Received: 17 September 2023 | Revised: 21 February 2024 | Accepted: 22 April 2024

DOI: 10.1002/bse.3798

RESEARCH ARTICLE

Business Strategy and the Environment WILEY

The impact of financial investment on corporate environmental sustainability: Reservoir effect or crowding-out effect?

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Funding information
National Social Science Fund of China, Grant/Award Number: 22BJY037; Chongqing Talent Program "Package System" under the Chongqing Social Science Planning, Grant/Award Number: 2022YC062

Abstract

This study empirically examines the impact of financial investment on environmental sustainability in publicly traded companies at the Shanghai and Shenzhen stock exchanges in China from 2011 to 2021. Using a generalized additive model (GAM), we scrutinize this relationship, revealing a consistent linear trend. Additionally, a panel model uncovers a crowding-out effect of financial investment, particularly pronounced in firms with weaker environmental performance. Corporate financial investment primarily undermines environmental sustainability by cutting down primary business investment, inhibiting green innovation, and diminishing human capital investment. Furthermore, in regions with favorable institutional environments, financial investment transitions its impact on corporate environmental sustainability from crowding out to reservoir effects. This shift is particularly pronounced when the financial regulatory index and regional marketization index surpass the respective thresholds of 0.314 and 0.618. This evidence indicates that it is pertinent to circumvent the adverse impacts of corporate financial investment on environmental sustainability at the institutional level.

KEYWORDS

financial investment, GAM, green total factor productivity, institutional contexts, threshold model

1 | INTRODUCTION

Corporate environmental sustainability is crucial for reducing pollution emissions, minimizing energy consumption, and transforming development paradigms to be more intensive and efficient (Hao et al., 2023; Liu et al., 2023). To attain this objective, investment in environmental protection facilities, optimization of production processes, and enhancement of green innovation are of necessity (Alam et al., 2019; Karim et al., 2021; Shi et al., 2023). These actions require firms to convert surplus into fixed capital. However, due to diminishing marginal returns, allocating substantial funds to reproduction poses high opportunity costs (Furlong, 2020; Jain & Gabor, 2020). In parallel, the physical sector in many countries, particularly emerging economies, yields lower investment returns compared to the financial sector on account of limited capital resources (Demir, 2009; Diab, 2022). In this context, firms are increasingly engaging in capital operation and financial investment to achieve profitability, entering the financial field, and expanding their financial asset allocation to maximize gains (Jorgenson, 1971; Stockhammer, 2004). Consequently, the distribution of corporate funds between financial products and capital investment is an important research area concerning its impact on environmental sustainability.

Abbreviations: ASSET, size of assets; CASH, share of corporate net cash; CORF, share of financial investment; DIRECT, number of corporate directors; DUAL, whether the chairman and general manager are the same person; FIRM, dummy variables representing firms; FIRST, shareholding ratio of the largest shareholder; GAM, generalized additive model; GTFP, green total factor productivity; HHI, Herfindahl–Hirschman index; INDEP, proportion of independent directors; INDUSTRY × FIRM, interaction term between industry and firm dummy variables; LEV, ratio of total liabilities to total assets; PROVINCE × FIRM, interaction term between provincial dummy variables and firm dummy variables; ROA, ratio of net profit to average total assets; STATE, whether the enterprise is a state-owned enterprise; YEAR, dummy variables representing years.

A bulk of the literature has examined the economic consequences of corporate financial investment, including its effects on innovation, fixed investment rates, and wage disparities (Jin et al., 2022; Lin & Tomaskovic-Devey, 2013; Su & Liu, 2021). Theoretical perspectives propose two explanations for the motives behind such investment: the reservoir effect and the crowding-out effect. The former suggests that non-financial firms hold financial assets for liquidity reserves, facilitating timely access to funds and easing financing pressures (Bontempi & Mairesse, 2015; Diaz & Sanchez, 2008). In contrast, the latter posits that financial investment competes with real investment due to resource scarcity, potentially deviating from optimal investment levels and negatively impacting corporate performance.

Empirical findings on the economic implications of corporate financial investment exhibit a wide range of arguments. Some studies point to its suppressive effect on corporate governance (Lin & Tomaskovic-Devey, 2013; Yahya & Lee, 2023), while others argue for a promotive effect (Gong et al., 2023). Furthermore, intensive debate persists concerning the linear correlation between financial investment and corporate governance in the body of research available (Huang et al., 2022; Tori & Onaran, 2020). In a word, contemporary research primarily focuses on analyzing the impacts of corporate financial investment on production factors, while there is a noticeable dearth of analysis regarding its influence on environmental sustainability. Furthermore, an ongoing discussion persists in the existing literature regarding the linear relationship between financial investment and corporate governance.

To bridge this gap, this study analyzes the impact and mechanisms of financial investment on environmental sustainability in the Chinese A-share market. Using data from publicly traded companies from 2011 to 2021, we employ non-parametric estimation to examine the relationship between financial investment and corporate environmental sustainability. We also investigate the mechanisms with respect to core operations, human capital, and green innovation. Moreover, we assess how institutional quality, including financial regulations and regional marketization, influences this relationship within the institutional economics framework. To identify specific institutional quality thresholds, we use a threshold regression strategy.

The marginal contributions of this study are as follows: First, this study integrates the relationship between financial investment and sustainable environmental practices into a comprehensive analytical framework, expanding our understanding of the economic implications of corporate financial investment. Previous studies have mainly focused on the impact of financial investment on production factors such as technological innovation (Su & Liu, 2021), wage disparities (Wang & Mao, 2022), and investment efficiency (Gong et al., 2023). However, these studies have not thoroughly examined the effect of financial investment on environmental sustainability, thereby questioning the linear relationship between the two (Huang et al., 2022; Tori & Onaran, 2020). This work addresses this gap by analyzing the impact of financial investment on corporate environmental sustainability using non-parametric and parametric models. By exploring the linear relationship and effects, this study enriches our theoretical understanding of the relationship between corporate financial investment, the real economy, and environmental sustainability.

Second, this study incorporates institutional quality into the research framework, offering valuable insights for policy formulation aimed at controlling excessive participation of the real sector in capital market investment. Existing research has primarily analyzed the heterogeneous effects of financial investment from the perspectives of firm characteristics such as internal control, financing constraints, and property rights (Gong et al., 2023; Jin et al., 2022; Klinge et al., 2021; Su & Liu, 2021). However, these studies have overlooked the potential effects of the macroinstitutional environment in which firms operate. This study documents that the institutional environment is able to influence the reservoir effect of financial investment and identify the threshold value of institutional quality that affects the "reservoir" effect of financial investment using a threshold regression strategy. These findings offer empirical guidance for global efforts to address environmental degradation and promote environmental sustainability.

Third, this study enriches the mechanistic understanding of how corporate financial investment affects environmental sustainability. While previous research predominantly concentrates on mechanisms associated with technological innovation and tangible investment (Gong et al., 2023; Jin et al., 2022; Klinge et al., 2021), it neglects the impact of corporate financial investment on human capital. By integrating core business inputs, human capital investment, and green innovation into the research framework, this study clarifies the underlying channels through which corporate financial investment affects environmental sustainability. This comprehensive explanation enhances our comprehension of the link between corporate financial investment and environmental sustainability.

The remaining structure of this paper is as follows: Section 2 reviews relevant literature and establishes research hypotheses. Section 3 outlines the empirical design, including econometric models, variable measurements, data sources, and critical variable summary statistics. Section 4 presents and analyzes empirical results. Finally, Section 5 concludes the paper and provides policy recommendations.

2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 | Literature review

2.1.1 | Literature on corporate environmental sustainability

A substantial body of literature has extensively explored the factors influencing corporate environmental sustainability from an external institutional perspective, specifically emphasizing environmental pollutant emissions and governance. Formal institutions play a crucial role in determining environmental sustainability. Emissions trading systems and green credit policies boost environmental-friendly production efficiency, benefiting both the environment and the economy

(Cui et al., 2022; Li et al., 2021). However, the impact of green policies varies. For example, while green credit policies facilitate green innovation inputs, they do not significantly improve enterprise sustainability (Yan et al., 2023). In the same vein, implementing carbon emissions trading systems has been seen to diminish corporate green investment (Zhang & Shi, 2023). The relationship between economic policies and corporate environmental sustainability is not linear, with tax incentives showing an inverted U-shaped pattern, initially promoting and then hindering environmental sustainability (Li et al., 2022). Additionally, informal institutions, such as social trust and institutional investor shareholding, have adverse effects on corporate pollutant emissions (Chen et al., 2021; Safiullah et al., 2022).

Another strand of literature delves into the determinants of environmental sustainability from a firm-level perspective. Research and development (R&D) investment is recognized for its positive impact on environmental performance, promoting corporate eco-sustainability (Alam et al., 2019). Additionally, the empowerment of digital technology fosters environmental sustainability by impacting facets such as managerial cognition, competitive prowess, data utilization, and resource efficiency (He et al., 2023). A firm's board composition also wields notable influence on pollutant emissions, with board diversity and independence serving pivotal roles (Konadu et al., 2022; Oyewo, 2023). Moreover, robust management capabilities correlate with reduced greenhouse gas emissions and a narrower emission range (Gaganis et al., 2023). CEO attributes also contribute substantially to shaping corporate environmental sustainability. For example, CEOs in their early tenure typically attain greater corporate environmental sustainability than those with longer tenures (Chen et al., 2019). CEOs possessing morally meaningful names also foster green investment (Jia et al., 2021). Moreover, the duality of CEO and chairman roles, as well as CEO power, exert a positive impact on environmental performance and transparency (Francoeur et al., 2021; Van Hoang et al., 2021).

