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Who does not advance loses ground: Green investment as a strategic response by small and medium-sized enterprises to economic policy uncertainty

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ABSTRACT

This study examines how listed small and medium-sized enterprises (SMEs) respond to economic policy uncertainty (EPU exposure) through their environmental decisions. We find that SMEs are associated with increased environmental investment when facing heightened EPU exposure. Notably, SMEs with greater EPU exposure are more likely to invest in clean energy-related initiatives, underscoring the important role of the energy sector in driving corporate sustainable strategies. Additionally, this study reveals that the impact of EPU exposure on environmental investments is more salient when SMEs face fewer financial constraints, are located in more marketized regions, operate in less competitive markets and non-heavily polluting industries, and after the implementation of the 2012 Green Credit Policy. These findings suggest that SMEs are more likely to adopt sustainable practices under heightened policy uncertainty, leveraging environmental initiatives as a strategic response to facilitate firm development and growth.

1. Introduction

Globalisation and geopolitical risks significantly influence economic activities, corporate strategies, and investment decisions in today's world (Li et al., 2024; Shen and Hong, 2023). The complexity of geopolitical events often intensifies uncertainties, affecting economic progress both domestically and internationally. In recent years, the convergence of heightened geopolitical tensions has underscored the significance of the economic policy uncertainty (EPU). EPU arises when government policies and regulatory frameworks are unclear or unpredictable, thereby creating risks and challenges for firms (He et al., 2020). A growing body of research explores how policy uncertainties affect firm behaviour.[1] Given the urgency of a global low-carbon transition, examining how EPU interacts with corporate environmental decision-making is critical for fostering a more sustainable economy. While recent studies have demonstrated that macro-level EPU negatively affects corporate green attitudes (Hou et al., 2022) and environmental innovation (Kyaw, 2022), the impact of policy uncertainty on environment-related corporate decision-making still remains underexplored (Hou et al., 2022). Further, little attention is even given to smaller enterprises which is surprising as SMEs are more sensitive to, and more affected by, changes in economic-related policies (Fan et al., 2021; Ghosal and Ye, 2014; Naes et al., 2011; Su et al., 2020). This raises the important question of how SMEs adopt resilience strategies in response to heightened exposure to policy uncertainty.

We use corporate environmental investment to study the resilience strategy of SMEs when their exposure to EPU is salient. SMEs play a vital role in the economy because they contribute significant value to various sectors in most economies (Mazzarol and Reboud, 2020; Schich, 2017) and promote sustainable development (Mahmud et al., 2020). While environmental investment has a long investment horizon with great uncertainties about returns, both characteristics of environmental investment exacerbate the risk of over- or under-investment especially for SMEs. On the one hand, less market access and insufficient bargaining power increase financing costs for SMEs due to increased uncertainties, which may lead to delayed capital decisions (Bajaj et al., 2021; Beck and Demirguc-Kunt, 2006; Chittenden and Derregia, 2015; Gertler and Gilchrist, 1994). Consequently, SMEs with heightened exposure to policy

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[1] For example, existing evidence shows that EPU significantly influences corporate investment decisions (Chen et al., 2019; Gulen and Ion, 2015; Kong et al., 2022; Wang et al., 2014), financing decisions (Tabash et al., 2022; Tran, 2021), corporate innovation (Cui et al., 2021; He et al., 2020; Liu et al., 2022b), risk-taking (Zhang et al., 2021), earnings management (Cui et al., 2020; Yung and Root, 2019), and information disclosure (Nagar et al., 2019).

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uncertainties may reduce environmental investment. On the other hand, green engagement can be used as an efficient strategy to enhance firm reputation (Ling, 2019) and improve competitiveness (Papadas et al., 2019). Firms are found to take more environmentally friendly actions to enhance their reputation in times of uncertainty (Hou et al., 2022). Since uncertainties are often associated with opportunities (Tarkom and Ujah, 2023), SMEs may adopt active strategies and react optimally by increasing environmental investment because they cannot afford to wait (Cao et al., 2020; Clemens et al., 2008). As a result, SMEs with heightened exposure to policy uncertainties could increase environmental investment. Overall, the impact of policy uncertainty on SMEs' environmental investment remains an open question.

To answer the above question, we use a sample of Chinese listed firms from 2003 to 2019. We choose the Chinese market because China's important position in global economy (Overholt, 2016; Qiu and Zhan, 2016) and China's rapidly evolving policy environment offer an ideal setting to investigate the nexus between EPU and corporate environmental decisions. First, as geopolitical conflicts cause international trade disputes and uncertainties, the Chinese context offers valuable insights into how firms adjust their strategies in an increasingly volatile global economy due to the complex geopolitical tensions. China's economy has entered the "new normal of Chinese economic growth" with characteristics of the "three-phase superposition" period, including the phase of shifting the economic growth rate from high speed to medium-to-high speed, the phase of structural adjustment with growing pains, and the phase of digestion period of the initial stimulating policies (Yu and Shen, 2020). Subsequently, the government introduced a series of policies and reforms, such as Mass Entrepreneurship and Innovation, the Belt and Road Initiative, and Supply-side Reform. The massive policy changes over past decades make China's EPU highly variable over time (see Fig. 1). Second, China's energy sector is undergoing a significant transformation. To facilitate the low-carbon transition and promote the green transformation of the economy, the Chinese government implemented several green policies, including the Green Credit Policy and a series of policies to achieve carbon peak and carbon neutrality.[2] These measures, alongside frequent reforms and multiple goals of macroeconomic objectives, contribute to a high degree of economic policy uncertainty (Gulen and Ion, 2015; Liu et al., 2022b). Taken together, China's pivotal role in the global market and the evolving policy environment provide a rich setting, which helps understand how EPU influences corporate environmental decision-making, particularly for SMEs as they develop resilience strategies under complex and shifting economic conditions.

We find that SMEs are positively associated with environmental investment when subject to heightened EPU exposure. This finding implies that SMEs may strategically respond to policy uncertainties through environmental investment, thereby supporting the argument that SMEs are more sensitive to changing policies and respond actively to seize opportunities in times of uncertainty (Cao et al., 2020; Clemens et al., 2008; Fan et al., 2021; Tarkom and Ujah, 2023). Our finding remains robust after constructing a series of robustness tests, including using alternative measures of EPU exposure and SMEs, applying industry-adjusted investment, clustering standard errors at *Firm* × *Year* level, controlling for the impact of macroeconomic influences, performing propensity score matching (PSM) approach, and constructing the instrumental variable 2SLS (IV-2SLS) approach. The sub-component analysis highlights the important role of the energy sector in motivating SMEs to pursue sustainable strategies in times of uncertainty. Specifically, our findings show that SMEs tend to increase investment in renewable energy projects in response to heightened EPU exposure. In the cross-sectional analyses, we further examine the factors shaping the influence of EPU exposure on SMEs' environmental investment decisions. We find that the impact is more salient in SMEs with lower financial constraints, located in regions with high marketization levels, in less competitive markets, and operate in non-heavily polluting industries. In addition, we find that SMEs are associated with higher environmental investment after the implementation of the 2012 Green Credit Policy.

This study contributes to the literature in three aspects. First, this study presents an important reference to investigate the resilience strategy of SMEs when policy uncertainties are exacerbated. Given the important role that SMEs play in securing economic development, technological innovation, and economic growth, it is crucial to understand their behaviour to gain insight for both developing and developed countries. For example, at the end of 2014, micro, small and medium-sized enterprises contributed 65 % of China's GDP, 50 % of the taxation revenue, 68 % of national exports, and over 75 % of total employment (Meng et al., 2018). This study reveals how SMEs react to policy uncertainty and demonstrates how different factors shape the influence of EPU exposures on corporate environmental investment. As such, this study provides new insights into other emerging markets with similar characteristics to understand and support the growth of SMEs.

Second, this study highlights the crucial role that the energy sector plays in an increasingly uncertain global economy. The literature indicates that the increased geopolitical risks significantly affects the economic and financial systems around the world, governments therefore introduce a range of policies intended to stabilise economic and political conditions (Liadze et al., 2023; Shen and Hong, 2023). However, frequent changes to these policies often exacerbate economic uncertainties (Baker et al., 2016), which may create challenges for firms to make resilience strategies. Nevertheless, this study shows that firms facing heightened EPU exposure allocate greater resources to renewable energy projects, highlighting how investment in energy sector serve as a strategic hedge against future regulatory shifts. As such, this study sheds light on the critical role the energy sector plays in supporting resilience in times of heightened uncertainties.

Third, while the influence of EPU on investment decision-making is an important research question (Liu et al., 2022b), limited studies shed light on corporate environmental engagement. The literature reveals that macro-level policy uncertainties affect corporate environmental information disclosure (Pan et al., 2020), firms' green attitudes (Hou et al., 2022), and environmental innovation (Kyaw, 2022; Yang et al., 2022). Little is known concerning the impact of EPU on environmental investment, especially in relation to the heterogeneous exposure of firms. Our study adds new evidence to the literature regarding how firms' heterogeneous exposure to policy uncertainties affects corporate investment strategies, which contributes to the growing literature on understanding the wide-ranging effects of firms' EPU exposure. Our heterogeneity analysis further indicates that several factors moderate the impact of EPU exposure on environmental initiatives in SMEs. For instance, Green Credit Policy significantly strengthens the relationship between EPU exposure and environmental investment, highlighting the role of government policy in promoting corporate sustainability, particularly among SMEs, which typically have limited access to external resources. Additionally, our results also demonstrate that SMEs operating in more competitive industries are less likely to engage in environmental investment compared to their peers in more concentrated industries. The result indicates that firms in highly competitive markets often face greater pressure to cut costs, leaving fewer resources available for environmental initiatives.

