika & Shankar, 2022).

Similarly, Liq (0.354) and LEV (0.421) are also significantly positively correlated with Investment-I, which guides the firm ability to manage the day-to-day business operations and access to lenders for investment are important factors in deciding long-term capital expenditures. However, Beta (–0.375) and FC (–0.431) are significantly negatively correlated with investment-I. It guides the firm capacity to absorb risk and access to the capital market are essential factors that need to revisit for financing the long-term investment (Allayannis & Mozumdar, 2004).

In contrast, in low-ESFs, financing cash flow variables like Tobin's Q (0.038), and CF (0.29) develop a significant positive correlation with Investment-I (Aivazian et al., 2005). Similarly, GF (0.336), Liq (0.354), and LEV (0.421) develop the significant positive correlation with investment-I (Bassetto & Kalatzis, 2011). It is noted that in low-ESFs, the magnitude of financing cash flows sensitivity with investment is lower than the high-ESFs firms. (Barnett, 2007) explains that high-ESFs financing cash flow sensitivity transmits more volatility toward the investment-I than the low-ESFs.

Additionally, the Beta (0.331), and FC (0.341) also significantly positively correlated with investment-I. However, the sensitivity of Beta (0.331), and FC (0.341) toward the investment-I is also low than the high-ESFs. It indicates that low-ESFs have more risk-absorbing capacity and access to the financial market at a reasonable cost than high-ESFs (Shad et al., 2019). The other variables in higher-ESFs at the upper part of the triangle and in low-ESFs at the lower part of the triangle are also moderately and weekly significantly correlated with each other.

Table 2. Correlations matric of high-ESF and low-ESF

	I	Tobin Q	CF	GF	Beta	FC	Liq	Lev
I	1.00	0.432 (0.001)	0.421 (0.000)	0.354 (0.003)	–0.375 (0.000)	–0.431 (0.002)	0.354 (0.001)	0.421 (0.000)
Tobin Q	0.381 (0.001)	1	0.210 (0.000)	0.174 (0.000)	0.132 (0.000)	0.231 (0.002)	0.198 (0.021)	0.251 (0.041)
CF	0.290 (0.000)	0.164 (0.051)	1	0.285 (0.001)	0.242 (0.002)	0.322 (0.001)	0.274 (0.000)	0.233 (0.000)
GF	0.336 (0.003)	0.132 (0.001)	0.183 (0.000)	1	0.242 (0.000)	0.252 (0.000)	0.284 (0.002)	0.244 (0.000)
Beta	0.311 (0.002)	0.0981 (0.000)	0.263 (0.000)	0.277 (0.003)	1	0.321 (0.003)	0.245 (0.001)	0.300 (0.040)
FC	0.341 (0.001)	0.251 (0.001)	0.295 (0.001)	0.194 (0.000)	0.290 (0.000)	1	0.240 (0.001)	0.274 (0.000)
Liq	0.432 (0.001)	0.273 (0.001)	0.340 (0.000)	0.220 (0.021)	0.234 (0.000)	0.184 (0.002)	1	0.264 (0.002)
LEV	0.472 (0.000)	0.230 (0.001)	0.254 (0.000)	0.184 (0.000)	0.298 (0.022)	0.285 (0.000)	0.241 (0.000)	1

3.2. Cluster regression analysis

Table 3 shows the results of financing cash flow sensitivity toward the investment of high-ESFs and low-ESFs by using cluster regression analysis. We split the sample into high-ESFs and low-ESFs under model-1 and model-2 to run the cluster regression analysis of financing cash flows sensitively and investment-I. To analyze each part, we run the cluster regression both under the year and industry effects. In the first part of regression under Model-1 both in Panel-A, year effect (Q = β; 0.045, p-value; 1%) and Panel-B, industry effect (Q = β; 0.044, p-values; 1%) clustering indicates that Q is significantly positively impact the investment-I.

Similarly, CF in both year and industry effect in Panel-A, year effect (CF = β; 0.041, p-value; 1%) and Panel-B, industry effect (CF = β; 0.040; p-values; 1%) significantly positively impact the investment-I as explain in hypothesis-1. In contrast, under Model-2 in low-ESFs in Panel-C, year effect (Q = β; 0.033, p-values; 1%) and in Panel-D, industry effect (Q = β; 0.033, p-values; 1%) are significantly positively affect the firm value. Similarly, under Model-2 in low-ESFs in Panel-C, year effect (CF = β; 0.034, p-values; 1%) and in Panel-D, industry effect (CF = β; 0.032, p-values; 1%) are significantly positively affect the firm value as explain in hypothesis-1. It is noted that in high-ESFs, financing cash flows are created more sensitive on investment-I than the low-ESFs. Chen and Zhao (2021) explain that ESFs are more severely influenced by the financial markets to generate the cash flows from routine business operations than non-environmental firms. Further, Han et al. (2022) find that firms that engage in environmental sustainability have stable cash flows, lower investment risk, and better governance structures.