2.1.2 | Literature on corporate financial investment

The diverse impact of financial investment on corporate performance has been thoroughly investigated. Su and Liu (2021) revealed an adverse effect of financial investment on innovation in manufacturing companies. Jin et al. (2022) observed an inverse relationship between corporate financial investment and fixed investment rates, indicating that financial asset investment displaces fixed asset investment. Smaller companies are particularly susceptible to the displacement effect of financial income on investment, whereas larger companies leverage financial income to support investment (Tori & Onaran, 2022). Sun and Gong (2023) provided evidence of a negative correlation between corporate financial investment and cost stickiness behavior. Financial investment also impacts employment dynamics within companies. For example, when a company falls short of earnings forecasts, it may resort to employee layoffs, signifying a failure to maximize shareholder value (Jung & Lee, 2022). The growing reliance on the returns of corporate financial investment, as found by Lin and Tomaskovic-Devey (2013), leads to wage disparities and excludes ordinary workers from income generation and compensation decisions. Moreover, excessive financial investment by non-financial firms diminishes the motivation to pursue high-risk yet lucrative investment projects (Wang & Mao, 2022). Moreover, Leng et al. (2023) identified a negative correlation between corporate financial investment and optimal real investment, suggesting that financial market speculation hampers long-term real investment.

Furthermore, the literature investigates the impact of corporate financial investment on corporate governance, uncovering a spectrum of effects encompassing both negative and positive associations, along with nonlinear patterns. Gong et al. (2023) identified a favorable impact of financial investment on investment efficiency. Tori and Onaran (2020) emphasized the adverse effects of financial payments and financial income on fixed asset investment, with the negative impact of financial income increase being nonlinearly related to company size. Huang et al. (2022) documented that financial investment, although generally negative for company performance, exhibits a U-shaped nonlinear effect.

2.1.3 | Comments on available literature

Studies available primarily examine determinants that shape corporate environmental sustainability, including emission trading systems and green credit policies. However, limited research incorporates financial investment and corporate environmental sustainability into a comprehensive framework, especially at the firm level. Furthermore, existing research on financial investment mainly concentrates on production factors. Still, its impact on corporate governance encompasses both the reservoir effect and the crowding-out effect, resulting in inconsistent findings. Moreover, the linear relationship between financial investment and corporate governance remains a matter of debate. To bridge these research gaps, this study thoroughly investigates the influence of corporate financial investment on environmental sustainability.

2.2 | Hypothesis development: Reservoir effect or crowding-out effect?

When firms allocate investments to the financial sector, two effects arise: the reservoir effect and the crowding-out effect. The former suggests that investing idle resources in the financial sector allows companies to benefit from its high returns, achieving optimal resource allocation. Realizing financial assets quickly and with low transaction costs helps alleviate liquidity constraints and maximize corporate value (Gong et al., 2023; Jin et al., 2022; Klinge et al., 2021; Su & Liu, 2021; Sun & Gong, 2023). Conversely, the latter points out that limited resources and capital availability prompt firms to redirect investment away from activities such as technological innovation, new product development, and fixed asset renewal. This diversion weakens the company's ability to pursue environmental sustainability

(Huang et al., 2022; Klinge et al., 2021; Leng et al., 2023; Liu & He, 2023; Tori & Onaran, 2022).

2.2.1 | Reservoir effect

Moderate financial investment encourages corporate environmental sustainability. On the one hand, financial returns support the improvement of green technologies, human capital, and production efficiency (Klinge et al., 2021), all of which are crucial determinants in improving environmental sustainability. Capital gains exhibit diminishing marginal returns, posing challenges for achieving Pareto optimality in actual profit as asset investment expands. In such cases, purchasing short-term financial assets during periods of financial abundance allows firms to maximize fund time value in financial markets. Proceeds can be allocated to core projects via additional investments and capital solidification, strengthening green development capabilities by supporting the enhancement of technology, human capital, and productive efficiency (Bontempi & Mairesse, 2015). Gong et al. (2023) pointed out that financial investment by physical firms enhances the efficiency of fund utilization, realizes capital preservation, and reduces financial distress via asset sales, meeting investments in innovation, product development, and human capital enhancement.

On the other hand, financial investment alleviates information asymmetry, enhancing the supply of green innovation and technical talent in the context of sustainable development. In the capital market, corporate financial investment serves as a real-time information window (Chen & Zhang, 2023), increasing the awareness of external investors by improving transparency. This broadens the absorption of green technologies and talent, providing elements to boost corporate environmental sustainability. Yu et al. (2024) noted that corporate financial investment significantly reduces the credit spread for bond-issuing companies, enhancing credit fund accessibility, contributing to increased R&D investment, and improving green development effectiveness. By and large, financial investment is a pragmatic strategy for firms to safeguard operations and address risk crises, with the judicious allocation of financial assets significantly impacting sustainable development. As a result, this paper proposes Hypothesis 1.

> **Hypothesis 1.** Financial investment fosters corporate environmental sustainability.

2.2.2 | Crowding-out effect

Excessive reliance on financial investment impedes the improvement of corporate environmental sustainability. First, the overreliance on financial investment induces resource misallocation, diminishing the efficiency of green production. A substantial investment in financial assets reduces the importance of production revenue, causing firms to prioritize short-term gains instead of long-term benefits (Liu & He, 2023; Su & Liu, 2021). Holding or diverting revenue to financial assets obstructs the accumulation of industrial capital, resulting in reduced expenditures on fixed and intangible assets, which hinders environmental sustainability (Leng et al., 2023; Liu & He, 2023). Second, excessive financial investment hampers the output of green technology innovation. Prolonged allocation of financial assets diverts funds intended for long-term physical investments, causing firms to deviate from their core business. This diversion brings about insufficient investment in R&D and production improvement, undermining market competitiveness and offsetting the efficiency-promoting effects of financial investment (Liu & He, 2023; Su & Liu, 2021; Zhong et al., 2022). Liu and He (2023) and Wang and Mao (2022) discovered that financial investment by non-financial firms reduces risk-bearing capacity, dramatically inhibiting the investment of R&D, which unfavorably impacts environmental sustainability in the industry (Jin et al., 2022). Finally, excessive financial investment damages employee welfare, hindering the enhancement of human capital. An increased proportion of financial investment returns exacerbates the income gap between production and investment departments, reducing the productivity and skill development of employees in the production department and hindering overall improvement in environmental sustainability (Jung & Lee, 2022). In a nutshell, this paper argues that excessive financial investment impedes the enhancement of green technology innovation and restricts the improvement of human capital, thereby lowering the level of environmental sustainability. Specifically, this paper proposes Hypothesis 2.

> **Hypothesis 2.** Financial investment impedes corporate environmental sustainability.

2.2.3 | The impact of the institutional contexts

Institutional economics posits that institutional contexts affect transaction costs and the decision-making of investors and entrepreneurs. This study examines how regional institutional contexts shape firm behavior and impact the crowding-out effect of corporate financial investment, specifically via financial regulation and marketization.

Financial regulatory effect

Strengthening financial regulation shrinks the supply of financial products, elevates market investment entry barriers, and limits corporate resource allocation in the financial market (Leng et al., 2023). Stringent financial regulation curtails financial investments, guiding firms toward green innovation and talent development, thereby enhancing environmental sustainability. It encourages financial institutions to trim interbank assets, shadow banking, and virtualized cross-financial products, facilitating the rational allocation of corporate financial assets (Chen & Zhang, 2023; Wang & Hu, 2023). This prompts firms to increase green technology research, human capital training, and capacity for environmental sustainability (Liu & He, 2023). Furthermore, the continual strengthening of financial regulation raises thresholds for corporate financial investments, reducing speculative tendencies and improving the effectiveness of environmental sustainability. Enhanced government financial regulation strengthens corporate information disclosure and internal governance. Government reinforcement of financial regulation improves corporate information disclosure and governance, limiting financial institution recognition to enterprises with robust capital, standardized governance, and competent management (Shi & Fang, 2023; Zhang, Zhang, et al., 2023). This raises investment thresholds, curbing subjectivity and speculation (Qin et al., 2023; Yang et al., 2024). In this context, corporate management prioritizes core business development and directs surplus funds to the R&D of green products, fortifying corporate environmental sustainability. Yang et al. (2024) stated that inspections by the China Securities Regulatory Commission markedly decreased financial investments by physical enterprises, especially those excessively engaged in financial activities.

Marketization effect

First, a high level of marketization drives corporate environmental sustainability by incentivizing innovation, ensuring strong intellectual property rights, and providing institutional support (Guo et al., 2023; Huang et al., 2021; Zhang, Chen, & Zhao, 2023). This minimizes risks related to green innovation and human capital development, fostering institutional backing for accelerated green innovation and enhanced development capacity. Additionally, heightened marketization expedites the adoption of advanced green production technologies from external sources (Zhou et al., 2016). Second, marketization inhibits factor distortions, advancing environmental sustainability via greater market transparency. Improved transparency accelerates the flow of manpower and funds, guiding rational green element allocation to firms and alleviating constraints on talent and funds in corporate environmental sustainability (Huang et al., 2021; Lu et al., 2020). Moreover, a high marketization level implies a sound legal regulatory system, facilitating investor supervision of corporate financial activities and encouraging firms to invest in improving sustainable development performance (Tang et al., 2022). Lastly, a high marketization level reduces potential political risks, allowing enterprises to offset unnecessary transaction costs and enhancing the efficiency of acquiring green resource elements (Guo et al., 2023; Huang et al., 2023). Furthermore, it inhibits distortions in enterprise behavior due to regional administrative intervention, encouraging a focus on long-term development over short-term financial benefits. This motivates firms to allocate economic resources to R&D and innovation related to core business areas, ultimately enhancing the effectiveness of corporate environmental sustainability (Li & Chen, 2022). As a result, we posit Hypothesis 3.

> **Hypothesis 3.** Regional institutional contexts play a pivotal role in shaping the crowding-out impact of corporate financial investment. This phenomenon encompasses two key dimensions.

Greater financial regulation fosters a more efficient allocation of surplus firms' capital, bolstering their environmental sustainability performance.

Elevated levels of marketization mitigate information asymmetry, ultimately driving enhancements in corporate environmental sustainability.

In conclusion, Figure 1 presents the analytical framework.