The remainder of the paper is organised as follows. Section 2 presents the literature and hypothesis development. Section 3 illustrates the data and sample construction. Section 4 reports the empirical analyses and discusses the results. Section 5 concludes.

[2] For instance, the Chinese government launches the "1 + N" Policy Framework to achieve a low-carbon economy.

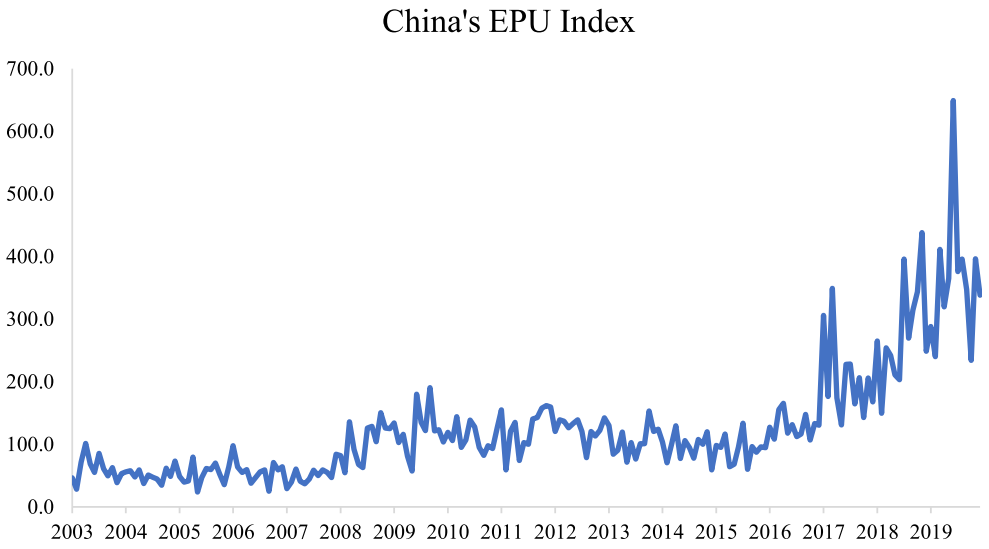

Fig. 1. EPU Index in China. Fig. 1 presents China's EPU Index based on mainland newspapers, *Renmin Daily* and *the Guangming Daily*, from 2003 to 2019. EPU Index is obtained from https://www.policyuncertainty.com.

2. Literature review and hypothesis development

2.1. Current studies on EPU

The literature reveals that EPU has a wide impact on corporate decision-making. For instance, existing studies find a significant impact of policy uncertainties on corporate investment activities (Gulen and Ion, 2015; Kong et al., 2022; Wang et al., 2014). Gulen and Ion (2015) illustrate that policy uncertainty induces corporate precautionary delays in investment because of investment irreversibility. As a result, firms tend to reduce investment when the level of policy uncertainty is high. Consistently, Chen et al. (2019) find that EPU decreases not only firms' long-term investment but also short-term investment. Using a sample of Chinese high-tech firms, Liu et al. (2022b) demonstrate that EPU shapes corporate investment preferences by inhibiting maintenance investment and stimulating innovation investment.

Further, EPU is found to affect corporate innovation activities (He et al., 2020; Kyaw, 2022), discourage firm-level green attitudes (Hou et al., 2022), and hinder firms' total factor productivity growth (Li et al., 2021). However, firms with aggressive strategies may use EPU as an opportunity to compete in the changing environment, leading to more corporate risk-taking behaviours when EPU is high (Zhang et al., 2021). The uncertainties in the future economic policy also affect firm expectations and managerial judgements, leading to different financial policies and decisions (Tabash et al., 2022; Yung and Root, 2019). Using an international setting of 17 countries, Tran (2021) finds that high EPU leads to higher default risk so that creditors increase the cost of debt to compensate for the information disadvantage associated with EPU. Yung and Root (2019) demonstrate that firms tend to increase earnings management when policy uncertainty is high. Nagar et al. (2019) find that managers increase their voluntary disclosures to reduce information asymmetry associated with increased EPU. A rise in EPU also exacerbates corporate financial constraints (Ma and Hao, 2022), increases the tax burden (Dang et al., 2019) and cash holdings (Phan et al., 2019), and adversely affects firms' trade credit (Jory et al., 2020). Moreover, fluctuations in economic policy affect stock markets. Phan et al. (2018) show that EPU affects stock excess returns using global evidence from 16 countries. Jin et al. (2019) and Luo and Zhang (2020) find that EPU may enhance the managerial ability and incentives to conceal bad news, which makes firms more prone to crash risk.

While a wide range of studies examines how policy uncertainties affect corporate decision-making using the macro-level EPU, it has been noticed that individual firms may have heterogeneous exposure to EPU based on their own characteristics (Cui et al., 2021). Therefore, corporate decision-making may vary among firms due to the heterogeneous exposure. Existing literature illustrates that firms with high EPU exposure are associated with less corporate innovative investment (Cui et al., 2021), more earnings management (Cui et al., 2020), and lower market value (Yang et al., 2019). In addition, Li (2017) finds that firms with higher EPU exposure earn higher average returns, and the EPU factor-mimicking portfolio earns significant abnormal returns.

2.2. Hypothesis development

Although existing studies reveal that EPU has different influences on corporate decisions in large firms and SMEs (Ghosal and Ye, 2014; Naes et al., 2011; Su et al., 2020), how SMEs' exposure to EPU affects environmental investment remains an open question. On the one hand, EPU increases firms' cost of capital and future cash flows instability, and especially so, for SMEs. Compared to large firms, SMEs have less access to external financing (Beck and Demirguc-Kunt, 2006; Casey and O'Toole, 2014), and therefore, in uncertain times, SMEs are more likely to be associated with higher costs of external financing due to limited market access and bargaining power (Bajaj et al., 2021; Gertler and Gilchrist, 1994). Consequently, financing constraints may lead to delayed capital decisions (Chittenden and Derregia, 2015). The real option theory indicates that uncertainties enhance incentives for firms to postpone investment projects (Bernanke, 1983; Gulen and Ion, 2015). Firms face an option to either defer, or expand, when making investment decisions. However, high uncertainty of the future environment, and the irreversibility nature of investment projects, make firms trade-off the profit difference between current and future investments. The higher the degree of uncertainty, the higher the value of delaying investment. Hence, when facing high uncertainty, the option to defer investment increases the value of firms delaying risky investment (Folta and O'Brien, 2004; McDonald and Siegel, 1986; Wang et al., 2014). Similarly, Kong et al. (2022) indicate that firms facing high uncertainties tend to reduce investment projects to reduce risk because capital projects are difficult to reverse. Therefore, due to the increased financing costs and the irreversibility nature of investment, it is likely that SMEs with higher EPU exposure decrease environmental investment. As such, we propose the following hypothesis:

Hypothesis 1. (a): SMEs with higher EPU exposure reduce their environmental investment.

On the other hand, the growth option theory suggests that

uncertainty tends to encourage investment projects because firms' prompt investment may help obtain early-mover advantage in times of uncertainty (Liu et al., 2022b; Vo and Le, 2017). Kulatilaka and Perotti (1998) indicate that, under imperfect competition, uncertainties can create future growth opportunities, which encourage firms to invest early to obtain a larger market share.

Since environmental protection is one of the government's critical tasks in China, environmental investment is likely to be used as a strategy to facilitate firm development and provide an insurance-like effect under uncertainties. For example, existing studies show that corporate green engagement can improve corporate performance and competitiveness (Ling, 2019; Papadas et al., 2019). Hou et al. (2022) find that firms intend to behave in an environmentally friendly manner to enhance their reputation in periods of high EPU. Moreover, Tarkom and Ujah (2023) suggest that in times of uncertainty, SMEs should be more forward-looking and make strategic decisions to seize opportunities. Similarly, Cao et al. (2020) and Clemens et al. (2008) demonstrate that SMEs facing uncertainties are more likely to implement active strategies and invest efficiently because they cannot afford to wait. Further, SMEs may use environmental engagement to mitigate financial burden and seek government support. For instance, Fan et al. (2021) find that small firms are associated with lower financing costs if they improve environmental performance. As such, SMEs facing higher exposure to EPU, may use environmental investment as an insurance and value-enhancing tool, which leads to the following hypothesis:

Hypothesis 1. (b): SMEs with higher EPU exposure increase their environmental investment.

3. Sample and variable construction

3.1. Data and sample

The initial sample used in this study consists of A-Share listed firms on the Shanghai and Shenzhen Stock Exchanges from 2003 to 2019. We manually collect the firm-level environmental investment data for all listed firms from their annual reports. The EPU index is obtained from the website (www.policyuncertainty.com) developed by Baker et al. (2016). All the other firm-level financial data are obtained from the China Stock Market and Accounting Research (CSMAR) database. After removing firms from the financial industry, delisted firms, firms with missing data on environmental investment, and observations with other missing information, the final sample includes 1039 firms from 2003 to 2019, corresponding to 5720 firm-year observations across 15 industries. All continuous variables are winsorised at the 1 % and 99 % levels.

