**Does Mutual Fund Ownership Increase Corporate Environmental Spending?**

**Abstract**

This paper examines how mutual fund ownership influences corporate environmental spending, and the channels through which this impact operates. Using a unique hand collected dataset of Chinese listed companies between 2011 and 2018, we report mutual fund investment is associated with significantly increased corporate environmental spending. This influence is moderated by institutional factors including state-owned enterprises and stronger legal environments. We also assess the environmental awareness associated with environmental spending through examining the number of ‘green’ questions raised by investors and the ‘green’ credentials of board members. Moreover, we find that mutual funds with green investment objectives have significantly increased corporate environmental spending levels. We conclude mutual find ownership has a positive influence on environmental spending and should be encouraged within China.

**Keywords:** Mutual fund; Environmental spending; State-owned enterprises; Legal environment; Green business; China.

**Does Mutual Fund Ownership Increase Corporate Environmental Spending?**

**1. Introduction**

The role of institutional investors has been described as the most powerful financial mechanism for altering corporations’ environmental decision making (Stroebel and Wurgler, 2021). This study examines the influence of mutual funds on the environmental spending undertaken by Chinese listed companies between 2011 and 2018. We focus on environmental spending as this metric quantifies the environmental intensity of an industry encompassing the corporate spending undertaken to alleviate the environmental costs arising from a firms' actions (Drobetz et al., 2024). Due to the heterogeneity of institutional investor behaviour (García-Sánchez et al., 2020) we consider a single class of institutional investment.

The link between mutual funds and corporate environmental spending decisions is assumed to occur through an isomorphic process whereby these institutional investors transmit environmental awareness to the shareholders or boards of their beneficiaries and ultimately altering environmental spending decisions (Dyck et al., 2019). Using a unique hand collected dataset of environmental expenditure incorporating sewage discharge, cleaning, landscaping, greening and environmental protection (Meng and Zhang, 2022), we report mutual fund investment is positively related with corporate environmental spending. We apply an institutional theoretical framework (DiMaggio and Powell, 1983, Jennings and Zandbergen, 1995, Sahasranamam et al., 2022) to examine the channels through which this environmental influence is transmitted to firms. As green finance is a socially constructed concept, and often used as an ambiguous ‘catch all’ term, (Bénabou and Tirole, 2010), multiple institutional factors may affect its dissemination. We assume institutions are symbolic systems, containing representational, constitutive, and normative rules (Jennings and Zandbergen, 1995).

The factors influencing this process include whether a firms’ board, management or owners are orientated towards ensuring sustainable outcomes. We report mutual fund investment enhances environmental awareness, quantified by the ‘green’ credentials of board members and the number of environmentally motivated questions raised by investors at annual general meetings (hereafter AGMs). We also examine the stringency of the legal environment in which firms operate, and the influence of this institutional factor over environmental spending decisions. Similarly, we assess if environmental spending is affected by whether the firm is owned by the state or state agency (Xu et al., 2023). Both factors play a significant moderating role in the relationship between mutual fund ownership and corporate environmental spending. These results are robust to the mutual funds’ investment objectives, firm size, and alternative measures of environmental spending. We also examine the influence of Qualified Foreign Institutional Investors (QFII) and the presence of grey institutions on environmental spending.