3 | EMPIRICAL DESIGN

3.1 | Model specifications

To examine the relationship between financial investment and corporate environmental sustainability, this study establishes a foundational specification (1).

$$GTFP_{ijpt} = \beta CORF_{ijpt} + \sum\nolimits_{1}^{s} a_s CONTROLS_{ijpt} + CONS_{ijpt} + \eta_i + \delta_t + \upsilon_{jt} + \tau_{pt} + \varepsilon_{ijpt} \quad (1)$$

where p denotes a province, j represents an industry affiliation, i stands for an enterprise, and t represents a year. The dependent

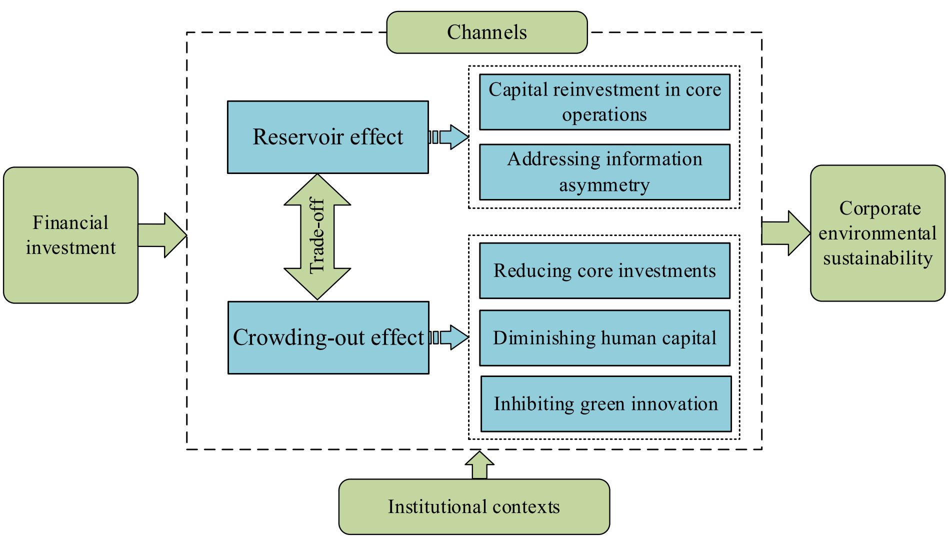

FIGURE 1 Analytical framework.

variable, *GTFP*, measures corporate environmental sustainability. *CORF* represents the level of corporate financial investment. *CONTROLS* include variables that affect financial investment and environmental sustainability. *CONS* signifies the constant term. η, δ, v, and τ capture firm, year, industry–year, and province–year fixed effects, respectively. Incorporating these fixed effects helps mitigate potential influences from industrial and regional policies, resulting in a more accurate estimation of the parameter β. Additionally, ε represents the random disturbance term.

3.2 | Variable definitions

3.2.1 | Corporate environmental sustainability

Following Huang et al. (2022) and Zhang et al. (2022), this study employs the super-slacks-based measure (SBM) strategy to gauge corporate environmental sustainability via green total factor productivity (GTFP). GTFP provides a holistic assessment of corporate performance by factoring in the environmental costs of corporate growth. Unlike traditional radial data envelopment analysis (DEA) models, the super-SBM model, introduced by Tone (2001), considers slack variables, addressing their limitations, and super-efficiency models resolve issues related to truncated efficiency values in measurements. Thus, this study utilizes a super-SBM-based super-efficiency model to estimate GTFP and appraise corporate environmental sustainability. The estimation of GTFP takes into account net fixed assets and employee count as input parameters, while gross operating revenue serves as the desired output, with pollutant emissions as the undesired output.

Figure 2 depicts the spatial distribution of corporate environmental sustainability. Provincial environmental sustainability is assessed by calculating the mean values of the GTFP index. The results reveal that firms in China's eastern region exhibit higher GTFP values, while those in the western region display comparatively lower values. This underscores substantial regional disparities in environmental sustainability levels. Therefore, addressing this challenge calls for intensified efforts to improve overall environmental sustainability efficiency within enterprises.

3.2.2 | Corporate financial investment

This study evaluates corporate financial investment through the financial assets to total assets ratio (*CORF*). A higher ratio indicates a greater extent of financial investment by the company. According to Demir (2009), this study classifies six items—including trading financial assets, derivative financial assets, available-for-sale financial assets, investment properties, held-to-maturity investments, and long-term equity investments—as financial assets. It's worth noting that currency, categorized as a financial asset, is excluded from the analysis due to its generation through operational activities.

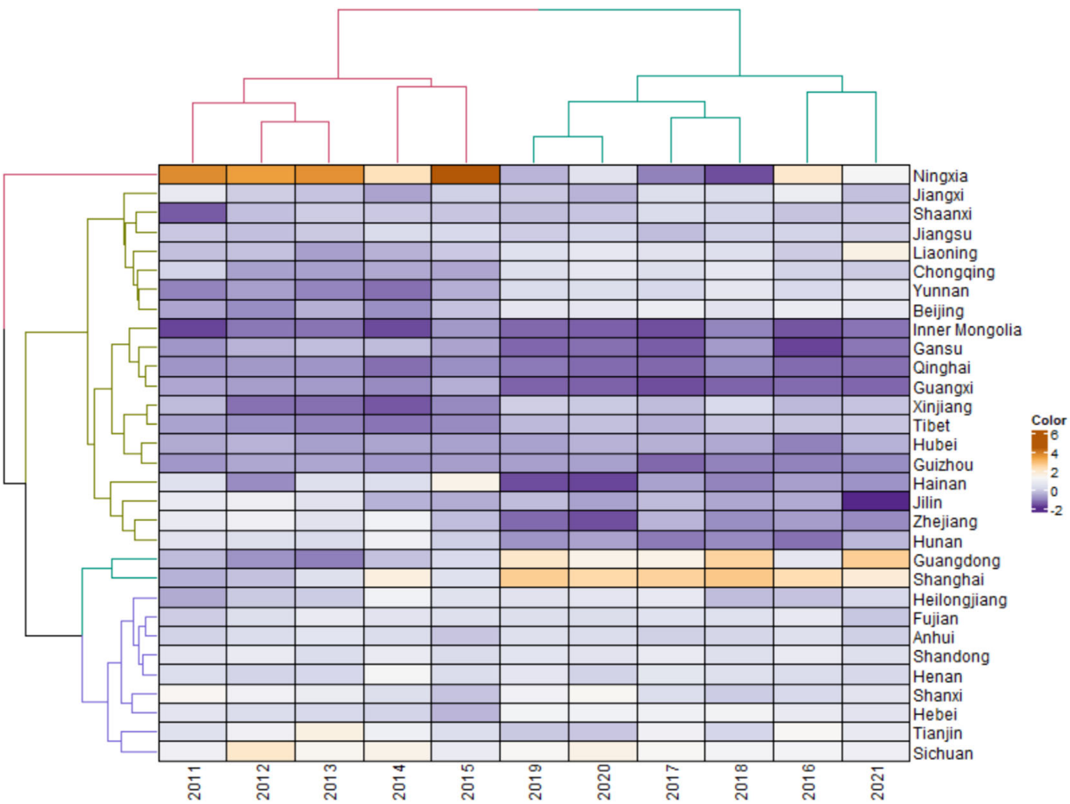

FIGURE 2 Distribution of corporate GTFP.

Figure 3 illustrates the trend of corporate financial investment during the sample period. The left plot shows the overall changes in the volume of corporate financial investment, represented as the annual aggregated sum measured in trillions. The data reveal a consistent and rapid growth in Chinese financial investment. The right plot displays the kernel density distribution of the financial asset-to-total asset ratio over the years. The curve reveals a decrease in kurtosis over time, with a distinct right-skewed and heavy-tailed distribution. This indicates greater dispersion in corporate financial investment distribution, highlighting noteworthy variations in investment levels among diverse enterprises.

3.2.3 | Control variables

Following previous research (Gong et al., 2023; Liu & He, 2023; Wang & Mao, 2022), this study incorporates control variables from three dimensions: firm characteristics, corporate governance, and external environmental factors. The selected variables are as follows: (1) firm size (*ASSET*), measured by the natural logarithm of total assets at the end of the year; (2) debt ratio (*LEV*), calculated as the ratio of total liabilities to total assets at the end of the year; (3) return on assets (*ROA*), computed as the ratio of after-tax profits to total assets in the current year; (4) largest shareholder ownership (*FIRST*), representing the proportion of shares held by the largest shareholder to the total outstanding shares; (5) dual role (*DUAL*), a binary variable assigned as 1 if the chairman and CEO roles are held by the same individual and 0 otherwise; (6) board size (*DIRECT*), indicating the number of directors on the board; (7) cash ratio (*CASH*), measured by the ratio of net cash flow from operating activities to total assets at the end of the year; (8) independent director proportion (*INDEP*), representing the ratio of independent directors to the total number of directors; (9) firm nature (*STATE*), a binary variable assigned as 1 if the company is state-owned and 0 otherwise; and (10) Herfindahl–Hirschman index (*HHI*), representing the ratio of the main operating income of the company to the total operating income of the industry segment. The detailed definitions and variable settings are provided in Table A1.

3.3 | Data source

This study employs a sample of publicly traded companies from the Shanghai and Shenzhen stock markets in China, spanning the period from 2011 to 2021. Given China's status as the largest global emitter of sulfur dioxide (SO_2) and carbon dioxide (CO_2), its role in achieving carbon neutrality goals is crucial. This study focuses on Chinese-listed companies to examine their promotion of environmental sustainability.

Following established practices in the literature (Huang et al., 2022; Shi et al., 2019), the sample data undergo the following selection criteria: (1) exclusion of financial, insurance, and real estate companies; (2) removal of observations for companies marked with ST, suspended trading, or delisted; (3) to capture gradual efficiency improvements over time, only samples of listed companies with continuous data spanning a minimum of 3 years are retained; and (4) samples with missing variables are excluded. To mitigate the impact of outliers, continuous variables are trimmed to the 1st and 99th percentiles.

The research data are sourced from the China Stock Market & Accounting Research (CSMAR), Wind, and Chinese Research Data Services Platform (CNRDS) databases. Missing values for specific variables are manually filled by referencing the China Securities Information Co., Ltd. website.