3.2. Variable construction

3.2.1. Environmental investment

We manually collect data of corporate environmental investment from “construction in progress” on a firm's annual report. Specifically, following studies such as Liu et al. (2022a) and Zhang et al. (2019), we identify investment items related to environmental projects and environmental protection from the detailed items under this account, such as desulfurisation projects, denitrification projects, sewage treatment, waste gas treatment, dust and haze management, energy-saving, or greening projects. We then aggregate all related investment items to quantify the firm's environmental investment. Finally, we construct two variables to measure corporate environmental investment. ENV/TA is calculated as a firm's environmental investment scaled by its total assets. ENV/SA refers to the ratio of a firm's environmental investment to its total sales revenue.

3.2.2. EPU exposure

Baker et al. (2016) construct time-varying EPU indices based on newspaper coverage for major economies, which is widely used in related studies (e.g., Cui et al., 2021; Kong et al., 2022; Li et al., 2021; Liu et al., 2022b; Ma and Hao, 2022; Yang et al., 2019; Zhang et al., 2021). Similarly, to measure China's EPU index, Davis et al. (2019) quantify uncertainty-related concepts using two mainland Chinese newspapers, the *Renmin Daily* and the *Guangming Daily*.[3] According to Cui et al. (2020), the *Renmin Daily* and the *Guangming Daily* are the two most influential news outlets that relay government policies in mainland China. Therefore, we use the EPU index constructed by Davis et al. (2019) to measure the macro-level EPU in China.

Since stock prices would at least partially reflect the potential impact of EPU changes on firm value (Cui et al., 2020; Francis et al., 2014; Nagar et al., 2019), we estimate firms' heterogeneous exposure to EPU by running the following model for each firm using monthly data of excess return:

$$R_{i,\tau} - r_{i,\tau} = \beta_0 + \beta_{i,\tau}^{EPU} EPU_\tau + \beta_{i,\tau}^{MKT} MKT_\tau + \beta_{i,\tau}^{SMB} SMB_\tau + \beta_{i,\tau}^{HML} HML_\tau + \varepsilon_{i,\tau} \quad (1)$$

where $R_{i,\tau} - r_{i,\tau}$ is the excess return on stock i in month τ, EPU_τ is China's EPU index in month τ, MKT_τ, SMB_τ, and HML_τ are Fama-French three factors in the Chinese stock market.

With Model (1), we use the 60-month (τ-60, τ-1) rolling window for each firm to estimate the beta of $\beta_{i,\tau}^{EPU}$, which captures firms' sensitivity to the changes in EPU. Similar in spirit to Francis et al. (2014), Luo and Zhang (2020), and Nagar et al. (2019), we use the absolute value of beta to measure firms' heterogeneous exposure to EPU because both positive and negative coefficients capture a firm's sensitivity to EPU. A high absolute value of beta indicates that the underlying stock is significantly affected by EPU changes. Finally, we average the monthly data as the proxy for annual EPU exposure, which is $EPU\ Beta_{i,t}$. Therefore, firms with higher $EPU\ Beta_{i,t}$ are associated with higher EPU exposure.

3.2.3. SMEs

To implement the *Small and Medium Enterprises Promotion Law* of the People's Republic of China, which was issued in 2002, the former State Economic and Trade Commission, the former State Planning Commission, the Ministry of Finance, and the National Bureau of Statistics formulated the *Interim Regulations for the Classification of Small and Medium-sized Enterprises* in 2003 (2003 Standards). The 2003 Standards provided the official classification of firm size in China. Specifically, the standards for large, medium and small-sized enterprises are formulated based on the number of employees, sales, total assets, combined with the characteristics of the industry.

The government updated the classification in 2011, the Ministry of Industry and Information Technology, the National Bureau of Statistics, the National Development and Reform Commission, and the Ministry of Finance formulated the *Standard Regulations for the Classification of Small and Medium-sized Enterprises* (2011 Standards). Similar to the 2003 Standards, firm sizes are determined by different indicators, such as the number of employees, sales, and total assets, based on industry characteristics. At the same time, the 2003 Standards were abolished.

The 2003 Standards and 2011 Standards both specify that large and medium-sized enterprises must meet the lower limit of the listed indicators at the same time, otherwise they will be lowered to the next level, such as small enterprises. Therefore, we construct $SME_{i,t}$ following the detailed 2003 Standards and 2011 Standards.[4] Specifically, $SME_{i,t}$ is a dummy variable which equals one if firm i is not identified as a large-sized enterprise based on the 2003 Standards for years before 2011 and 2011 Standards for years on and after 2011, and zero otherwise.

[3] The detailed construction of the EPU index in mainland China is available in https://www.policyuncertainty.com.

[4] The detailed standards for each industry are available in National Bureau of Statistics at https://www.stats.gov.cn/

3.2.4. Control variables

Referring to Xiao and Shen (2022), Liu et al. (2022a), and Wang and Zhang (2020), we control for a set of firm characteristics that may affect corporate environmental investment. *Total Assets* is calculated as the natural logarithm of total assets. *Leverage* refers to the ratio of total debt to total assets. *Firm Age* is calculated as the natural logarithm of the years a firm has been established. *ROA* is the proxy of firm performance and is defined as the ratio of net income to total assets. *Tobin's Q* is the ratio of the total market value of equity to the total book value of assets at the end of each year. *Return* refers to a firm's annual stock return. *Capex* is the capital expenditure scaled by total assets. *Cash Flow* is the ratio of cash flow from operations to total assets. *Sales Growth* is the annual growth rate in revenues. The detailed definitions of all variables used in this study are provided in Appendix A.

4. Empirical analysis

4.1. Descriptive statistics

We present the summary statistics of the main variables used in this study in Panel A of Table 1. The average values of environmental investment relative to total assets and total sales are 0.012 and 0.028, respectively. Around 18.4 % of the sample firms used in this study are classified as SMEs, indicating the significance of investigating the resilience strategies of SMEs. On average, the mean value of $EPU\ Beta_{i,t}$ is 0.037 in this study. Panel B of Table 1 reports the univariate analysis of firm characteristics regarding SMEs. We find preliminary results that SMEs have higher EPU exposure compared to large firms, indicating that SMEs are more sensitive to EPU.

Table 2 reports the correlation matrix for the main variables and shows that multicollinearity is not a concern in this study. In addition, we find that *SME* is positively correlated with *EPU beta* at the 1 % significance level, which implies the significant influence of EPU on SMEs.

4.2. Baseline findings

To examine how firms' heterogeneous exposure to EPU affects corporate environmental investment in SMEs, we construct Model (2) as follows:

$$\begin{aligned}\text{Env Inv}_{i,t+1} =& \beta_0 + \beta_1 \text{SME}_{i,t} \times \text{EPU Beta}_{i,t} + \beta_2 \text{SME}_{i,t} + \beta_3 \text{EPU Beta}_{i,t} \\ &+ \sum_k \beta_k \text{Controls}_{i,t} + \text{Fixed Effects} + \varepsilon_{i,t}\end{aligned} \tag{2}$$

where $Env\ Inv_{i,t+1}$ is the proxy for corporate environmental investment in year $t + 1$, measured by ENV/TA or ENV/SA. $SME_{i,t}$ is a dummy variable representing small and medium-sized firms as discussed in *Section 3.2.3*. $EPU\ Beta_{i,t}$ is the measurement of firms' heterogeneous exposure to EPU, a higher value of $EPU\ Beta_{i,t}$ stands for higher level of EPU exposure. $Controls_{i,t}$ refers to a set of control variables discussed above. Firm- and year-fixed effects are included in Model (2) to control for time-invariant firm-level influences and potential time trend effects. Our variable of interest is the interaction term $SME_{i,t} \times EPU\ Beta_{i,t}$, which examines the impact of firm-level EPU exposure on corporate environmental investment in SMEs. We expect the coefficient β_1 in Model (2) to be significantly negative if *Hypothesis 1(a)* is supported, or significantly positive if *Hypothesis 1(b)* is supported.

Table 3 reports the results of Model (2). Columns (1) and (2) report the results using ENV/TA_{t+1} and ENV/SA_{t+1} as the dependent variable, respectively. We find that the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are significantly positive in Columns (1) and (2) at the 1 % level, respectively. The positive coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ indicate that SMEs are more likely to increase their environmental investment when they are subject to higher EPU exposure. Our findings are not only statistically but also economically significant. The coefficient estimate in Column (1) implies that environmental investment in SMEs increases by 16.7 % relative to the sample mean for one standard-deviation increase in EPU exposure. The coefficient estimate in Column (2) implies that environmental investment in SMEs increases by 20.2 % relative to the sample mean for one standard-deviation increase in EPU exposure.

In addition, we also find evidence showing that firm characteristics such as leverage, ROA, and capital expenditure are related to corporate environmental investment. For example, the significantly negative coefficient on *Leverage* implies that firms tend to decrease environmental investment when their leverage ratio is high. The significantly positive coefficient on *ROA* indicates that firms with higher profitability are more likely to invest in environment-related projects.