Further, under model-1, GF in high-ESFs in Panel-A, year effect (GF = β; 0.032, p-values 1%) and in Panel-B, industry effect (GF = β; 0.033; p-values 1%) significantly positively explain the investment-I. Likewise, under model-2, GF in low-ESFs in Panel-C,

Table 3. Regression analysis of high-ESFs and low-ESFs

	High ESF (Model-1)						Low ESF (Model-2)					
	Panel A (Yearly Effect)			Panel B (Industry Effect)			Panel C (Yearly Effect)			Panel D (Industry Effect)		
	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF
Q	0.045[a]	2.16	1.56	0.044 [a]	2.25	1.67	0.033 [a]	2.25	1.84	0.031 [a]	2.23	1.90
CF	0.041[a]	2.19	1.79	0.040[a]	2.34	1.98	0.034[b]	2.28	1.96	0.032	2.23	1.74
GF	0.032 [a]	3.48	1.87	0.033 [a]	3.44	1.67	0.029 [b]	3.24	1.88	0.028 [a]	3.17	1.65
Beta	0.033 [b]	1.97	1.23	0.031 [b]	1.89	1.34	0.029 [c]	1.89	1.35	0.027[b]	1.86	1.14
FC	0.053 [a]	2.54	1.66	0.052 [a]	2.33	1.70	0.034 [a]	2.67	1.54	0.035 [a]	2.41	1.47
Liq	0.044[c]	2.79	1.78	0.042[c]	2.49	1.75	0.021 [c]	2.44	1.55	0.024 [c]	2.24	1.33
Lev	0.054 [a]	1.94	1.18	0.042 [b]	1.87	1.24	0.451 [a]	1.84	1.38	0.043[b]	1.78	1.27
IND	0.012 [b]	1.93	1.10	0.012 [a]	1.99	1.14	0.011 [b]	1.67	1.16	0.014 [a]	1.51	1.22
Year	0.020 [a]	1.55	1.17	0.020 [a]	1.47	1.14	0.021 [a]	1.89	1.09	0.021[a]	1.78	1.27

Note: [a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

year effect (GF = β; 0.029, p-values 1%), and in Panel-D, industry effect (GF = β 0.028, p-values 1%) significantly positively affect the investment-I (Guang-Wen & Siddik, 2022). It indicates that green finance may help the firm to design a sustainable investment policy with the support of different stakeholders and fund providers of the firm. The results indicate that GF is more important for high-ESFs to reduce investment sensitivity than low-ESFs (Gomez-Echeverri, 2018).

Under Table 4, in model-1 and model-2, cluster regression uses to analyze the integration of green finance with financing cash flows sensitivity on firm investment. In the first part of regression of high-ESFs both under Panel-A, integration of Q×GF, year effect (Q×GF = β; 0.021; p-values 1%) and in Panel-B, integration of Q×GF, industry effect (Q×GF = β; 0.021; p-values 1%) indicate that green finance reduces the financing cash flows sensitivity on firm investment-I (Devika & Shankar, 2022). Similarly, in low-ESF, integration of Q×GF under Panel-A, year effect, (Q×GF = β; 0.022; p-values 5%) and in Panel-B, integration of Q×GF, industry effect, (Q×GF = β; 0.023; p-values 5%) significantly explain the investment-I (Guang-Wen & Siddik, 2022) as explain in hypothesis-1.

Further, the integration of GF with CF under high-ESFs in Panel-A, year effect (GF×CF β; 0.014; p-values 1%) and in Panel-B, industry effect (GF×CF = β; 0.013; p-values 1%) and under low-ESFs in Panel-C, year effect (GF×CF = β; 0.024; p-values 1%) and in Panel-D, industry effect (GF×CF = β 0.024; p-values 1%) are significant positively explain the dependent variable investment-I (Han et al., 2022) as explain in hypothesis-2. The findings indicate that integration of GF with firm financing cash flows both high and low-ESFs reduces the cash flows sensitivity of investment-I. Moreover, it indicates that ESFs should redesign the firm capital structure to reduce the negative market sentiments on firm investment by considering the environmental and societal issues (Chen & Zhao, 2021).