3.4 | Descriptive analysis

Table 1 summarizes essential variables in our study, including observation count, mean, maximum, minimum, and standard deviation. Notably, GTFP ranges from 0.751 to 1.105, with a mean of 0.945 and a standard deviation of 0.039, indicating substantial variations in environmental sustainability among sampled firms during the study period. Similarly, *CORF* varies significantly, with values ranging from 0.000 to 0.894 and a standard deviation of 0.113. This variation underscores differences in financial investment strategies among firms, raising concerns about the risk of “excessive financialization” and potential

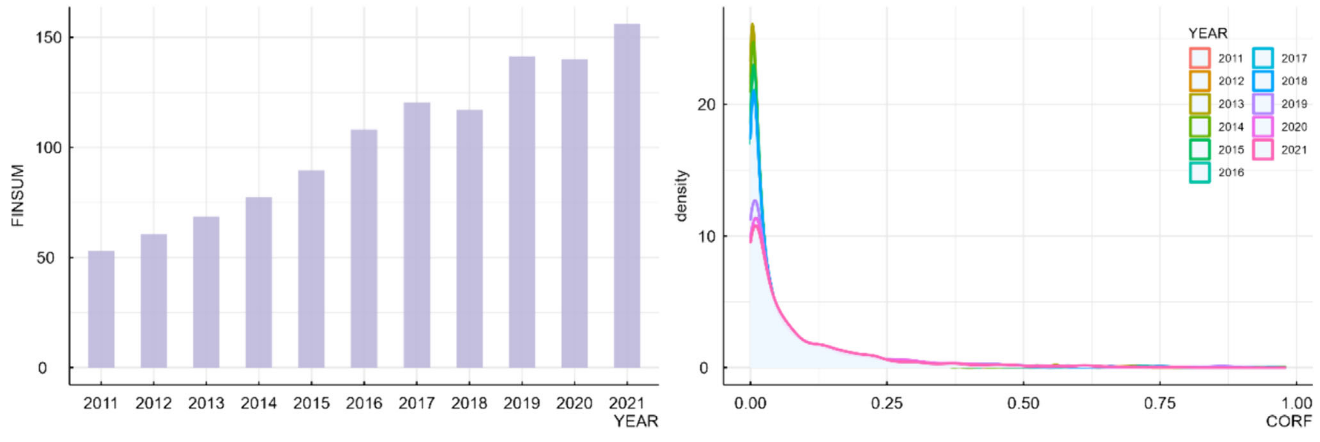

FIGURE 3 Distribution of corporate financial investment.

TABLE 1 Descriptive statistical analysis.

VarName	Obs	Mean	SD	Min	Max
GTFP	16,547	0.945	0.039	0.751	1.105
CORF	16,547	0.086	0.113	0.000	0.894
ASSET	16,547	22.300	1.595	19.214	27.787
LEV	16,547	0.422	0.219	0.055	0.976
ROA	16,547	0.040	0.061	−0.292	0.205
FIRST	16,547	0.350	0.151	0.081	0.756
DUAL	16,547	0.283	0.450	0.000	1.000
DIRECT	16,547	8.615	1.857	5.000	15.000
CASH	16,547	0.172	0.136	0.007	0.680
INDEP	16,547	0.377	0.054	0.100	0.571
STATE	16,547	0.410	0.492	0.000	1.000
HHI	16,547	0.076	0.097	0.012	0.760

resource misallocation. The descriptive statistics for control variables are also available in Table 1, without further elaboration in this specific context.

4 | EMPIRICAL RESULTS AND DISCUSSION

4.1 | Linearity testing based on a semi-parametric strategy

A substantial body of literature has explored the connection between financial investment and corporate governance. Some studies suggest a linear link (Lin & Tomaskovic-Devey, 2013; Yahya & Lee, 2023), while others propose a nonlinear relationship (Huang et al., 2022; Tori & Onaran, 2020). To do so, this study further delves into the uncertain nature of the relationship between financial investment and corporate environmental sustainability, with the specific functional form of their interaction left unspecified, operating at a latent level.

To preliminarily investigate the overarching patterns in the impact of financial investment on corporate environmental sustainability, this paper employs a generalized additive model (GAM) for a linear assessment. Unlike conventional statistical models, GAM automatically selects unknown non-parametric functions for fitting, enabling us to validate the presence of linear relationships among variables. Following Parteka (2010), the GAM estimation specification for the effect of financial investment on corporate environmental sustainability in this study is presented as Equation (2).

$$GTFP_{ijpt} = g\left(CORF_{ijpt}\right) + CONS_{ijpt} + \varepsilon_{ijpt} \tag{2}$$

In this context, $g()$ represents a smoothing function employed to delineate the dependency relationship of financial investment on corporate environmental sustainability, with the other parameters in Equation (2) remaining consistent with specification (1). Assuming that the kernel density estimate of the random variable $g(CORF)$ follows a Gaussian kernel function, the equation conforms to the distribution specified in model (3).

$$f_x(x_i, x_0, h) = \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{(x_i - x_0)^2}{2h^2}\right] \tag{3}$$

where $f_x(x_i, x_0, h)$ denotes the probability density of x_i at x_0, with h as the smoothing parameter determining the bandwidth size around x_0 for x_i. A larger bandwidth leads to a smoother kernel density estimate.

Figure 4 presents the results of the GAM estimation. Notably, the GAM regression curve for financial investments about corporate GTFP exhibits a notably smooth pattern, confirming the linear assumption. Furthermore, our adoption of a linear regression model for fitting reveals a statistically significant inverse relationship between financial investment and corporate environmental sustainability. This outcome aligns with the GAM findings, offering partial validation of Hypothesis 2 while refuting the argument of the reservoir effect associated with financial investment.

4.2 | Baseline analysis: Reservoir effect or crowding-out effect?

The semi-parametric GAM confirms a linear relationship between corporate financial investment and GTFP, but the specific impact magnitude remains uncertain. This study aims to address two questions using specification (1): (1) Does financial investment affect corporate environmental sustainability? (2) If so, what is the specific magnitude of this impact?

Table 2 presents the estimation of financial investment and corporate environmental sustainability. First, a panel logit model is employed to examine whether financial investment remarkably affects corporate environmental sustainability. A dummy variable (*ISGTFP*) is constructed based on the average industry-level GTFP, assigning a value of 1 if it exceeds the average and 0 otherwise. The logit estimation results in columns (1) and (2) show a significantly negative effect of *CORF* on *ISGTFP* at the 1% statistical level, indicating a considerable relationship between financial investment and corporate environmental sustainability. After controlling for variables, the estimation for *CORF* in *ISGTFP* remains significantly negative (column 2), reinforcing the credibility of the finding that financial investment affects corporate environmental sustainability.

Furthermore, this study estimates the specific impact magnitude of financial investment on corporate environmental sustainability (columns 3 and 4 of Table 2). In column (3), the estimation for *CORF* is consistently unfavorable and significant at the 1% statistical level, indicating that financial investment counteracts corporate environmental sustainability. To ensure estimation reliability, we reapply the analysis with control variables, yielding a consistent result. The benchmark result in column (4) reveals that for every 1% rise in corporate financial investment, there is a corresponding decrease of 1.6% in GTFP. This suggests that financial investment lowers resource allocation in the realm of corporate environmental sustainability, impeding

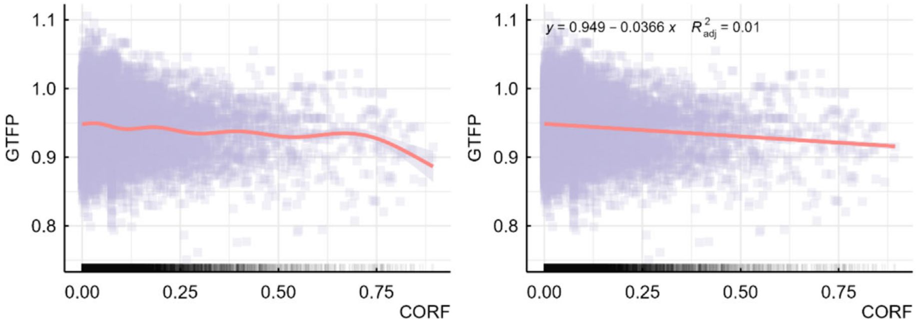

FIGURE 4 Linear assumption check.

its performance. Consistent with previous studies by Leng et al. (2023) and Yahya and Lee (2023), the empirical findings of this study support the hypothesis of the crowding-out effect of financial investment. In a nutshell, Hypothesis 2 is validated in this paper, while Hypothesis 1 is not supported.

The semi-parametric linear test confirms that the relationship between corporate financial investment and GTFP varies with different stages (Figure 4). This indicates that the crowding-out effect of financial investment may differ based on the level of environmental sustainability. To explore this, a quantile regression strategy, following Tori and Onaran (2022), is employed to estimate the impact of financial investment on enterprises at various percentiles (10th, 25th, 50th, 75th, and 90th) of environmental sustainability. Table 3 presents the estimated effects of corporate financial investment (*CORF*) at different percentiles. Results show that *CORF* has a consistently unfavorable impact on GTFP across all percentiles, indicating the crowding-out effect of financial investment on GTFP, thus abating environmental sustainability. Furthermore, the absolute values of the coefficients display an increasing–decreasing pattern over the percentiles, highlighting a stronger crowding-out effect for firms with lower levels of GTFP. In short, financial investment tends to crowd out environmental sustainability, particularly for enterprises with lower levels of environmental sustainability.

4.3 | Robustness checks

The baseline regression analysis documents an adverse impact of financial investment on the performance of corporate environmental sustainability. To strengthen the validity of these findings, this study employs diverse endogeneity tests, including instrumental variable analysis, the Hackman strategy, and the construction of a difference-in-differences model. Additionally, additional robustness checks are conducted as well.

4.3.1 | Endogeneity

Instrumental variable analysis

To mitigate endogeneity concerns, we employ the number of Western-style universities established in different regions of China by the end of 1920 as an instrumental variable. On the one hand, this instrument is based on historical data from over a century ago, ensuring its exogeneity to current environmental management. Hence, it is unrelated to corporate environmental sustainability, satisfying the relevance requirement. On the other hand, Christian universities in China impart education on economic and investment studies, potentially enhancing investment skills and financial management abilities, which in turn influence the decisions of corporate financial investment.