This examination of environmental spending compliments multiple studies examining the link between institutional ownership and Environmental, Social, and Governance (ESG)/ Corporate Social Responsibility (CSR) indices (e.g. Alda, 2018, Aluchna et al., 2022, Cheng et al., 2022, Erhemjamts and Haung, 2019, Harjoto et al., 2017, Jia et al., 2022, Jin et al., 2024, Li et al., 2021, McGuniness et al., 2017, Nofsinger et al., 2019, Utza et al., 2015, Yahia et al., 2023, Yan et al., 2021). These synthetic CSR/ESG indices are constructed using a diversity of methodologies and economic and social criteria (Escrig-Olmedo, 2014, Velte, 2022) and unsurprisingly diverge significantly from each other (Avramov et al., 2022, Berg, et al., 2022, Serafeim and Yoon, 2023, Tan and Pan, 2023, Wang et al., 2023). Indeed, CSR and ESG metrics are only moderately correlated with corporate environmental spending (Freiberg et al., 2021) and can suffer from a lack of accuracy and reliability (Jonsdottir et al., 2022). Predictably many studies have employed alternative approaches or metrics to CSR/ESG indices when quantifying aspects of sustainable decision making. For example through assessing investment decisions from funds which use socially responsible criteria (Matallín-Salez et al., 2019), social capital (Choy et al., 2023), or examining voluntary corporate social performance (CSP) targets (Wang and Chen., 2017), compliance violations (Raghunandan and Rajgopal, 2022), sustainability reports (García-Sánchez et al., 2020), corporate site visits by institutional investors (Jiang et al 2022), or patent data (Xu et al., 2023).[[1]](#footnote-1)

Our paper is builds upon these contributions and specifically the work of Drobetz et al., (2024) who examined the relationship between institutional ownership internationally and levels of corporate environmental costs. This study reported foreign institutional ownership constrains environmental costs and generates substitutability between the firms’ governance and institutional owners. Our research differs from this contribution by examining how mutual funds interact with their beneficiaries and through assessing which institutional factors moderate levels of corporate environmental spending. These are compelling, if previously under researched questions (Humphrey and Li, 2021), which contribute to a nascent literature on how environmental sentiment is disseminated (Falcone et al., 2018, Morone, 2018).

Understanding why mutual fund investment influences firms environmental spending is important for many reasons. We live in a world typified by resource exhaustion, imbalance in ecological systems and pollution. Indeed, such environmental concerns create both significant short-term regulatory risks and longer-term physical risks (Stroebel and Wurgler, 2021). This is apposite for China, the focus of this study, due to this nations’ spectacular yet environmentally unsustainable economic growth (Bai et al., 2018). This economic expansion whilst creating multifarious benefits, has been accompanied by high and unsustainable levels of energy consumption and pollution with deleterious effects felt internationally. Enhancing the corporate response to these environmental concerns and specifically increasing current levels of environmental spending is a Chinese and global policy priority (Nordhaus, 2019). Therefore, comprehending how corporate environmental spending decisions are made and can ultimately ameliorate environmental concerns is important for policy makers, firms and the wider public.

The paper is organised into five sections. After this introduction, we review the related literature and develop hypotheses. In section three, we consider the methodology. The results are presented in section four with conclusions and implications outlined in the final section.

**2. Literature Review and Hypothesis Development**

Shifting economic activity to a more sustainable basis lies at the heart of the green finance movement (Morone, 2018). This transformation requires new metrics to quantify progress towards a greener economy, policy measures to ensure a level playing field for firms choosing between fossil fuel and sustainable production processes, and education to inform finance practitioners (Morone, 2018). Overcoming the uncertainty arising from this change also requires the cooperation and coordination of green finance professionals (Falcone et al., 2018) and multiple legal, governmental, and international financial institutions.

This study examines the relatively under-researched metric of environmental spending and the channels through which green finance concepts are transmitted to firms, alter corporate values, and influence environmental decision making. We posit investment by mutual funds acts as a conduit for the dissemination of environmental awareness (Jennings and Zandbergen, 1995, García-Sánchez et al., 2020). This dissemination occurs as mutual funds expect their investees to align with their values. This social pressure, reported in previous studies (Dyck et al., 2019), matters as the values held by institutional investors are often reflected in the actions of their beneficiaries (Oikonomou et al., 2020).

We argue this dissemination of environmental awareness is plausible for many reasons. Mutual funds have a long-term investment horizon allowing them to benefit from monitoring efforts (Gaspar et al., 2005, Kim et al., 2019a), relative to short-term institutional investors, which have fewer monitoring incentives (Kim et al., 2019b). This creates strong incentives to monitor investees and mitigate environmental risks through engagement with their investee firms (Li et al., 2021). Indeed, this process is illustrated by institutional investors’ sensitivity to attacks on the reputations of their beneficiaries (Clark and Hebb, 2005), corporate site visits by institutional investors (Jiang et al., 2022) and the proportion of mutual funds which are signatories of the Principles of Responsible Investment accords (Humphrey and Li, 2021).