We run cluster regression analysis simultaneously for both time and year effect next in Table 5 and Table 6 respectively. Under Table 5, both high-ESFs and low-ESFs are further classified into high-beta and low-beta firms based on systematic risk. The firms are arranged in ascending order based on beta score. The top 50% of firms are included in the list of high-beta and the bottom 50% are included in the list of low-beta firms (Bassetto & Kalatzis, 2011). The findings show under model-1 in Panel-A of high beta-firms, financing cash flows sensitivity (Q = β 0.045; p-values 1%) and (CF = β 0.041; p-values 1%) into the investment-I are higher as compared under model-1 in Panel-B in the low-beta firms of financing cash flows sensitivity (Q = β 0.031; p-values 1%) and (CF = β 0.033; p-values 5%) toward the investment-I (Shad et al., 2019). The findings guide that high-beta firms have lower risk absorbing capacity and it transmits more sensitivity of financing cash flows to investment than the low-beta firms.

Similarly, under Model-2 in Panel C of high-beta firms, financing cash flows sensitivity (Q = β 0.038; p-values 1%) and (CF = β 0.034; p-values 1%) toward the investment are higher as compared under model-2 in Panel-D of low-beta firms of financing cash flows sensitivity (Q = β 0.024; p-values 1%) and(CF = β 0.028; p-values 5%) toward the investment (Moyen, 2004). The findings indicate that high-ESFs have lower risk absorbing capacity and low-ESFs have higher risk absorbing capacity to transmit the sensitivity of financing cash flow into investment-I (Ding et al., 2021). Further, we reveal that in higher-ESF, Beta (Beta = β 0.039;

Table 4. Regression analysis of integration of green finance with firm financing-cash flows

	High ESF (Model-1)						Low ESF (Model-2)					
	Panel A (Yearly Effect)			Panel B (Industry Effect)			Panel C (Yearly Effect)			Panel D (Industry Effect)		
	Coff	T	VIF	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF
Q	0.044[a]	2.14	1.56	0.042	2.21	1.64	0.037 [a]	2.25	1.82	0.030 [a]	2.18	1.89
CF	0.039[a]	2.10	1.74	0.039[a]	2.32	1.96	0.035[b]	2.21	1.95	0.032	2.21	1.72
GF	0.031 [a]	3.45	1.86	0.031 [a]	3.43	1.65	0.028 [b]	3.21	1.88	0.027 [a]	3.14	1.63
Q*GF	0.021 [a]	2.87	1.85	0.21 [a]	2.97	1.76	0.022[b]	3.12	2.03	0.023[b]	3.19	2.07
CF*GF	0.014 [a]	2.46	1.77	0.013 [a]	2.51	1.73	0.024 [a]	2.34	1.65	0.024 [a]	2.67	1.72
Beta	0.038 [b]	1.96	1.22	0.037 [b]	1.93	1.37	0.026 [c]	1.83	1.34	0.024[b]	1.81	1.13
FC	0.043 [a]	2.53	1.63	0.042 [a]	2.47	1.52	0.031 [a]	2.62	1.51	0.036 [a]	2.42	1.45
Liq	0.042[c]	2.76	1.73	0.040[c]	2.44	1.76	0.022 [c]	2.41	1.52	0.021 [c]	2.22	1.30
Lev	0.044 [a]	1.91	1.18	0.043 [b]	1.85	1.23	0.352 [a]	1.88	1.39	0.034[b]	1.79	1.28
IND	0.016 [b]	1.91	1.14	0.015 [a]	1.98	1.16	0.014 [b]	1.66	1.17	0.014 [a]	1.63	1.15
Year	0.024 [a]	1.51	1.12	0.024 [a]	1.49	1.11	0.023 [a]	1.45	1.09	0.023[a]	1.44	1.11

Note: [a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

Table 5. Regression analysis of integration of green finance and risk absorbing firms