Column (1) of Table 4 presents the estimation results using the two-stage least squares strategy. The coefficient for *CORF* is unfavorable and statistically significant at the 1% level, indicating that even after addressing endogeneity, financial investment continues to exert an unfavorable impact on corporate environmental sustainability. In doing so, this reaffirms our main conclusion.

Hackman strategy

Firms with favorable operational performance and surplus funds are regularly inclined to engage in financial investment. If investment decisions were random, a simple examination of the correlation between the levels of financial investment and GTFP would be sufficient. However, investment decisions are generally driven by factors such as risk perception and industry characteristics, leading to potential self-selection bias in the sample.

To address this issue, we employ the Heckman two-stage model. In addition to specification (1), a probit model is used to estimate the probability of financial investment, and the inverse Mills ratio (*LAMBA*) is constructed based on the predicted values. The inverse Mills ratio is then included in specification (1) to correct for potential selection bias. The results, presented in column (2) of Table 4, indicate that the estimated *LAMBA* is significant at the 1% level, suggesting the presence of sample distribution bias in corporate financial investment. Considering the potential estimation bias resulting from self-selection is essential. Furthermore, the estimation for *CORF* remains statistically significant at the 1% level, aligning with the baseline regression results. This indicates that the main conclusion holds even after accounting for selection bias.

Propensity score matching

This study employs propensity score matching to address endogeneity concerns arising from sample self-selection bias. Initiating the process,

TABLE 2 Financial investment and corporate environmental sustainability.

Variables	(1) ISGTFP	(2) ISGTFP	(3) GTFP	(4) GTFP
CORF	−3.187***	−1.209**	−0.020***	−0.016***
	(−7.475)	(−2.215)	(−3.828)	(−3.319)
ASSET		1.453***		0.013***
		(17.520)		(11.631)
LEV		−0.253		0.001
		(−0.747)		(0.153)
ROA		−2.160***		−0.003
		(−3.262)		(−0.576)
FIRST		4.316***		0.009
		(6.512)		(1.323)
DUAL		−0.000		−0.000
		(−0.001)		(−0.130)
DIRECT		0.064		0.000
		(1.324)		(0.543)
CASH		−1.613***		−0.012***
		(−4.382)		(−3.835)
INDEP		1.839		−0.004
		(1.641)		(−0.442)
STATE		−0.556***		−0.003
		(−2.736)		(−1.324)
HHI		−1.273**		−0.021***
		(−2.055)		(−3.634)
FIRM	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
PROVINCE × *FIRM*	Yes	Yes	Yes	Yes
INDUSTRY × *FIRM*	Yes	Yes	Yes	Yes
CONS	—	—	0.947***	0.648***
	—	—	(2113.307)	(25.046)
N	7184	7184	16,547	16,547
R^2	—	—	.804	.821

Note: This table displays the estimated effects of financial investment (*CORF*), measured as the ratio of corporate financial assets to total assets, on corporate environmental sustainability. The dependent variables in columns (1) and (2) are dummy variables, based on the average industry-specific GTFP (*ISGTFP*), to investigate whether financial investment impacts corporate environmental sustainability. The dependent variables in columns (3) and (4) are corporate GTFP, assessed using the super-SBM strategy. Appendix A provides further details on the variables. The values in parentheses indicate the corresponding *t* statistics. To ensure precise estimation results, this study employs cluster-robust estimation at the firm level.

*Statistically significant at the 10% level, as determined by significance tests on the regression coefficients.

**Statistically significant at the 5% level, as determined by significance tests on the regression coefficients.

***Statistically significant at the 1% level, as determined by significance tests on the regression coefficients.

we create dummy variables (*ISCORF*) using the mean of annual and industry-specific corporate financial investment. Subsequently, we apply a logit model to assign probability scores to companies opting for financial investment. In light of these scores, the paper conducts nearest neighbor matching in a 1:1 ratio, using control variables from the baseline specification as covariates to align treatment and control groups with similar characteristics. After matching, the average treatment effect of *CORF* is estimated at

TABLE 3 Quantile regression.

Variables	(1) 10% GTFP	(2) 25% GTFP	(3) 50% GTFP	(4) 75% GTFP	(5) 90% GTFP
CORF	−0.027**	−0.036***	−0.028***	−0.016**	−0.018**
	(−2.346)	(−4.741)	(−3.795)	(−2.526)	(−2.318)
ASSET	0.006***	0.002**	−0.001	0.001	0.003
	(5.600)	(2.044)	(−0.532)	(0.792)	(1.566)
LEV	0.028***	0.028***	0.009	0.018***	0.013
	(3.694)	(4.469)	(1.422)	(2.928)	(1.618)
ROA	0.041***	0.042***	0.007	−0.016*	−0.007
	(3.076)	(4.374)	(0.743)	(−1.814)	(−0.675)
FIRST	0.029***	0.051***	0.075***	0.046***	0.006
	(2.752)	(5.062)	(7.408)	(3.823)	(0.353)
DUAL	0.001	−0.001	−0.000	0.002	0.001
	(0.364)	(−0.411)	(−0.184)	(0.959)	(0.535)
DIRECT	0.001**	0.002***	0.002***	0.001*	0.001
	(2.226)	(2.658)	(3.465)	(1.744)	(0.896)
CASH	0.007	0.036***	−0.000	−0.005	−0.002
	(0.955)	(5.527)	(−0.048)	(−1.226)	(−0.421)
INDEP	−0.014	0.009	0.013	−0.005	−0.002
	(−1.046)	(0.614)	(0.855)	(−0.306)	(−0.096)
STATE	−0.002	−0.002	−0.005	−0.001	−0.002
	(−0.492)	(−0.542)	(−1.413)	(−0.423)	(−0.593)
HHI	−0.006	0.009	−0.000	0.003	0.001
	(−0.574)	(0.679)	(−0.026)	(0.317)	(0.074)
FIRM	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
PROVINCE × *FIRM*	Yes	Yes	Yes	Yes	Yes
INDUSTRY × *FIRM*	Yes	Yes	Yes	Yes	Yes
CONS	0.375***	0.468***	0.564***	0.567***	0.563***
	(13.439)	(17.713)	(18.399)	(16.500)	(12.208)
N	16,547	16,547	16,547	16,547	16,547
R^2	.019	.034	.026	.012	.004

Note: This table displays quantile regression findings for financial investment impacting corporate environmental sustainability. *GTFP*, signifying corporate environmental sustainability, is obtained through assessment using the super-SBM strategy. *CORF* is the pivotal explanatory variable, gauged by the ratio of corporate financial assets to total assets. The values in parentheses represent the corresponding *t* statistics. To ensure accurate estimation results, this study employs cluster-robust estimation at the firm level.
*Statistically significant at the 10% level, based on significance tests for the regression coefficients.
**Statistically significant at the 5% level, based on significance tests for the regression coefficients.
***Statistically significant at the 1% level, based on significance tests for the regression coefficients.

−0.014, passing the 1% significance test. Table A2 displays the results of covariate balance tests, indicating that standardized biases for all covariates are below 10%, signifying a considerable reduction in differences after matching and successful balance testing. Subsequently, the paper regresses the matched sample, with results presented in column (3) of Table 4. It is observed that the estimate for *CORF* remains remarkably negative, affirming the baseline conclusion even after addressing selection issues.

Policy impact of inclusive financial development

In January 2016, the Chinese government initiated the "2016–2020 Inclusive Finance Development Plan" with the aim of providing

TABLE 4 Endogeneity treatments.

Variables	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP
CORF	−0.018***	−0.015***	−0.018***	
	(−3.668)	(−3.282)	(−2.756)	
ISCORF × INFIN				−0.012***
				(−8.270)
LAMBA		−0.023***		
		(−5.615)		
ASSET	0.014***	0.009***	0.013***	0.009***
	(12.059)	(6.083)	(6.969)	(9.459)
LEV	0.001	−0.015***	0.012*	0.006**
	(0.228)	(−3.268)	(1.842)	(2.076)
ROA	−0.002	−0.010*	0.013	−0.002
	(−0.328)	(−1.784)	(1.497)	(−0.357)
FIRST	0.012*	−0.047***	0.010	−0.002
	(1.794)	(−4.003)	(1.062)	(−0.466)
DUAL	0.000	0.003***	0.000	0.000
	(0.267)	(3.168)	(0.200)	(0.008)
DIRECT	−0.000	−0.002***	0.000	0.000
	(−0.387)	(−4.014)	(0.339)	(0.676)
CASH	−0.006**	−0.011***	−0.017***	−0.010***
	(−2.020)	(−3.692)	(−3.220)	(−4.306)
INDEP	−0.008	0.002	0.003	−0.006
	(−0.932)	(0.200)	(0.251)	(−0.843)
STATE	−0.003	−0.003	−0.000	−0.001
	(−1.505)	(−1.214)	(−0.094)	(−0.746)
HHI	−0.019***	−0.021***	−0.015*	−0.012***
	(−3.352)	(−3.559)	(−1.652)	(−2.666)
FIRM	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes
PROVINCE × FIRM	Yes	Yes	Yes	Yes
INDUSTRY × FIRM	Yes	Yes	Yes	Yes
CONS	–	0.824***	0.657***	0.769***
	–	(20.575)	(16.442)	(37.124)
N	16,547	16,547	6346	16,547
R^2	.084	.823	.855	.874

Note: The values in parentheses represent the corresponding *t* statistics. To ensure accurate estimation results, this study employs cluster-robust estimation at the firm level.
*Statistically significant at the 10% level, based on significance tests for the regression coefficients.
**Statistically significant at the 5% level, based on significance tests for the regression coefficients.
***Statistically significant at the 1% level, based on significance tests for the regression coefficients.

comprehensive financial services to a wide range of market participants. This policy encourages the diversification of financial products tailored to the investment needs of diverse firms while simultaneously reducing transaction costs and improving accessibility.