This link between mutual fund ownership and environmental spending is also important to address in the Chinese context. Mutual funds are the largest institutional investors in China (Aggarwal et al., 2015) with $3.1 trillion total net assets under management by the end of 2020 (AMAC, 2021, Flood, 2021). Since China introduced mutual funds in 1997, mutual fund investment has grown significantly (Wang and Chen, 2017), expanding by over 30% in the last five years (Li et al., 2021). These mutual funds possess a substantial capacity to shape the sustainable policies of the firms in their portfolio by ‘voting with their feet’, and selling their investments; a power other funds, including index funds, do not possess (Li et al., 2021). Chinese mutual funds are also subject to significant regulatory scrutiny, resulting in the disclosure of details such as investment portfolio compositions, and an enhanced inclination to consider sustainability issues (Wang et al., 2019b). Subsequently, as mutual funds are likely to invest in firms with robust sustainable policies, we propose mutual funds encourage their beneficiaries to engage in more environmental spending, and therefore examine the following hypothesis:

***H1.*** *Mutual fund ownership is positively related to corporate environmental spending.*

Sustainability concepts are also shaped by institutional forces and particularly the state (Jennings and Zandbergen, 1995). While China has relatively weak environmental protections, the governments’ commitment to addressing pollution problems and encouraging ‘green’ corporate practices is well documented (Nordhaus, 2019). Since 2016, green finance has been actively supported by the Chinese state through the ‘Guidelines for Establishing the Green Financial System’ (Liu et al., 2020) and policies including ‘Green Finance Pilot Zones’ (Irfan et al., 2022), and the ‘Green Credit Policy’ (Zhang et al., 2021). The Chinese state has also supplied delegates to environmental summits and UN events, with Chinese firms issuing around 15% of global CSR reports in the past decade (Wang and Chen, 2017).

As China has extensive state ownership of firms; this is an obvious channel through which environmental awareness can be encouraged. Chinese companies, often possess a highly concentrated ownership structure, and are frequently controlled by the state or state agencies (Wang et al., 2024). We therefore examine if state owned enterprises (hereafter SOEs) have increased their environmental spending relative to privately owned firms. While it is important for all firms to behave sustainably, we propose SOEs actively undertake more environmental spending, as they are required to act as role models for their private sector counterparts (Lau et al., 2016, Wang and Zhang, 2020, Chen et al., 2022), and shoulder social and environmental policy burdens as well as maximising financial benefits (Wang et al., 2024). In comparison to non-SOEs, governmental support, such as financial resources, is generally more readily available for SOEs, such as access to financial resources from state-owned banks (Du et al., 2017, Wang et al., 2019). In summary, it is expected that the impact of mutual fund ownership over environmental spending decisions is more pronounced in SOEs, leading to the following hypothesis:

***H2.*** *Mutual fund ownership increases corporate environmental spending within SOEs more compared to non-SOEs.*

In addition to state ownership, the legal environment affects many aspects of firms’ behaviour (Dimaggio and Powell., 1983), and particularly CSR issues (Liang and Renneboog, 2017, Rubin 2008). This institutional influence has as a significant impact over sustainable outcomes in China, including limiting emissions (Li, 2023), upholding environmental standards (Wang et al., 2021), and is typified by the swift development within the Chinese green bond market (Huang and Yue, 2020). This effect is associated with Chinese civil law traditions and a history of government intervention (Liang and Renneboog, 2017), which has constrained shareholder protection affecting the scale (Khorana et al., 2005) and performance (Ferreira et al., 2013) of mutual fund investment.