	Model-1 High-ESF						Model-2 Low-ESF					
	Panel A (High Beta)			Panel B (Low Beta)			Panel C (High Beta)			Panel D (Low Beta)		
	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF
Q	0.045[a]	2.16	1.56	0.031 [a]	2.25	1.84	0.038 [a]	2.25	1.67	0.024 [a]	2.23	1.90
CF	0.041[a]	2.19	1.79	0.033[b]	2.28	1.96	0.034[a]	2.34	1.98	0.028[b]	2.23	1.74
GF	0.032 [a]	3.48	1.87	0.029 [b]	3.24	1.88	0.033 [a]	3.44	1.67	0.028 [a]	3.17	1.65
Beta	0.039 [b]	1.97	1.23	0.037 [b]	1.89	1.35	0.026 [b]	1.89	1.34	0.024[b]	1.86	1.14
GF*Beta	0.023 [a]	2.39	1.54	0.020 [a]	2.31	1.43	0.019 [a]	2.44	1.62	0.017 [a]	2.37	1.41
FC	0.053 [a]	2.54	1.66	0.034 [a]	2.67	1.54	0.052 [a]	2.33	1.70	0.035 [a]	2.41	1.47
Liq	0.044[c]	2.79	1.78	0.021 [c]	2.44	1.55	0.042[c]	2.49	1.75	0.024 [c]	2.24	1.33
Lev	0.054 [a]	1.94	1.18	0.451 [a]	1.84	1.38	0.042 [b]	1.87	1.24	0.043[b]	1.78	1.27
IND	0.012 [b]	1.93	1.10	0.011 [b]	1.67	1.16	0.012 [a]	1.99	1.14	0.014 [a]	1.51	1.22
Year	0.020 [a]	1.55	1.17	0.021 [a]	1.89	1.09	0.020 [a]	1.47	1.14	0.021[a]	1.78	1.27

Note: [a] significant at 1%; [b] significant at 5%; [c] significant at 10.

Table 6. Regression analysis of integration of green finance and financing cost

	Model-1 Higher ESF						Model-II Lower ESF					
	Panel A (High FC)			Panel B (Low FC)			Panel C (High FC)			Panel D (Low FC)		
	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF	Coffic	T	VIF
Q	0.043[a]	2.16	1.56	0.032 [a]	2.25	1.84	0.030[a]	2.16	1.56	0.022 [a]	2.25	1.84
CF	0.040[a]	2.19	1.79	0.031[b]	2.28	1.96	0.032[a]	2.19	1.79	0.021[b]	2.28	1.96
GF	0.032 [a]	3.48	1.87	0.029 [b]	3.24	1.88	0.032 [a]	3.48	1.87	0.029 [b]	3.24	1.88
Beta	0.022 [b]	1.97	1.23	0.021 [c]	1.89	1.35	0.022 [b]	1.97	1.23	0.021 [c]	1.89	1.35
FC	0.047 [a]	2.45	1.56	0.046 [a]	2.41	1.53	0.034 [a]	2.46	1.59	0.032 [a]	2.37	1.53
GF*FC	0.031 [a]	2.39	1.54	0.022 [a]	2.31	1.43	0.020 [a]	2.39	1.54	0.011 [a]	2.31	1.43
Liq	0.044[c]	2.79	1.78	0.021 [c]	2.44	1.55	0.044[c]	2.79	1.78	0.021 [c]	2.44	1.55
Lev	0.054 [a]	1.94	1.18	0.451 [a]	1.84	1.38	0.054 [a]	1.94	1.18	0.451 [a]	1.84	1.38
IND	0.012 [b]	1.93	1.10	0.011 [b]	1.67	1.16	0.012 [b]	1.93	1.10	0.011 [b]	1.67	1.16
Year	0.020 [a]	1.55	1.17	0.021 [a]	1.89	1.09	0.020 [a]	1.55	1.17	0.021 [a]	1.89	1.09

Note: [a] significant at 1%; [b] significant at 5%; [c] significant at 10%.

p-values 5% and (Beta = β 0.037; p-values 5%) transmit more volatility on investment than the lower-ESFs (Beta = β 0.026; p-values 5% and (Beta = β 0.024; p-values 5%). It indicates that firms that are more sensitive to investment have greater systematic risk and transmit higher volatility into firm investment (Galanti et al., 2022).

Further, we investigate the integration of (GF × Beta) under Model-1, in Panel-A, (GF × Beta = β 0.023; p-values 1%) and in Panel-B, (GF × Beta = β 0.020; p-values 1%) have lower sensitivity on firm investment than the traditional source of financing as we proposed in hypothesis-3 (Pang et al., 2022). Similarly, integration of (GF × Beta) under Model-2 in Panel-C (GF × Beta; β 0.019; p-values 1%) and in Panel-D (GF × Beta = β 0.017; p-values 1%) has a significantly lower sensitivity to financing cash flows on firm investment than the traditional source as we proposed in hypothesis-3. It has been noted that in high-ESFs integration of (GF × Beta) more significantly influences investment-I than the low-ESFs (Chen & Zhao, 2021).