To assess the policy's effects, we created a dummy variable (*ISCORF*) representing corporate financial investment and a policy impact variable (*INFIN*) denoting the implementation of the inclusive financial plan (2016). By employing a difference-in-differences strategy, the regression results, displayed in column (4) of Table 4, reveal that the estimated interaction term (*ISCORF × INFIN*) is statistically significant at the 1% level. This finding suggests that financial investment has a detrimental impact on corporate environmental performance, thereby reinforcing our primary research conclusion.

4.3.2 | Other robustness checks

Altering measures of corporate financial investment

In this analysis, we use the logarithm of the sum of tradable, derivative, available-for-sale, investment properties, held-to-maturity investment, and long-term equity investment as a proxy for corporate financial investment (*LNCFIN*). The impact of financial investment on corporate environmental sustainability is reassessed accordingly. Column (1) of Table 5 presents the estimates. The results show that *LNCFIN* continues to have a significant unfavorable impact on GTFP, reaffirming the reliability of our main conclusion.

Alternative measures of corporate environmental sustainability

In line with Ackerberg et al. (2015), we utilize the ACF method to measure corporate total factor productivity, reflecting the performance of environmental sustainability. Subsequently, we conduct a regression analysis using model (1) and this alternative measure (column 2 of Table 5). The estimate of *CORF* remains statistically

TABLE 5 Other robustness checks.

	(1)	(2)	(3)	(4)	(5)
Variables	*GTFP*	*ACF*	*GTFP*	*GTFP*	*GTFP*
LNCFIN	−0.017***				
	(−3.172)				
CORF		−0.019**	−0.017***	−0.027***	−0.012**
		(−2.560)	(−3.252)	(−6.493)	(−2.408)
ASSET	0.014***	0.010***	0.013***	0.015***	0.014***
	(11.913)	(5.165)	(10.176)	(25.875)	(11.881)
LEV	0.002	−0.002	0.002	0.001	−0.002
	(0.462)	(−0.410)	(0.576)	(0.552)	(−0.424)
ROA	−0.003	−0.029***	−0.004	−0.007	0.001
	(−0.631)	(−3.239)	(−0.634)	(−1.528)	(0.157)
FIRST	0.008	0.009	0.008	0.012***	0.007
	(1.205)	(0.815)	(1.134)	(2.756)	(0.922)
DUAL	−0.000	−0.001	−0.000	−0.001	0.000
	(−0.182)	(−0.458)	(−0.231)	(−1.258)	(0.388)
DIRECT	0.000	0.000	0.000	−0.000	−0.000
	(0.619)	(0.703)	(0.487)	(−0.903)	(−0.082)
CASH	−0.011***	−0.029***	−0.011***	−0.014***	−0.013***
	(−3.674)	(−5.801)	(−3.328)	(−5.062)	(−4.189)
INDEP	−0.003	−0.001	−0.004	−0.011	−0.006
	(−0.402)	(−0.037)	(−0.386)	(−1.405)	(−0.686)
STATE	−0.003	−0.002	−0.002	0.003**	−0.002
	(−1.283)	(−0.647)	(−1.005)	(2.413)	(−0.785)
HHI	−0.021***	−0.030***	−0.021***	−0.010**	−0.028***
	(−3.600)	(−2.681)	(−3.496)	(−2.469)	(−4.089)
FIRM	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes
PROVINCE × *FIRM*	Yes	Yes	Yes	Yes	Yes
INDUSTRY × *FIRM*	Yes	Yes	Yes	Yes	Yes
CONS	0.638***	1.138***	0.670***	0.640***	0.636***
	(24.600)	(27.393)	(24.499)	(56.039)	(23.512)
N	16,547	16,547	14,763	16,547	13,916
R^2	.821	.582	.810	—	.827

Note: The values in parentheses represent the corresponding *t* statistics. To ensure accurate estimation results, this study employs cluster-robust estimation at the firm level.
*Statistically significant at the 10% level, based on significance tests for the regression coefficients.
**Statistically significant at the 5% level, based on significance tests for the regression coefficients.
***Statistically significant at the 1% level, based on significance tests for the regression coefficients.

significant and unfavorable, underscoring that, irrespective of the measurement approach applied to GTFP, financial investment continues to exert an adverse impact on corporate environmental sustainability. Our baseline findings stand strong.

Considering the impact of COVID-19

In early 2020, to mitigate the effects of the COVID-19 pandemic on public safety, production activities were widely restricted, leading to a sharp decline in consumer demand and motivation for corporate environmental sustainability. To address the impact of this unprecedented public health event, we exclude samples from 2020 onwards and re-estimate the regression (column 3 of Table 5). Despite considering the outbreak of COVID-19, the estimation results for the impact of financial investment on corporate environmental sustainability remain significant. Our baseline conclusion remains valid.

Tobit strategy

As the measurement of corporate environmental sustainability using GTFP does not include adverse values, it is left-censored data. To address potential estimation bias, we employ a Tobit regression strategy. The results (column 4 of Table 5) show that the estimation for *CORF* is statistically remarkable at the 1% level, aligning with our main conclusion.

Subsample analysis

Considering that Shanghai, Shenzhen, and Beijing are financial centers in China and are home to major stock exchanges, firms located in these cities have advantages in terms of information availability and trading convenience. Thus, we exclude samples registered in these cities and re-test model (1) with the remaining data. The results (column 5 of Table 5) indicate that the estimation for *CORF* remains statistically significant at the 5% level, consistent with the baseline regression results.

4.4 | Channel analysis

The preceding studies have shown that financial investment has a crowding-out effect on corporate environmental sustainability, and a series of robustness checks have ensured the reliability of this conclusion. Now, we examine the underlying mechanism through which financial investment inhibits corporate environmental sustainability. In the following discussion, we address this issue.

Theoretical analysis indicates that when firms allocate surplus funds to the financial sector, it triggers several consequences. First, relying on investment returns decreases the accumulation of industrial capital, leading to decreased spending on fixed and intangible assets, thereby impeding the enhancement of corporate environmental sustainability (Jung & Lee, 2022; Sun & Gong, 2023). Second, financial investment diminishes funding in areas such as technological R&D and production improvements, which are vital for improving market competitiveness (Gong et al., 2023; Su & Liu, 2021). This cross-industry arbitrage behavior offsets the efficiency-enhancing effects of financial investment. Finally, excessive financial investment unfavorably alters employee welfare and impedes the development of human capital within enterprises (Klinge et al., 2021).

We next conduct empirical tests to unveil the three impact mechanisms limiting corporate environmental sustainability through financial investment. Following Yao et al. (2021), we employ a variable replacement method to investigate the channel mechanisms. We utilize the ratio of net fixed assets to total assets as a measure of core business investment (*FIXRTO*). The performance of green innovation is represented by the natural logarithm of 1 plus the number of patent applications (*GINVEN*). Human capital investment is measured by the ratio of employee compensation expenses to the number of employees at the end of the period (*HUCAP*). The rationale behind this analysis is grounded in previous literature, which has established the positive effects of core business investment, human capital investment, and green innovation on corporate environmental sustainability. If financial investment is undesirably correlated with these variables, it implies that financial investment suppresses corporate environmental sustainability via these variables.

Table 6 displays the estimate of corporate financial investment on the mechanism variables. In column (1), the estimation of *CORF* is dramatically unfavorable, with a p value <.01, indicating that financial investment substitutes for core business investment and primarily exerts a crowding-out effect rather than a reservoir effect. In column (2), the estimation of *CORF* is significantly unfavorable at the 1% level, indicating that financial investment hampers the advancement of green innovation performance. Column (3) shows that the estimation of *CORF* remains impressively undesirable at the 5% level, suggesting that financial investment hinders the enhancement of human capital investment.

The above regression results suggest that corporate financial investment crowds out investment in core business and human capital and inhibits green innovation, thereby creating unfavorable conditions for environmental sustainability. These findings are consistent with Su and Liu (2021) and Tori and Onaran (2020). However, our research takes a deeper look, scrutinizing the economic implications of financial investment on core business investment and inhibiting green innovation.

While the channel analysis is conducted using a variable replacement technique, the credibility of this approach hinges on ensuring that the mechanism variables unequivocally foster corporate environmental sustainability. Despite the plethora of studies endorsing the favorable influence of core business investment, human capital investment, and green innovation on corporate environmental sustainability, we do not explicitly examine these relationships in the current study.

In the following step, we investigate the impact of the mechanism variables on financial investment and corporate environmental sustainability. Figure 5 illustrates the interaction effects between different mechanism variables and financial investment on GTFP. The horizontal axis represents financial investment, while the vertical axis represents mechanism variables. In subfigures (a), (c), and (e), diverse colors represent variations in the GTFP index, with red denoting higher values and lighter shades indicating lower values. These

TABLE 6 Channel analysis.

Variables	(1) FIXRTO	(2) GINVEN	(3) HUCAP
CORF	−0.040***	−0.337***	−0.413**
	(−3.310)	(−2.731)	(−2.129)
ASSET	0.020***	−0.034	0.311***
	(6.297)	(−1.340)	(7.365)
LEV	−0.101***	−0.003	0.387***
	(−9.249)	(−0.034)	(2.796)
ROA	0.023	0.241	0.212
	(1.544)	(1.454)	(0.930)
FIRST	0.683***	0.035	−0.033
	(30.152)	(0.226)	(−0.121)
DUAL	0.002	0.043	−0.036
	(0.936)	(1.471)	(−0.897)
DIRECT	0.005***	0.012	0.027
	(4.445)	(1.035)	(1.561)
CASH	0.085***	−0.082	−0.069
	(10.055)	(−0.899)	(−0.513)
INDEP	−0.051**	−0.134	0.730*
	(−2.124)	(−0.489)	(1.775)
STATE	−0.015**	0.036	−0.103
	(−1.996)	(0.654)	(−1.384)
HHI	0.018	−0.159	−1.007***
	(1.171)	(−1.164)	(−3.809)
FIRM	Yes	Yes	Yes
YEAR	Yes	Yes	Yes
PROVINCE × *FIRM*	Yes	Yes	Yes
INDUSTRY × *FIRM*	Yes	Yes	Yes
CONS	−0.136*	1.954***	−3.780***
	(−1.795)	(3.401)	(−3.830)
N	16,547	16,547	16,547
R^2	.911	.722	.866

Note: The values in parentheses represent the corresponding *t* statistics. To ensure accurate estimation results, this study employs cluster-robust estimation at the firm level.
*Statistically significant at the 10% level, based on significance tests for the regression coefficients.
**Statistically significant at the 5% level, based on significance tests for the regression coefficients.
***Statistically significant at the 1% level, based on significance tests for the regression coefficients.

subfigures consistently demonstrate that higher values of the mechanism variables are associated with elevated GTFP, affirming a favorable correlation between these mechanisms and corporate GTFP. This demonstrates that core business investment, green innovation, and human capital investment dramatically spur corporate environmental sustainability. These findings align with Gong et al. (2023) and Tori and Onaran (2022). Moreover, as the values of the interaction terms between the mechanism variables and financial investment increase, GTFP decreases (as observed in the blue segments in subfigures a, c, and e), indicating that financial investment counteracts GTFP through its influence on core business investment, green innovation, and human capital investment.