Overall, the results in Table 3 support *Hypothesis 1(b)* that SMEs choose to increase environmental investment when they are subject to higher exposure to EPU. This finding is in line with the argument that environmental engagement may help SMEs regarding the influences of policy uncertainties (Hou et al., 2022; Ling, 2019; Tarkom and Ujah, 2023).

4.3. Robustness checks

We construct a series of robustness tests in this section, including employing alternative measures of EPU exposure and SMEs, adjusting dependent variables by industry influences, clustering standard errors at *Firm* × *Year* level, and controlling for the impact of macroeconomic influences.[5]

4.3.1. Alternative measures of EPU exposure and SMEs

We construct three alternative measures of EPU exposure and report results in Panel A of Table 4. In the previous section, we use the 60-month (τ-60, τ-1) rolling window for each firm to estimate the beta of $\beta_{i,\tau}^{EPU}$. Therefore, we first employ a shorter horizon to estimate EPU exposure. In particular, we use a 36-month (τ-36, τ-1) rolling window for Model (1) to re-estimate firms' EPU exposure, which produces $EPU\ Beta\ 36_{i,t}$. We then replace $EPU\ Beta_{i,t}$ in Model (2) with $EPU\ Beta\ 36_{i,t}$. Columns (1) and (2) of Panel A report the results using the first alternative measure of EPU exposure. Consistent with the baseline finding, we find that the coefficients on $SME_{i,t} \times EPU\ Beta\ 36_{i,t}$ all remain statistically positive.

Secondly, we re-construct EPU exposure by controlling for Fama-French five factors (Fama and French, 2015) with the following model:

$$\begin{aligned}\text{R}_{i,\tau} - \text{r}_{i,\tau} =& \beta_0 + \beta_{i,\tau}^{\text{EPU}} \text{EPU}_\tau + \beta_{i,\tau}^{\text{MKT}} \text{MKT}_\tau + \beta_{i,\tau}^{\text{SMB}} \text{SMB}_\tau + \beta_{i,\tau}^{\text{HML}} \text{HML}_\tau \\ &+ \beta_{i,\tau}^{\text{RMW}} \text{RMW}_\tau + \beta_{i,\tau}^{\text{CMA}} \text{CMA}_\tau + \varepsilon_{i,\tau}\end{aligned} \tag{3}$$

where $R_{i,\tau} - r_{i,\tau}$ is the excess return on stock i in month τ, EPU_τ is China's EPU index in month τ. MKT_τ, SMB_τ, HML_τ, RMW_τ, and CMA_τ are Fama-French five factors in the Chinese stock market.

We employ the same approach as previously and obtain our second alternative measure of EPU exposure, which is $EPU\ Beta\ FF_{i,t}$. We then replace $EPU\ Beta_{i,t}$ in Model (2) with $EPU\ Beta\ FF_{i,t}$ and report the results in Columns (3) and (4) of Panel A. We find that our baseline finding remains unchanged. That is, SMEs are associated with higher levels of environmental investment when exposed to EPU.

Lastly, considering the significant impact of economic policy fluctuations in the U.S. on global economies (Wang et al., 2014), and taking into account China's close economic ties with the U.S. through a wide range of international trades (Wu et al., 2019), we construct a refined measure of China's EPU following Gulen and Ion (2015). This measure effectively eliminates the contaminating part of the index by extracting the component of China's EPU index that is orthogonal to the U.S. EPU index. Specifically, we run a regression using China's EPU index as the dependent variable and the U.S. EPU index as the independent variable.

[5] We thank the anonymous reviewers for these insights.

Table 1
Descriptive statistics.

Panel A: Summary statistics

Variables	N	Mean	SD	Min	P25	Median	P75	Max
ENV/TA $_{t+1}$	5720	0.012	0.024	0.000	0.000	0.002	0.010	0.144
ENV/SA $_{t+1}$	5720	0.028	0.070	0.000	0.001	0.004	0.020	0.461
SME	5720	0.184	0.388	0.000	0.000	0.000	0.000	1.000
EPU Beta	5720	0.037	0.037	0.000	0.010	0.025	0.050	0.189
Total Assets	5720	22.504	1.270	20.184	21.578	22.337	23.276	26.330
Leverage	5720	0.499	0.185	0.091	0.365	0.510	0.641	0.879
Firm Age	5720	2.721	0.386	1.619	2.488	2.780	3.002	3.412
ROA	5720	0.034	0.052	−0.181	0.012	0.031	0.058	0.188
Tobin's Q	5720	1.813	0.925	0.898	1.179	1.501	2.100	5.758
Return	5720	0.200	0.705	−0.707	−0.244	0.011	0.403	3.185
Capex	5720	0.062	0.057	−0.044	0.022	0.048	0.086	0.268
Cash Flow	5720	0.055	0.066	−0.125	0.016	0.053	0.093	0.252
Sales Growth	5720	0.178	0.323	−0.422	0.001	0.123	0.285	1.703

Panel B: Univariate analysis

	SME = 0		SME = 1			
Variables	N	Mean	N	Mean	Mean-Diff	t
ENV/TA $_{t+1}$	4665	0.011	1055	0.014	−0.003***	−3.382
ENV/SA $_{t+1}$	4665	0.026	1055	0.039	−0.013***	−5.240
EPU Beta	4665	0.034	1055	0.047	−0.013***	−10.153
Total Assets	4665	22.760	1055	21.370	1.390***	35.447
Leverage	4665	0.513	1055	0.435	0.079***	12.613
Firm Age	4665	2.755	1055	2.567	0.188***	14.561
ROA	4665	0.035	1055	0.029	0.005***	3.001
Tobin's Q	4665	1.747	1055	2.104	−0.356***	−11.421
Return	4665	0.181	1055	0.286	−0.105***	−4.389
Capex	4665	0.061	1055	0.065	−0.003*	−1.762
Cash Flow	4665	0.056	1055	0.051	0.005**	2.419
Sales Growth	4665	0.175	1055	0.193	−0.017	−1.576

This table presents descriptive statistics of main variables used in this study. Panel A presents the summary statistics. Panel B compares firm characteristics based on firm size. The sample includes 5720 firm-year observations from 2003 to 2019. The detailed variable definition of each variable is presented in Appendix A.

Table 2
Correlation Matrix.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(1) ENV/TA $_{t+1}$	1					
(2) ENV/SA $_{t+1}$	0.903***	1				
(3) SME	0.045***	0.069***	1			
(4) EPU Beta	0.014	0.015	0.133***	1		
(5) Total Assets	−0.025	−0.011	−0.424***	−0.175***	1	
(6) Leverage	0.020	0.024	−0.165***	−0.037***	0.406***	1
(7) Firm Age	−0.010	0.017	−0.189***	−0.255***	0.252***	0.035***
(8) ROA	0.025	−0.002	−0.040***	0.075***	0.063***	−0.361***
(9) Tobin's Q	−0.029	−0.023	0.149***	0.106***	−0.349***	−0.348***
(10) Return	0.000	−0.018	0.058***	0.083***	−0.074***	0.018
(11) Capex	0.243***	0.243***	0.023	0.121***	0.002	−0.004
(12) Cash Flow	0.010	−0.027	−0.032	0.011	0.051***	−0.146***
(13) Sales Growth	0.047***	0.026	0.021	0.072***	0.006	0.043***

	(7)	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*
(7) Firm Age	1						
(8) ROA	−0.036***	1					
(9) Tobin's Q	0.048***	0.219***	1				
(10) Return	−0.133***	0.154***	0.321***	1			
(11) Capex	−0.215***	0.150***	−0.001	0.034	1		
(12) Cash Flow	−0.008	0.408***	0.101***	0.109***	0.154***	1	
(13) Sales Growth	−0.127***	0.258***	0.061***	0.115***	0.166***	0.052***	1

This table reports the correlation matrix of main variables used in regression analysis. A detailed definition of all variables is reported in Appendix A. *** indicates significance at the 1 % level.

We obtain the residuals from the regression and use the residuals as a refined measure of China's EPU. We then replace China's EPU index in Model (1) with the residuals and employ the same approach as in *Section 3.2.2*. to re-estimate EPU exposure, which produces *EPU Beta Clean*$_{i,t}$. Columns (5) and (6) present the results using *EPU Beta Clean*$_{i,t}$ in Model (2). The positive and significant coefficient on *SME*$_{i,t}$ × *EPU Beta Clean*$_{i,t}$

Table 3
Baseline results.

	(1)	(2)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.054***	0.153***
	(2.769)	(2.795)
SME	−0.003*	−0.003
	(−1.875)	(−0.796)
EPU Beta	0.011	0.024
	(0.941)	(0.740)
Total Assets	−0.002**	−0.002
	(−2.015)	(−0.888)
Leverage	−0.006*	−0.004
	(−1.806)	(−0.412)
Firm Age	−0.004	−0.001
	(−0.907)	(−0.113)
ROA	0.007	0.042*
	(0.883)	(1.767)
Tobin's Q	−0.001	−0.003*
	(−1.116)	(−1.705)
Return	−0.000	0.001
	(−0.279)	(0.256)
Capex	0.066***	0.202***
	(10.622)	(11.461)
Cash Flow	−0.004	−0.033**
	(−0.696)	(−2.159)
Sales Growth	0.001	−0.004
	(0.689)	(−1.575)
Constant	0.058***	0.069
	(2.921)	(1.226)
Observations	5720	5720
Adjusted R-squared	0.344	0.395
Firm-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes

This table presents the baseline regression results. The dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

in Column (5) continues to support our finding that SMEs are associated with higher levels of environmental investment when exposed to EPU.