Under Table 6, both high-ESF and low-ESF are further classified into high-FC firms and low-FC firms. The Weighted Average Cost of Capital (WACC) is used to measure the financing cost of each firm. The industry financing cost is used in this study as a benchmark to segregate into high-FC and low-FC firms (Bassetto & Kalatzis, 2011). The integration of green finance with firm FC under Model-1 in Panel-A (GF×FC = β 0.031; p-values 1%) and in Panel-B (GF×FC = β 0.022; p-values 1%) are significantly lower sensitivity of financing cash flows into an investment than the traditional source of financing (Pang et al., 2022). Similarly the integration of green finance with firm FC under Model-2 in Panel-C (GF×FC = β 0.02; p-values 1%) and in Panel-D (GF×FC = β 0.011; p-values 1%) have significant lower sensitivity into investment than the tradition financing (Xu et al., 2022).

The findings indicate that integration of green finance with financing cost transmits the lower sensitivity into investment as proposed in hypothesis-4. It also guides that green finance both in high-ESFs and low-ESFs reduces the sensitivity of financing costs on firm investment (Chen & Zhao, 2021). The findings reaffirm the existing literature that firm financing cost affects the firm financing cash flow volatility on investment. Bassetto and Kalatzis (2011) find that ESFs reduce financial constraints by implementing environment-friendly policies and adopting CSR disclosures for sustainable investment. Similarly, Sudha (2015) shows that high ESFs face more constraints to avail the investment opportunities and green finance is a modern way of financing to recover the confidence of stakeholders for sustainable investment.

Conclusions

This study analyzes the influence of financing cash flows sensitivity on investment decisions of environmental firms. Firstly, high ESFs and low ESFs are classified on the basis of environmental disclosure scores attained by a firm during the sample period. The cluster regression econometric has applied to test the investment volatility of high-ESFs and low-ESFs. The study finds that high ESFs firms have more cash flows volatility than the lower ESFs as proposed in hypothesis-1. It indicates that volatility to finance the investment is also based on the firms' long-term investment policy to protect the environment rather than only on financial performance. Further, we reveal that financing the investment with green finance reduces

the cash flows volatility of ESFs as proposed in hypothesis-2. It guides that green finance reduces the negative market sentiment on firm investment by considering environmental and societal issues. The inclusion of green finance into firm capital structure facilitates to manage business effectively and reduces investment sensitivity by addressing societal issues.

Additionally, this study finds that green finance improve the risk absorbing capacity of a firm regarding the cash flows volatility of investment projects as proposed in hypothesis-3. It indicates that ESFs use green finance as an instrument for improving their risk-absorbing capacity to implement sustainable business practices. Findings guide that green finance assists the ESFs to reduce their systematic risk by reviving it reputation and transmitting the signal into markets regarding social welfare and sustainable investment for stakeholders. Moreover, we find that ESFs can reduce the financing cost on firm investment by financing through green finance with traditional source of financing as proposed in hypothesis-4.

It indicates that ESFs use green finance to reduce financial constraints on their investment portfolios. The findings guide that firms that engage in green investment have lower financing cost due to positive market reactions and better reputations among their stakeholders. In respect of practical implications, this study explains the firms can reduce investment sensitivity by introducing green finance into their capital structure. It assists to implement sustainable investment policies with the support of stakeholders and funds providers of the firm. The managers can increase the firm risk absorbing capacity by developing the green finance optimal capital structure. It may also help managers to reduce the firm idiosyncratic risks by reviving its reputation and acceptance among its stakeholders. Further, managers may use green finance as a means to reduce financial constraints on their investment portfolios.

Future studies can also be conducted how different types of ESG compliance integration with green financings such as social capital, human rights, health and safety of employees affects the firm performance. There are several limitations of this research study. Firstly, we narrow the definition of competitive advantage focus only on firms equity return more than its financing cost. Secondly, the data collection period has very limited disclosures by large firms so we could not collect the other components of ESG compliance. Finally, our data is limited to Chinese firms only and future studies can also explore the integration of green finance with ESG disclosures across the Asian firms.

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Author contributions

All authors have equally contributed to complete this research study.

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