Furthermore, we conduct a detailed analysis of how financial investment responds to different values of the mechanism variables. The estimation results are depicted in subfigures (b), (d), and (f). These subfigures demonstrate a decreasing trend in the estimation of *CORF*, which implies that core business investment, green innovation, and human capital investment influence the relationship between corporate financial investment and GTFP. By and large, considering the empirical results in Table 6, we unwaveringly assert that financial investment suppresses corporate environmental sustainability by affecting the scale of core business investment, inhibiting green innovation, and impeding human capital investment.

4.5 | Additional analysis

Theoretical analysis underscores the imperative role of institutional contexts in shaping the relationship between financial investment and corporate environmental sustainability. In this section, we examine how institutional factors impact the crowding-out effect of corporate financial investment on environmental sustainability. We first investigate whether institutional contexts affect this relationship by employing interaction terms. Then, we construct model (4) to explore how heterogeneous institutional conditions make a difference in this relationship. The model specification is as follows:

$$
\begin{aligned}
GTFP_{ijpt} = {} & \alpha + \beta_1 CORF_{ijpt} I\left(INSTITUT_{pjit} \le \varsigma\right) \\
& + \beta_2 CORF_{ijpt} I\left(INSTITUT_{pjit} \ge \varsigma\right) + \sum\nolimits_1^s a_s CONTROLS_{ijpt} \\
& + CONS_{ijpt} + \eta_i + \delta_t + \upsilon_{jt} + \tau_{pt} + \varepsilon_{ijpt}
\end{aligned} \tag{4}
$$

where $I(\bullet)$ represents the threshold indicator function for specific threshold values. All other parameters are consistent with specification (1). *INSTITUT* stands for the institutional variable. Specifically, we gauge local financial regulation (*REGUL*) by employing the ratio of financial regulatory expenses to local financial sector value-added as a proxy. Additionally, following Zhang, Chen, and Zhao (2023), we measure the level of marketization using data from the "China Provincial Marketization Index Report (2021)" (*LIBERT*). Notably, *REGUL* and *LIBERT* are standardized, enabling us to assess the net impact of institutional environments on the relationship between financial investment and corporate environmental sustainability. Furthermore, we introduce variables *ISREGUL* and *ISLIBERT*, taking on a value of 1 if the institutional environment exceeds the respective mean values, to examine the impact of the institutional contexts on the relationship between financial investment and corporate environmental sustainability. We treat *REGUL* and *LIBERT* as threshold variables, incorporating them into specification (4) to explore the specific threshold

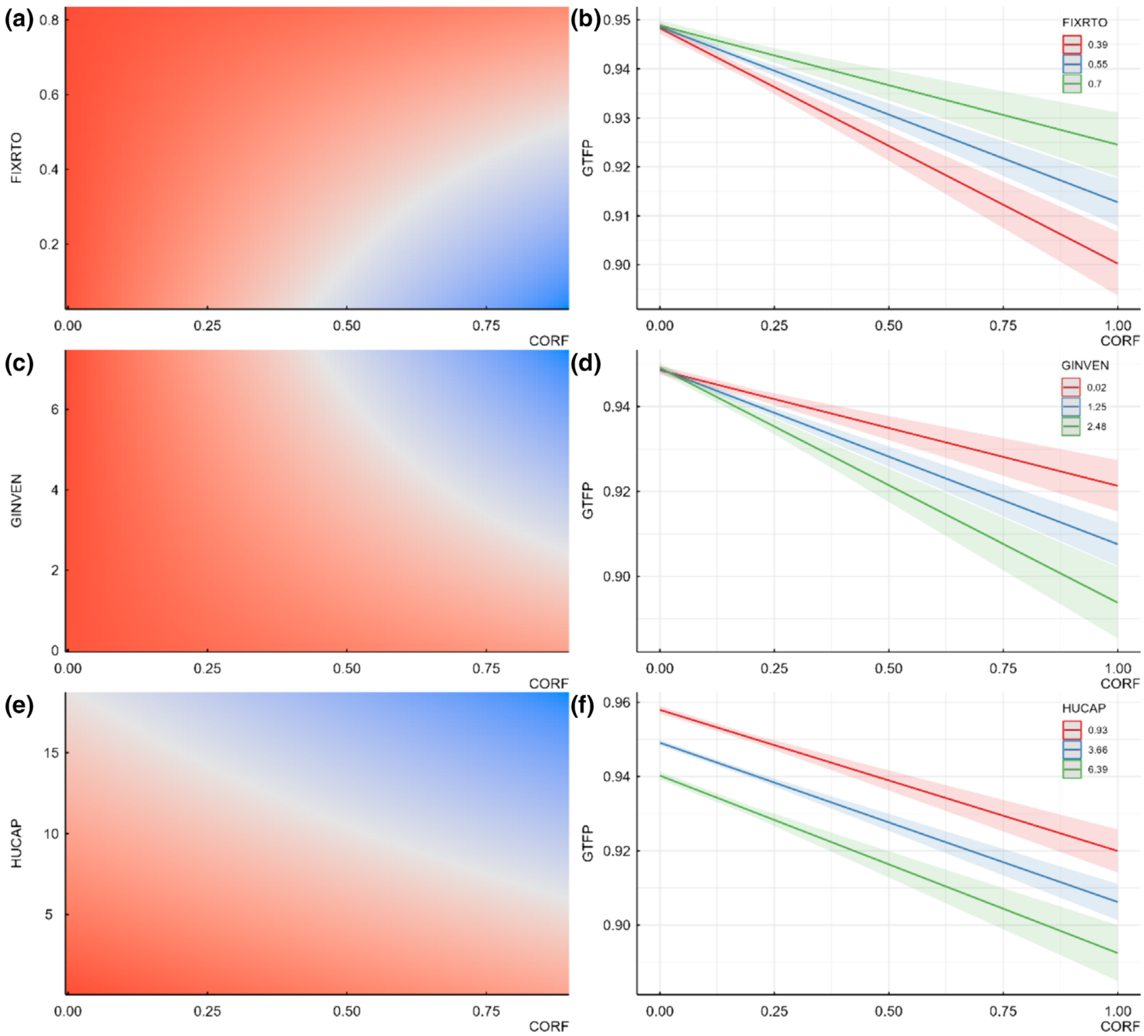

FIGURE 5 Interaction term estimation. This figure illustrates the results of examining the mechanisms between corporate financial investment and corporate environmental sustainability. (a), (c), and (e) provide an overview of how corporate financial investment interacts with firm-specific investment (*FIXRTO*), corporate green innovation performance (*GINVEN*), and human capital input (*HUCAP*) in relation to corporate environmental sustainability. Subsequently, (b), (d), and (f) demonstrate the varying impact of financial investment on corporate environmental sustainability across different levels of corporate financial investment and firm-specific investment (*FIXRTO*), corporate green innovation performance (*GINVEN*), and human capital input (*HUCAP*).

breakpoints at which the institutional environment affects corporate environmental sustainability.

Table 7 presents the estimated impact of the institutional environment on the relationship between financial investment and corporate environmental sustainability. Our primary focus is on the estimates and significance of the interaction terms. In columns (1) and (2), we observe significant and positive estimated coefficients for the interaction terms *CORF* × *ISREGUL* and *CORF* × *ISLIBERT*, suggesting that the institutional environment plays a crucial role in mitigating the crowding-out effect of financial investment and promotes a reservoir effect. Moving on to columns (3) and (4), we uncover that the estimated coefficients for the interaction terms *CORF* × *REGUL* and *CORF* × *LIBERT* are 0.014 and 0.012, respectively, both with p values below .01. This implies that a 1% rise in financial regulatory and market liberalization corresponds to a 1.4% and 1.2% enhancement in environmental sustainability performance via financial investment (institutional variables have been standardized). In a similar vein, columns (5) and (6) present the results of threshold regression, indicating dramatic variations in the estimated coefficients for the impact of financial investment on corporate GTFP at various institutional threshold values. These differences pass the significance test at the 1% level. This suggests that strengthening financial regulation and promoting market liberalization motivate financial investment to facilitate a reservoir effect, thereby improving corporate environmental sustainability performance. In short, our hypotheses, as presented in Hypothesis 3, receive empirical support.

TABLE 7 Heterogeneity analysis.