We also construct alternative measures of SMEs focusing on the total number of employees (Audretsch and Elston, 2002; Beck et al., 2005) and a firm's market value. Specifically, *SME* $(EMP)_{i,t}$ is a dummy variable that equals one if firm *i*'s total employee in year *t* is lower than the median level in the same industry, and zero otherwise. *SME* $(MKT)_{i,t}$ is a dummy variable that equals one if firm *i*'s market value in year *t* is lower than the median level in the same industry, and zero otherwise. We then replace $SME_{i,t}$ with *SME* $(EMP)_{i,t}$ and *SME* $(MKT)_{i,t}$ in Model (2), respectively. We report the results in Columns (1) to (4) of Panel B in Table 4. We continue to find statistically positive coefficients on *SME* $(EMP)_{i,t} \times EPU\ Beta_{i,t}$ and *SME* $(MKT)_{i,t} \times EPU\ Beta_{i,t}$.

4.3.2. Industry-adjusted investment, double clustering, and macroeconomic influences

To mitigate the potential industrial influences and capture the corporate environmental investment of a firm relative to its industry peers, we replace the dependent variables used in Model (2) with industry-adjusted values following Zaman et al. (2021). That is, for each industry and year, we calculate the median level of environmental investment and subtract the industrial-median environmental investment from the firm-level environmental investment for the corresponding year, which produces *Adj. ENV/TA* and *Adj. ENV/SA*. Columns (1) and (2) of Panel A in Table 5 report the results. The coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are significantly positive. The results are consistent with our baseline finding.

Furthermore, we cluster the standard errors of our baseline regressions by *Firm* × *Year* as an additional robustness check. We report the results in Columns (3) and (4) of Panel A in Table 5. The positive and significant coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ in both columns indicate our findings still hold after clustering standard errors at *Firm* × *Year* level.

We also control for the impact of macroeconomic conditions which may influence EPU exposures. Following studies such as Cui et al. (2021) and Xu (2020), we construct *GDPVOL* to capture the influence of economic growth volatility and *CICSI* to measure the influence of capital market sentiment. Specifically, *GDPVOL* is calculated as the standard deviation of GDP growth rates from *t-1* to *t + 1,* while *CICSI* is the composite investor sentiment index of the Chinese stock market.[6] We add *GDPVOL* and *CICSI* to our baseline regressions as additional controls and report the results in Panel B of Table 5. The positive and significant coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ indicate that our findings remain robust after controlling for the impact of macroeconomic influences.

Overall, the results in Table 4 and Table 5 show that our baseline finding remains robust after using various robustness checks. The evidence supports *Hypothesis 1(b)* that SMEs increase environmental investment when they face high EPU exposure.

4.3.3. Propensity score matching (PSM)

We also apply the propensity score matching (PSM) approach to mitigate the potential sample selection bias by matching SMEs to large firms using a set of firm characteristics. Specifically, to obtain the propensity score in the first stage analysis,[7] we construct a logit regression using $SME_{i,t}$ as the dependent variable and a set of firm characteristics as used in Model (2) as control variables. We employ a one-to-one matching method without replacement. After obtaining the PSM score, we re-estimate Model (2) using the PSM sample and report the results in Table 6.

Panel A of Table 6 presents the balance test of the PSM approach. As reported in the unmatched sample, we find that treatment and control groups have significant differences in most observable firm characteristics, such as total assets, leverage, firm age, ROA, Tobin's Q, stock return, and cash flow. The differences in control variables between treatment and control groups become all statistically insignificant using the PSM sample. As such, the treatment and control groups have similar observable firm characteristics after the PSM. Panel B of Table 6 reports the regression results using the PSM sample. We find that SMEs with high EPU exposure are associated with more environmental investment, which supports our baseline finding.

4.3.4. Instrumental variable approach

Reverse causality may be a concern in this study. For example, firms with greater levels of environmental investment may influence their exposures to EPU. To address potential endogeneity problems, we use the instrumental variable 2SLS (IV-2SLS) method to further examine the impact of EPU exposure on SME's environmental investment decisions. Following Cui et al. (2021), we use the mean value of EPU exposure of firms in the same industry-year ($Avg.EPU\ Beta_{i,t}$) as the instrumental variable for $EPU\ Beta_{i,t}$. If $EPU\ Beta_{i,t}$ is associated with concerns of endogeneity problems, the interaction term of $SME_{i,t} \times EPU\ Beta_{i,t}$ is also likely to have endogeneity concerns. Therefore, we further use the interaction term $SME_{i,t} \times Avg.EPU\ Beta_{i,t}$ as the instrumental variable for $SME_{i,t} \times EPU\ Beta_{i,t}$ and report the results in Table 7.

The first-stage regressions reported in Columns (1) and (2) show that $Avg.EPU\ Beta_{i,t}$ is significantly related with $EPU\ Beta_{i,t}$ and $SME_{i,t} \times Avg.EPU\ Beta_{i,t}$ is significantly related to $SME_{i,t} \times EPU\ Beta_{i,t}$. The SW F-statistics are both substantially higher than 10, indicating they are strong

[6] The index accommodates common variations in six underlying proxies for investor sentiment, including the discount rate of market funds, number of IPOs, average first-day IPO returns, market turnover, consumer confidence, and number of newly opened investor accounts.

[7] Results of the first stage analysis are not tabulated and available on request.

Table 4
Alternative measures of EPU exposure and SMEs.

Panel A: Alternative measures of EPU exposure

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta 36*	0.066***	0.180***				
	(4.305)	(4.140)				
*SME * EPU Beta FF*			0.037*	0.092*		
			(1.955)	(1.715)		
*SME * EPU Beta Clean*					0.032*	0.076
					(1.775)	(1.517)
SME	−0.004***	−0.006	−0.002	−0.001	−0.002	−0.000
	(−2.683)	(−1.486)	(−1.427)	(−0.179)	(−1.285)	(−0.036)
EPU Beta 36	−0.008	−0.021				
	(−0.965)	(−0.865)				
EPU Beta FF			0.018	0.043		
			(1.594)	(1.350)		
EPU Beta Clean					0.009	0.012
					(0.935)	(0.432)
Controls and constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5720	5720	5720	5720	5720	5720
Adjusted R-squared	0.345	0.396	0.344	0.395	0.343	0.394
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Alternative measures of SMEs

	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME (EMP) * EPU Beta*	0.046***	0.138***		
	(2.644)	(2.821)		
*SME (MKT) * EPU Beta*			0.040**	0.100**
			(2.326)	(2.049)
SME (EMP)	−0.002**	−0.005		
	(−2.006)	(−1.532)		
SME (MKT)			−0.001	0.000
			(−0.503)	(0.068)
EPU Beta	0.001	−0.008	0.006	0.021
	(0.040)	(−0.201)	(0.489)	(0.559)
Controls and constant	Yes	Yes	Yes	Yes
Observations	5720	5720	5720	5720
Adjusted R-squared	0.344	0.395	0.344	0.395
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the results of Model (2) using different measures of EPU exposure and SMEs. Dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. Panel A reports results using alternative measures of EPU exposure. *EPU Beta 36* represents firms' exposure to EPU estimated using the 36 month-window of Model (1). *EPU Beta FF* refers to EPU exposure estimated using Fama-French Five Factors. *EPU Beta Clean* measures firms' clean EPU exposure. Panel B reports results using alternative measures of SMEs. *SME (EMP)* is a dummy variable equal to one if firm *i*'s total employee in year *t* is lower than the industrial median, and zero otherwise. *SME (MKT)* is a dummy variable equal to one if firm *i*'s market value in year *t* is lower than the industrial median, and zero otherwise. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

instruments. Columns (3) and (4) report results of the second-stage estimations. The coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are positive and statistically significant at 1 % level, which further supports our baseline findings. In addition, the Anderson LM test suggests no concern of under identification, given the large test statistic (234.58), while the Cragg-Donald F-statistic (99.49) indicates there is no weak instrument issue. Overall, the validity tests of the instrument variable indicate that *Avg. EPU Beta* is a valid IV.

4.4. Sub-components analysis

Our results so far indicate that SMEs are associated with higher environmental investments when facing heightened EPU exposure, as evidenced by aggregated investment data related to environmental projects. In this section, we focus on sub-components of environmental investments. Specifically, we divide environmental investments into four groups. *Green* refers to projects that are related to ecological protection. *Energy* refers to projects that are related to renewable and/or clean energy. *Waste* refers to projects that reduce wasted water, gas, solid and related waste treatment and management. *Air* refers to projects that improve air quality.

We present sub-components analysis results in Panel A of Table 8. As reported in Columns (2) and (6), we find that the coefficients on *SME * EPU Beta* are positive and significant at the 1 % level. This finding indicates that SMEs are more inclined to invest in clean energy-related initiatives when facing higher EPU exposure. However, we do not find similar results with respect to green-, waste-, and air-related projects.

We further construct sub-sample analysis concerning firms' negative and positive exposures to EPU with respect to clean energy-related projects. We report the results in Panel B of Table 8. We find that the coefficients on *SME * EPU Beta* are statistically insignificant Columns (1) and (2) where firms have negative exposures to EPU. However, the coefficients on *SME * EPU Beta* become statistically significant and positive in Columns (3) and (4) where firms are positively exposed to EPU. This finding implies that positive EPU exposure is likely to motivate SMEs to increase their energy-related projects.

Table 5
Industry-adjusted investment, double clustering standard errors, and additional controls.

Panel A: Industry-adjusted investment and clustering standard errors by *firm* × *year*

	(1)	(2)	(3)	(4)
Variables	*Adj. ENV/TA* $_{t+1}$	*Adj. ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.056***	0.161***	0.054**	0.153**
	(2.887)	(2.952)	(2.142)	(2.016)
SME	−0.003*	−0.004	−0.003	−0.003
	(−1.850)	(−0.851)	(−1.409)	(−0.543)
EPU Beta	0.007	0.012	0.011	0.024
	(0.617)	(0.368)	(0.934)	(0.793)
Controls and constant	Yes	Yes	Yes	Yes
Observations	5720	5720	5720	5720
Adjusted R-squared	0.315	0.351	0.344	0.395
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes
Firm × Year Clustering	No	No	Yes	Yes

Panel B: Controlling for macroeconomic influences

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.054***	0.153***	0.054***	0.153***	0.054***	0.153***
	(2.769)	(2.795)	(2.769)	(2.795)	(2.769)	(2.795)
SME	−0.003*	−0.003	−0.003*	−0.003	−0.003*	−0.003
	(−1.875)	(−0.796)	(−1.875)	(−0.796)	(−1.875)	(−0.796)
EPU Beta	0.011	0.024	0.011	0.024	0.011	0.024
	(0.941)	(0.740)	(0.941)	(0.740)	(0.941)	(0.740)
GDPVOL	0.595*	1.134			0.136	0.392
	(1.892)	(1.275)			(1.534)	(1.564)
CICSI			0.001*	0.001	0.000	0.001
			(1.892)	(1.275)	(1.258)	(0.720)
Controls and constant	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5720	5720	5720	5720	5720	5720
Adjusted R-squared	0.344	0.395	0.344	0.395	0.344	0.395
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

This table presents the results of Model (2) applying additional robustness checks. Panel A reports the results using industry-adjusted investment and clustering standard errors at *firm* × *year* level. Panel B reports the results controlling for the impact of macroeconomic influences. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

Cui et al. (2021) and Li (2017) indicate that stocks with negative betas tend to provide less optimal hedge against risks in EPU, indicating firms suffer more from the adverse effects of EPU changes. On the other hand, positive EPU exposures indicate that firms benefit from changes in EPU, implying that they are more adaptable and more likely to seek new opportunities in times of uncertainty. We argue firms are motivated to increase clean energy-related projects for three reasons. First, technological advancements result in continual cost reductions in renewable energy material and equipment, which greatly improves applicability of renewable-energy projects (Kim et al., 2017). Second, governments have played a critical role facilitating the boom and development of renewable energy, such as providing new business opportunities, favourable policy frameworks, and incentive programmes (Kim et al., 2017; Wüstenhagen and Menichetti, 2012). Third, recognising the challenge associated with climate change, there is also an increasing demand of clean energy in the global market. For instance, China becomes the global market leader in renewable energy with a rapid market growth in the sector (Wüstenhagen and Menichetti, 2012). Therefore, governments' substantial efforts in promoting the utilisation of renewable energy and the increasing demand have seen significant economic benefits in the market (Liu and Zeng, 2017; Zeng et al., 2018; Zhang et al., 2016). Consequently, investing in clean energy projects are more likely to provide economic benefits to firms.

4.5. Subsample analysis

4.5.1. The impact of financial constraints

Our baseline finding shows that SMEs with higher EPU exposure are more likely to increase environmental investment, which supports our argument that SMEs tend to adopt environmental investment as a resilience strategy in times of uncertainty. However, as discussed, SMEs are associated with challenges such as limited access to external sources of finance compared to large firms (Bajaj et al., 2021; Su et al., 2020). That is, SMEs facing severe financial constraints are not likely to implement such a resilience strategy. Therefore, we examine the impact of financial constraints on our baseline finding in this section.

Hadlock and Pierce (2010) use firm size and firm age to estimate the degree of financial constraints and construct the SA index. In particular, the SA index is calculated as follows:

Table 6
Propensity score matching.

Panel A: The balance test of PSM analysis						
	Unmatched (U)	Mean			*t*-test	
Variable	Matched (M)	Treated	Control	% bias	t	p > | t|
Total Assets	U	21.370	22.760	−133.7	−35.45	0.000
	M	21.552	21.597	−4.3	−1.25	0.212
Leverage	U	0.435	0.513	−42.3	−12.61	0.000
	M	0.443	0.449	−3.4	−0.71	0.479
Firm Age	U	2.567	2.756	−48.3	−14.56	0.000
	M	2.607	2.591	4.1	0.84	0.402
ROA	U	0.029	0.035	−9.8	−3.00	0.003
	M	0.030	0.031	−2.4	−0.49	0.627
Tobin's Q	U	2.104	1.748	35.9	11.42	0.000
	M	2.030	1.998	3.2	0.64	0.524
Return	U	0.286	0.181	14.0	4.39	0.000
	M	0.272	0.276	−0.5	−0.11	0.915
Capex	U	0.065	0.061	5.7	1.76	0.078
	M	0.064	0.065	−1.9	−0.38	0.704
Cash Flow	U	0.051	0.056	−8.0	−2.42	0.016
	M	0.053	0.054	−1.9	−0.40	0.687
Sales Growth	U	0.193	0.175	5.2	1.58	0.115
	M	0.183	0.197	−4.3	−0.88	0.377

Panel B: PSM sample		
	(1)	(2)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.082*	0.281**
	(1.957)	(2.292)
SME	−0.007**	−0.011
	(−2.095)	(−1.144)
EPU Beta	−0.012	−0.057
	(−0.332)	(−0.554)
Controls and constant	Yes	Yes
Observations	1760	1760
Adjusted R-squared	0.264	0.278
Firm-fixed effects	Yes	Yes
Year-fixed effects	Yes	Yes

This table reports the regression results using the PSM analysis. Panel A refers to the balance test of the PSM analysis. Panel B presents the regression results using the PSM sample. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

$$SA = -0.737 \times Size + 0.043 \times Size^2 - 0.040 \times Age \quad (4)$$

The larger absolute value of the SA index indicates greater financial constraints. We then construct subsample analyses and divide sample firms into two groups based on each industry's annual median value of the financial constraint index. Firms with index values higher than the median are classified as having high financial constraints (*High Financial Constraints*), while those with index values lower than the median are classified as having low financial constraints (*Low Financial Constraints*).

We report the results in Table 9. Columns (1) and (2) represent firms with low financial constraints. We find that the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are significantly positive at the 1 % level. Columns (3) and (4) refer to firms with high financial constraints, and we do not find any significant results on $SME_{i,t} \times EPU\ Beta_{i,t}$.

Overall, the results in Table 9 indicate that the impact of EPU exposure on environmental investment is more pronounced for SMEs who are not hampered by severe financial constraints. This finding highlights the important role of financial constraints in shaping investment decisions of SMEs.

4.5.2. The impact of marketization

This section examines whether and how marketization, which varies across regions in China affects our baseline findings. Regions with higher marketization levels have more connections with the market and a higher proportion of market allocation of economic resources (Wang et al., 2014; Zhao and Su, 2022). Consequently, firms can benefit from a more liberal business environment and have better risk protection through the economic development of the local market (Yang et al., 2019). According to the literature a higher degree of marketization is associated with faster market reactions, making firms in more marketized regions more responsive to changes in uncertainty arising from economic policies (Wang et al., 2014; Zhu et al., 2020), we expect that SMEs in high-marketization regions to increase their environmental investment as a responsive strategy to EPU exposures.

We employ the Marketization Index developed by Wang et al. (2021) to measure the marketization level of different regions in China. The index measures the regional market development based on five aspects, including the relationship between government and markets, the development of non-state-owned sectors in the economy, the development of product markets, the development of factor markets, and the development of market intermediaries and legal environment. High scores of the index indicate good institutional development. We then construct a subsample analysis based on the level of the regional marketization index where a firm is located. *High Marketization* includes firms if they are in regions with an index higher than the national median value in a given year. *Low Marketization* includes firms that are in regions with an index lower than the national median value in a given year.

We report the results in Table 10. Columns (1) and (2) refer to firms in low-marketization regions. However, we do not find any significant results on $SME_{i,t} \times EPU\ Beta_{i,t}$. Columns (3) and (4) refer to firms in high-marketization regions, we find that the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are significantly positive at the 1 % level, indicating that SMEs with high EPU exposure are more likely to increase environmental investment when they are in regions with high levels of marketization. Together, the results with the previous section and this section, suggest that SMEs require either or both the means, sound financial condition (e.g. low financial constraints) and sound business environment (high-

Table 7
Instrumental variable approach.