Variables	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP	(5) GTFP	(6) GTFP
CORF	−0.022***	−0.021***	−0.011**	−0.014***		
	(−4.096)	(−3.447)	(−2.460)	(−3.198)		
ISREGUL	−0.002***					
	(−2.750)					
CORF × *ISREGUL*	0.021***					
	(3.576)					
ISLIBERT		0.001				
		(1.462)				
CORF × *ISLIBERT*		0.016**				
		(2.437)				
REGUL			−0.001			
			(−1.572)			
CORF × *REGUL*			0.014***			
			(4.127)			
LIBERT				0.001**		
				(1.991)		
CORF × *LIBERT*				0.012***		
				(3.149)		
CORF × (*REGUL* < 0.314)					0.012***	
					(4.100)	
CORF × (*REGUL* ≥ 0.314)					0.042***	
					(11.766)	
CORF × (*LIBERT* < 0.618)						0.014***
						(3.930)
CORF × (*LIBERT* ≥ 0.618)						0.033***
						(9.473)
ASSET	0.014***	0.013***	0.013***	0.013***	0.002***	0.002***
	(11.621)	(11.519)	(11.554)	(11.451)	(4.772)	(4.682)
LEV	0.001	0.001	0.001	0.001	0.019***	0.018***
	(0.176)	(0.184)	(0.166)	(0.201)	(9.532)	(9.391)
ROA	−0.003	−0.004	−0.003	−0.004	0.016***	0.016***
	(−0.491)	(−0.693)	(−0.475)	(−0.770)	(4.263)	(4.102)
FIRST	0.009	0.009	0.009	0.009	0.044***	0.044***
	(1.321)	(1.291)	(1.297)	(1.312)	(13.487)	(13.637)
DUAL	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
	(−0.105)	(−0.069)	(−0.192)	(−0.099)	(−0.072)	(−0.106)
DIRECT	0.000	0.000	0.000	0.000	0.001***	0.001***
	(0.523)	(0.337)	(0.481)	(0.009)	(5.575)	(5.662)
CASH	−0.012***	−0.012***	−0.012***	−0.011***	0.005**	0.005***
	(−3.905)	(−3.828)	(−3.913)	(−3.780)	(2.505)	(2.672)
INDEP	−0.004	−0.003	−0.004	−0.002	−0.004	−0.003
	(−0.432)	(−0.356)	(−0.474)	(−0.243)	(−0.633)	(−0.571)
STATE	−0.003	−0.002	−0.003	−0.002	−0.003***	−0.003**
	(−1.300)	(−1.070)	(−1.279)	(−0.958)	(−2.585)	(−2.447)

TABLE 7 (Continued)

Variables	(1) GTFP	(2) GTFP	(3) GTFP	(4) GTFP	(5) GTFP	(6) GTFP
HHI	−0.021***	−0.021***	−0.021***	−0.022***	0.000	−0.000
	(−3.637)	(−3.649)	(−3.604)	(−3.683)	(0.114)	(−0.015)
FIRM	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
PROVINCE × *FIRM*	Yes	Yes	Yes	Yes	Yes	Yes
INDUSTRY × *FIRM*	Yes	Yes	Yes	Yes	Yes	Yes
CONS	0.648***	0.651***	0.650***	0.655***	0.875***	0.875***
	(25.033)	(25.267)	(25.219)	(25.521)	(96.925)	(96.567)
N	16,547	16,547	16,547	16,547	16,547	16,547
R^2	.821	.821	.822	.822	.038	.035

Note: The values in parentheses represent the corresponding *t* statistics. To ensure accurate estimation results, this study employs cluster-robust estimation at the firm level.
*Statistically significant at the 10% level, based on significance tests for the regression coefficients.
**Statistically significant at the 5% level, based on significance tests for the regression coefficients.
***Statistically significant at the 1% level, based on significance tests for the regression coefficients.

5 | CONCLUSION AND IMPLICATIONS

The quest for global sustainable development is a pressing imperative (Balasubramanian et al., 2021). Firms, as substantial sources of pollution, are indispensable for global sustainability by scaling down emissions, adopting clean energy, and spurring resource efficiency (Safiullah et al., 2022). To attain environmental sustainability, firms must invest in eco-friendly infrastructure, optimize production, and promote green innovation, necessitating surplus conversion into fixed capital (Alam et al., 2019; Karim et al., 2021). However, capital scarcity, resulting from divergent investment returns between financial and non-financial sectors, brings about resource imbalances as corporate assets swiftly shift toward finance. Therefore, exploring the environmental impact of resource reallocation to finance emerges as an essential and far-reaching research endeavor.

This paper utilizes data from publicly traded companies in China's Shanghai and Shenzhen stock markets between 2011 and 2021 to investigate whether and how financial investment affects corporate environmental sustainability. The findings are summarized as follows: First, applying a GAM, we observe a linear relationship between financial investment and corporate environmental sustainability performance, consistent with available literature (Jin et al., 2022; Su & Liu, 2021; Tori & Onaran, 2022). Panel analysis further demonstrates the crowding-out effect of financial investment on environmental sustainability, as supported by various robustness checks, including instrumental variable analysis, Heckman selection models, and difference-in-differences estimations. These findings validate previous research on the inhibitory effects of financial investment on green innovation and its influence on employee turnover (Gong et al., 2023; Su & Liu, 2021; Tori & Onaran, 2020).

Second, we identify that the suppression of environmental sustainability performance by corporate financial investment primarily stems from reductions in core business revenue, impeding green innovation, and diminished investment in human capital. These outcomes align with existing evidence on the adverse impact of financial investment on green innovation and its correlation with increased employee turnover. Our study goes beyond previous research by shedding light on additional channels of the crowding-out effect of financial investment, especially in terms of diminished human capital investments. This provides fresh perspectives for future research on the connection between corporate financial investment and human capital.

Third, the institutional environment plays a mitigating role in the crowding-out effect of financial investment on corporate environmental sustainability. We examine this effect from the perspectives of financial regulation and regional marketization. The analysis reveals that higher levels of financial regulation and market liberalization transform the effect of financial investment from crowding-out to a reservoir effect. Specifically, a 1% rise in financial regulatory and market liberalization corresponds to a 1.4% and 1.2% enhancement in corporate environmental sustainability performance via financial investment. Threshold regression analysis documents that this shift is particularly pronounced when the financial regulatory index and regional marketization index surpass the respective thresholds of 0.314 and 0.618.

In accordance with the preceding findings, we extract several policy implications. First, enterprises should avoid prioritizing short-term financial returns at the expense of boosting environmental sustainability. Instead, they should allocate resources to promote environmental sustainability, which is critical for energy efficiency and pollution reduction. Strengthening environmental sustainability can ultimately enhance competitiveness. Second, enterprises should allocate resources specifically for spurring their green performance. This includes investments in innovation, technology R&D, new product development, employee training, management innovation, organizational innovation, and fixed assets. Striking a balance between long-term environmental investments and short-term financial gains is essential. Lastly, enhancing the institutional environment is crucial for improving environmental sustainability. Government departments should refine market competition mechanisms, monitor enterprise investment behavior, and guide the transition toward environmentally sustainable practices. Regulatory measures should also be implemented to prevent excessive financialization of enterprises and the neglect of tangible activities for virtual ones.

This study solely examines the impact of corporate financial investment on environmental sustainability, utilizing data from listed companies in China. Future research could broaden the scope by including non-listed companies via questionnaire surveys. Additionally, future studies may explore the macro-level effects of financial investment on environmental sustainability using regional-level data and analyze potential spatial spillover effects.

AUTHOR CONTRIBUTIONS

The authors equally contributed to this paper.

ACKNOWLEDGMENTS

The authors acknowledge financial support from the National Social Science Fund of China (grant no. 22BJY037) and the Chongqing Talent Program "Package System" under the Chongqing Social Science Planning (grant no. 2022YC062). The authors are grateful to the anonymous referees who provided valuable comments and suggestions to significantly improve the quality of the paper.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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How to cite this article: Shi, P., & Huang, Q. (2024). The impact of financial investment on corporate environmental sustainability: Reservoir effect or crowding-out effect? *Business Strategy and the Environment*, *33*(6), 6084–6105. https://doi.org/10.1002/bse.3798

APPENDIX A

TABLE A1 Variable definition.

Variables	Variable description
GTFP	Measure with green total factor productivity based on the super-SBM strategy
CORF	Ratio of corporate financial assets to total assets, where corporate financial assets include trading financial assets, derivative financial assets, available-for-sale financial assets, investment properties, held-to-maturity investments, and long-term equity investments
ASSET	Natural logarithm of 1 plus total assets
LEV	Ratio of total liabilities to total assets
ROA	Ratio of net profit to average total assets
FIRST	Equity ownership percentage held by the largest shareholder
DUAL	1 is assigned when the chairman also serves as the CEO and 0 otherwise
DIRECT	Number of corporate directors
CASH	Ratio of net operating cash flow to total assets
INDEP	Ratio of independent directors to total directors on the board
STATE	1 is assigned to state-owned enterprises and 0 otherwise
HHI	Primary business revenue-to-industry total revenue ratio
FIRM	A set of dummy variables representing firms
YEAR	A set of dummy variables representing years
PROVINCE × *FIRM*	Interaction term between provincial dummy variables and firm dummy variables
INDUSTRY × *FIRM*	Interaction term between industry and firm dummy variables, using two-digit industry codes specified in the 2012 "Guidelines for Industry Classification" by the China Securities Regulatory Commission

TABLE A2 Covariate balance check.

Variables	Type	Mean		Bias (%)
		Treated	Control	
ASSET	Unmatched	22.70	22.15	33.10
	Matched	22.70	22.72	−1.100
LEV	Unmatched	0.424	0.422	0.800
	Matched	0.424	0.433	−4.200
ROA	Unmatched	0.0408	0.0401	1.100
	Matched	0.0407	0.0383	3.900
FIRST	Unmatched	0.345	0.352	−4.200
	Matched	0.345	0.346	−0.300
DUAL	Unmatched	0.265	0.289	−5.300
	Matched	0.266	0.267	−0.400
DIRECT	Unmatched	8.798	8.547	12.90
	Matched	8.798	8.726	3.700
CASH	Unmatched	0.159	0.177	−13.70
	Matched	0.159	0.152	5.400
INDEP	Unmatched	0.377	0.377	−0.800
	Matched	0.377	0.378	−2.000
STATE	Unmatched	0.473	0.387	17.50
	Matched	0.473	0.473	−0.100
HHI	Unmatched	0.0779	0.0759	2.100
	Matched	0.0779	0.0747	3.300

Note: This table displays covariate balance results for propensity score matching. "Bias" gauges dissimilarity between sample types, with values under 10% signifying minimal variances between treatment and control groups. Notably, the values of "bias" for matched samples are all below 10%, indicating a substantial reduction in covariate differences and favorable matching outcomes.