Variables	(1) *EPU Beta*	(2) *SME * EPU Beta* $_1$	(3) *ENV/TA* $_{t+1}$	(4) *ENV/SA* $_{t+1}$
Avg. EPU Beta	0.761***	−0.100***		
	(12.297)	(−2.968)		
*SME * Avg. EPU Beta*	0.352***	1.310***		
	(4.599)	(31.230)		
*SME * EPU Beta*			0.129***	0.392***
			(2.832)	(3.058)
SME	−0.010***	−0.007***	−0.006***	−0.015**
	(−2.652)	(−3.423)	(−2.622)	(−2.157)
EPU Beta			−0.017	−0.018
			(−0.314)	(−0.119)
Controls and constant	Yes	Yes	Yes	Yes
Observations	5720	5720	5720	5720
F-value	107.75	501.22		
SW Chi-sq	250.85	977.28		
SW F-statistic	204.05	794.98		
Anderson LM test			234.58	234.58
Cragg-Donald F-statistic			99.49	99.49
R-squared	0.546	0.732	0.028	0.030
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table reports the regression results using the IV-2SLS approach. The SW F-statistics in Columns (1) and (2) indicate strong instrumental variables. The Anderson LM test statistic indicates no under-identification concerns. The Cragg-Donald F-statistic indicates no weak-identification concerns. The *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

Table 8
Sub-components analysis of environmental initiatives.

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	*Green/TA* $_{t+1}$	*Energy/TA* $_{t+1}$	*Waste/TA* $_{t+1}$	*Air/TA* $_{t+1}$	*Green/SA* $_{t+1}$	*Energy/SA* $_{t+1}$	*Waste/SA* $_{t+1}$	*Air/SA* $_{t+1}$
*SME * EPU Beta*	0.018	0.167***	0.001	−0.025	0.084	0.407***	0.003	−0.057
	(0.562)	(3.509)	(0.061)	(−1.012)	(1.328)	(3.064)	(0.046)	(−0.988)
SME	−0.001	−0.005	−0.002	−0.001	−0.001	−0.005	−0.002	−0.001
	(−0.359)	(−1.372)	(−1.102)	(−0.446)	(−0.184)	(−0.468)	(−0.409)	(−0.295)
EPU Beta	0.016	0.024	−0.010	−0.006	0.023	0.077	−0.027	−0.035
	(1.158)	(0.915)	(−0.975)	(−0.377)	(0.832)	(1.073)	(−0.759)	(−1.032)
Controls and constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1686	1939	1755	588	1686	1939	1755	588
Adjusted R-squared	0.400	0.313	0.494	0.346	0.465	0.377	0.544	0.414
Firm-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B

	Negative EPU Exposure		Positive EPU Exposure	
	(1)	(2)	(3)	(4)
Variables	*Energy/TA* $_{t+1}$	*Energy/SA* $_{t+1}$	*Energy/TA* $_{t+1}$	*Energy/SA* $_{t+1}$
*SME * EPU Beta*	0.096	0.327	0.127**	0.297*
	(1.042)	(1.300)	(2.041)	(1.672)
SME	0.008	0.039**	−0.005	−0.014
	(1.289)	(2.247)	(−0.883)	(−0.835)
EPU Beta	0.081*	0.195	−0.037	−0.064
	(1.781)	(1.561)	(−0.990)	(−0.595)
Controls and constant	Yes	Yes	Yes	Yes
Observations	931	931	1008	1008
Adjusted R-squared	0.292	0.382	0.366	0.401
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents results using different components of environmental initiatives as the dependent variable. *Green* refers to projects that are related to ecological protection. *Energy* refers to projects that are related to renewable and/or clean energy. *Waste* refers to projects that reduce wasted water, gas, solid and related waste treatment and management. *Air* refers to projects that improve air quality. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

Table 9
The impact of financial constraints.

	Low Financial Constraints		High Financial Constraints	
	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.079***	0.237***	0.005	0.017
	(2.981)	(3.082)	(0.164)	(0.189)
SME	−0.002	−0.004	−0.004	−0.005
	(−1.019)	(−0.568)	(−1.635)	(−0.829)
EPU Beta	0.009	0.029	0.012	0.029
	(0.532)	(0.597)	(0.687)	(0.629)
Controls and constant	Yes	Yes	Yes	Yes
Observations	2916	2916	2804	2804
Adjusted R-squared	0.386	0.415	0.342	0.427
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the subsample analysis regarding the impact of financial constraints, which is measured by the SA index. Dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

Table 10
The impact of marketization.

	Low Marketization		High Marketization	
	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.023	0.065	0.091***	0.263***
	(0.795)	(0.820)	(3.190)	(3.233)
SME	−0.004**	−0.008	−0.002	−0.002
	(−1.993)	(−1.339)	(−0.905)	(−0.244)
EPU Beta	0.019	0.055	−0.001	−0.019
	(1.190)	(1.255)	(−0.045)	(−0.375)
Controls and constant	Yes	Yes	Yes	Yes
Observations	3158	3158	2562	2562
Adjusted R-squared	0.354	0.409	0.330	0.378
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the subsample analysis regarding the impact of marketization, which is measured by Marketization Index. Dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

marketization), to increase environmental investment when exposed to high EPU.[8]

4.5.3. The impact of market competition

The literature indicates that market competition can lead to divergent corporate decisions (Abdoh and Maghyereh, 2020; Jiang et al., 2015; Laksmana and Yang, 2015; Yang et al., 2019). Therefore, in this section, we examine the impact of product market competition on the

[8] We construct additional analysis regarding the joint impact of financial constraints and marketization. Our results are strongest when firms have low financial constraints and in high-marketization regions at the same time. Results are available on request.

Table 11
The impact of market competition.

Panel A: HHI				
	Lower HHI		Higher HHI	
	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.042	0.102	0.061**	0.186**
	(1.425)	(1.307)	(2.157)	(2.236)
SME	−0.000	0.002	−0.005**	−0.008
	(−0.191)	(0.270)	(−2.428)	(−1.229)
EPU Beta	0.019	0.053	−0.005	−0.030
	(0.999)	(1.069)	(−0.304)	(−0.677)
Controls and constant	Yes	Yes	Yes	Yes
Observations	2623	2623	3097	3097
Adjusted R-squared	0.307	0.353	0.390	0.455
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

Panel B: Concentration Ratio (CR)				
	Lower CR		Higher CR	
	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.044	0.092	0.073**	0.220***
	(1.559)	(1.231)	(2.505)	(2.587)
SME	−0.001	0.003	−0.006**	−0.009
	(−0.283)	(0.407)	(−2.565)	(−1.484)
EPU Beta	0.006	0.023	0.005	−0.003
	(0.320)	(0.467)	(0.304)	(−0.057)
Controls and constant	Yes	Yes	Yes	Yes
Observations	2649	2649	3071	3071
Adjusted R-squared	0.331	0.383	0.385	0.445
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the subsample analysis regarding the impact of market competition. Panel A reports the results using *HHI* as the proxy for competition. Panel B presents the results using Concentration Ratio (*CR*) as the proxy for competition. Dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

relationship between EPU exposure and environmental investment in SMEs.[9] Specifically, we construct two proxies of market competition following studies such as Jiang et al. (2015), Jory et al. (2020), Xu (2020), and Yang et al. (2019). Our first proxy of competition is the Herfindahl-Hirschman index (*HHI*), which is calculated as the sum of squared market shares for all firms in each industry. We divide samples into two groups according to the median of *HHI* in each year. Higher *HHI* indicates higher market shares among industry constituent firm, while lower *HHI* implies a more competitive market. Our second proxy for market competition is the concentration ratio (*CR*), which is calculated as the market share of the four largest firms in each industry. Similarly, we divide samples into two groups according to the median of *CR* in each year. Higher (lower) *CR* represents a higher (lower) concentration ratio in the industry and hence lower (higher) competition.

Yang et al. (2019) demonstrate that less competitive industries are good defences under uncertainty, as it is more difficult for suppliers, customers and investors to transfer to other firms, compared to firms in highly competitive industries. Abdoh and Maghyereh (2020) imply that competition brings a greater uncertainty to firm performance if the investment outcome is unfavourable. As such, higher levels of market competition under uncertainty could increase the likelihood of being driven out of the market. We report the results of using *HHI* and *CR* as subsamples in Panels A and B of Table 11, respectively. The coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are positive and statistically significant only when firms are in industries with higher concentration ratios, indicating SMEs with greater market shares are associated with higher environmental investment when facing heightened EPU exposure. This suggests that SMEs operating in competitive industries are less likely to engage in environmental investment, particularly under heightened EPU exposure, due to the greater associated risks, compared to their peers in more concentrated industries.

4.5.4. The impact of industry properties

In addition to financial conditions, local marketization levels, and market competition, SMEs' environmental decisions may also be affected by industry properties, such as heavily and non-heavily polluting industries. We identify heavily polluting industries in accordance with the "*Catalogue of Classified Management of Environmental Protection Verification Industries of Listed Firms*" issued by the Ministry of Environmental Protection of China,[10] 16 industries are defined as heavily polluting industries, including thermal power, iron and steel, cement, electrolytic aluminium, coal, metallurgy, building material, mining, chemical, petrochemical, pharmaceutical, brewing, papermaking, fermentation, textile, and tanning. We construct subsample analysis based on whether firms belong to heavily or non-heavily polluting industries and report the results in Table 12.

Columns (1) and (2) present the regression results for firms in the non-heavily polluting industries and Columns (3) and (4) report the results for firms in the heavily polluting industries. We find that the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are significantly positive in Columns (1) and (2) but insignificant in Columns (3) and (4), indicating our baseline finding is more salient in firms in non-heavily polluting industries.

We find that SMEs with high EPU exposure are associated with higher environmental investment in non-heavily polluting industries compared to heavily polluting industries. One possible explanation is that firms in heavily polluting industries are usually the major source of

Table 12
The impact of industry properties.

	Non-Heavily Polluting		Heavily Polluting	
	(1)	(2)	(3)	(4)
Variables	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$	*ENV/TA* $_{t+1}$	*ENV/SA* $_{t+1}$
*SME * EPU Beta*	0.097***	0.300***	−0.002	−0.026
	(3.428)	(3.575)	(−0.080)	(−0.348)
SME	−0.005**	−0.012*	0.002	0.009
	(−2.446)	(−1.749)	(0.983)	(1.594)
EPU Beta	−0.001	−0.006	0.024	0.053
	(−0.062)	(−0.113)	(1.562)	(1.311)
Controls and constant	Yes	Yes	Yes	Yes
Observations	2692	2692	3028	3028
Adjusted R-squared	0.414	0.466	0.304	0.357
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the subsample analysis regarding the impact of industry properties, including non-heavily polluting industries and heavily polluting industries. Dependent variable is corporate environmental investment, which is measured by *ENV/TA* $_{t+1}$ and *ENV/SA* $_{t+1}$. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

[9] We thank for the anonymous reviewers' insight that product market competition can moderate the relationship between EPU exposure and environmental investment in SMEs.

[10] It is now the Ministry of Ecology and Environment of the People's Republic of China.

Table 13
The impact of the 2012 Green Credit Policy.

	Pre-Policy Period		Post-Policy Period	
	(1)	(2)	(3)	(4)
Variables	ENV/TA_{t+1}	ENV/SA_{t+1}	ENV/TA_{t+1}	ENV/SA_{t+1}
*SME * EPU Beta*	0.046	0.128	0.082***	0.295***
	(1.500)	(1.515)	(2.656)	(3.335)
SME	−0.003	−0.004	−0.004*	−0.010
	(−1.045)	(−0.494)	(−1.745)	(−1.381)
EPU Beta	0.016	0.013	−0.005	−0.020
	(0.771)	(0.231)	(−0.335)	(−0.454)
Controls and constant	Yes	Yes	Yes	Yes
Observations	2021	2021	3699	3699
Adjusted R-squared	0.315	0.371	0.421	0.475
Firm-fixed effects	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes

This table presents the subsample analysis regarding the impact of the 2012 Green Credit Policy. Dependent variable is corporate environmental investment, which is measured by ENV/TA_{t+1} and ENV/SA_{t+1}. *t*-statistics are displayed in parentheses. ***, **, and * denote the significance levels at 1 %, 5 %, and 10 %, respectively. Variable definitions are summarised in Appendix A.

environmental pollution, therefore, they are subject to more market scrutiny, strengthened supervision, and more stringent regulations than firms in other industries (Cho and Patten, 2007; Liu et al., 2022a). Consequently, firms in heavily polluting industries are inherently associated with more investments in environment-related projects due to regulation requirements, and they may have a more moderate response to uncertainties concerning the use of environmental investments compared to firms in non-heavily polluting industries. For instance, Yang et al. (2022) examine the impact of EPU on green technology innovation (GTI) in Chinese listed firms and find that EPU has a promoting effect on GTI. However, they find that the promoting effect is weaker in high-polluting firms than in other firms. Yang et al. (2022) argue that green innovation of high-polluting firms is less affected by EPU because such firms naturally invest more in GTI than other firms.

Another explanation could be the varying financial conditions across industries. Yao et al. (2021) find that green credit policy increases financial constraints in heavily polluting firms. Firms in heavily polluting industries may encounter more financial difficulties compared to firms in non-heavily polluting industries. As such, the limited credit from banks may limit polluting firms' investment projects.

4.5.5. The impact of the 2012 green credit policy

Existing research indicates a significant relationship between green credit policies and corporate behaviour (Hu et al., 2021; Yao et al., 2021; Zhang et al., 2022). Therefore, we examine the impact of the green credit policy on our findings in this section.[11] Specifically, we divide our sample into two groups based on the year of 2012 when the China Banking Regulatory Commission (CBRC) officially issued the "Green Credit Guidelines" to guide financial institutions on conducting green credit policy business. Consequently, we expect that SMEs are more likely to increase their environmental investment in response to heightened EPU exposure following the implementation of the 2012 Green Credit Policy, particularly if sustainable practices are used as part of their resilience strategy to hedge against future regulatory shifts.

The results reported in Columns (1) and (2) of Table 13 show that before the 2012 Green Credit Policy, the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are statistically insignificant. In contrast, Columns (3) and (4) show that after Green Credit Policy is implemented, the coefficients on $SME_{i,t} \times EPU\ Beta_{i,t}$ are positive and significant at the 1 % level. This supports our conjecture that SMEs adopt sustainable practices to hedge against regulatory impacts as their resilience strategy.

5. Conclusions

While studies highlight that SMEs are more sensitive to, and affected by economic-related policy changes, there is limited evidence on whether, and how policy uncertainties affect corporate environmental behaviours in SMEs, particularly considering the heterogeneous exposure of firms to uncertainties. This study examines the impact of corporate heterogeneous exposure to EPU on SMEs' environmental investment.

We find that SMEs increase environmental investment when subject to higher EPU exposure, highlighting that SMEs react positively to heightened EPU as a resilience strategy. This result still holds after conducting a series of robustness tests. Notably, we find that SMEs with heightened EPU exposure allocate more resources to renewable energy projects, implying the important role that the energy sector plays in hedging against potential regulatory shifts. We further find that multiple factors, such as financial constraints, regional marketization levels, market competition, industry properties, and the 2012 Green Credit Policy shape the influence of EPU exposure on environmental investment in SMEs. Overall, this study highlights the importance of examining the impact of policy uncertainties on SMEs' decision-making. It demonstrates how EPU affects investment decisions of SMEs, the crucial role that the energy sector plays, and reveals various factors shaping the influence of EPU on firms. Given the importance of SMEs in promoting economic development, this study provides new insights to understand SMEs' behaviours, which contributes to a deeper understanding of corporate strategies in an increasingly uncertain landscape.

CRediT authorship contribution statement

Shuai Yue: Writing – review & editing, Methodology, Data curation, Writing – original draft, Formal analysis, Conceptualization. **Hamish D. Anderson:** Writing – review & editing, Methodology, Supervision, Conceptualization. **Jing Liao:** Writing – review & editing, Methodology, Supervision, Conceptualization.

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Declaration of competing interest

All authors declare that they have no conflicts of interest.

[11] We thank for the anonymous reviewers' insight that the green credit policy may moderate the impact of EPU exposure on environmental investment in SMEs.

Appendix A. Variable definitions

Variable	Definition
Dependent variable	
ENV/TA	A firm's environmental investment scaled by its total assets.
ENV/SA	A firm's environmental investment scaled by its total sales revenue.
Adj. ENV/TA	Industry-adjusted *ENV/TA*.
Adj. ENV/SA	Industry-adjusted *ENV/SA*.
Independent variables	
SME	Dummy variable equals one if firm *i* is not identified as a large-sized enterprise based on the 2003 Standards for years before 2011 and 2011 Standards for years on and after 2011, and zero otherwise.
SME (EMP)	Dummy variable equals one if firm *i*'s total employee in year *t* is lower than the median level in the same industry, and zero otherwise.
SME (MKT)	Dummy variable equals one if firm *i*'s market value in year *t* is lower than the median level in the same industry, and zero otherwise.
EPU Beta	Firm sensitivity to EPU estimated using China's EPU Index and China's Fama-French three factors over the past 60-month window. See *Section 3.2.2* for details.
EPU Beta 36	Firm sensitivity to EPU estimated using China's EPU Index and China's Fama-French three factors over the past 36-month window. See *Section 4.3.1* for details.
EPU Beta FF	Firm sensitivity to EPU estimated using China's EPU Index and China's Fama-French five factors over the past 60-month window. See *Section 4.3.1* for details.
EPU Beta Clean	Firm sensitivity to EPU after extracting the component of the China's EPU index orthogonal to the EPU index of the U.S. See *Section 4.3.1* for details.
Total Assets	The natural logarithm of total assets
Leverage	Ratio of total debt to total assets.
Firm Age	The natural logarithm of the number of years a firm has been established.
ROA	Ratio of net income to total assets.
Tobin's Q	The ratio of the total market value of equity to the total book value of assets at the end of each year.
Return	A firm's annual stock return.
Capex	The capital expenditure scaled by total assets.
Cash Flow	The ratio of cash flow from operations to total assets.
Sales Growth	The annual growth rate in revenues.
GDPVOL	Standard deviation of GDP growth rates from *t-1* to $t + 1$.
CICSI	Composite investor sentiment index of the Chinese stock market.
Financial Constraints	SA index is the proxy for financial constraints. See *Section 4.5.1* for details.
Marketization Index	Marketization Index developed by Wang et al. (2021).
Market Competition	Market competition is measured by the Herfindahl-Hirschman index (*HHI*) and concentration ratio (*CR*), respectively.
Heavily Polluting Industries	Dummy variable equals one if for firms in heavily polluting industries, and zero otherwise.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eneco.2025.108712.

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