The stringency of the legal enforcement varies across different Chinese regions enabling the examination of how this institutional factor influences environmental spending. Stronger legal environments are associated with a greater probability of catching environmental violations (Huang et al., 2023). Subsequently, firms operating in areas typified by robust legal environments are likely to comply with environmental regulations, disclose more corporate information (Wang et al., 2021), have more channels for monitoring firm behaviour and undertake greater levels of environmental spending, relative to firms located within areas typified by a weaker legal environment. This outcome is also thought to alter how firms interact with stakeholders (Wu et al., 2016), whereby, those firms with a higher proportion of mutual fund investment provide additional voluntary disclosure of sustainability-related information to meet stakeholders’ information demands. We therefore examine the following hypothesis, across the 31 Chinese provincial administrative regions:

***H3.*** *Mutual fund ownership has a greater positive influence on corporate environmental spending for firms located in provinces with a stronger legal environment.*

Lastly, we examine the channels through which environmental awareness may be transmitted. If institutional investors hold environmental values, we expect their representatives to share these values with their beneficiaries, ensuring environmental spending is considered both normal and a future imperative (Grewal et al., 2016). These investors, predominantly from North America and Europe, often support ‘green’ values (Kruger et al., 2020) and voice environmental concerns to limit risks within their beneficiaries (Drobetz et al., 2024). Institutional investors undertake this monitoring and guidance through incorporating environmental factors into their research, analysis, and selection processes; all practices identified using quantitative analysis (Alda, 2019, Erhemjamts and Huang, 2019), interview data (McCahery et al., 2022), and survey assessment (Przychodzen et al., 2016).

We explore two channels through which mutual fund investment affects environmental awareness and in turn, environmental spending. Environmental awareness could be represented by the number of environmentally themed queries at shareholder AGMs (Sjostrom, 2008). These queries and clarifications of ESG information raised in AGM question and answer (Q&A) sessions record the real-time interaction between investors and managers, important for fast-paced markets where timely and accurate information is highly valued (Chen et al., 2018). While only a quarter of these questions were successful and comprehensively addressed by management, they do illuminate how investors attempt to instil environmental awareness (Cahan et al., 2017).

We also examine the environmentally orientated qualifications and experience held by the firms’ directors. We propose a ‘green’ board exists when board members have ‘green’ working experience and qualifications. The educational and working background of directors is expected to instil an awareness of environmental and social issues, encourage board members to prioritize green initiatives and sympathetically influence corporate environmental policies (Li et al., 2021). For firms with higher levels of mutual fund ownership, these directors are expected to develop sustainable values, to prioritize sustainability, and align their business practices with institutional investment principles. Subsequently, it is expected that mutual funds will encourage firms to appoint board members with environmentally orientated academic degrees or working experience to address environmentally related issues and minimize associated risks. We therefore test the following hypothesis:

***H4.*** *Firms with greater mutual fund ownership undertake more environmental spending, contingent on greater environmental awareness, including more ‘green’ questions raised by investors at AGMs; and more board members with* *environmentally orientated academic degrees and working experience.*

**3. Methodology**

*3.1 Data and Variables*

To examine these hypotheses, we manually collected data on corporate environmental spending from annual reports and corporate social responsibility reports. Institutional ownership data was downloaded from the RESSET database. Corporate governance, financial performance, and firm characteristics data are collected from the China Stock Market and Research (CSMAR) database. Society and governance score variables are assembled from the Huazheng database. The AGM investor questions are from the Chinese Research Data Services (CNRDS) database. As Chinese listed firms have only disclosed relevant social and environmental information in recent years, our research sample runs from 2011 to 2018. After excluding the missing values, the final sample contains 6,560 firm-year observations. To remove the impact of outliers, we winsorize the environmental spending, mutual fund ownership and control variables at the 1% level.

The dependent variable, corporate environmental spending, consists of expenses for sewage discharge, cleaning, landscaping, greening and environmental protection;[[2]](#footnote-2) a definition consistent with recent research (Meng and Zhang, 2022). The independent variables include state-owned enterprises, legal environment, green questions, and green board. SOEs are represented by a dummy variable, which equals one if the ultimate controller of a listed firm is the state or state agencies and zero otherwise. Legal environment refers to the legal development of a province where a listed firm is located. We use the regional-level legal environment index from the National Economics Research Institute (NERI), which quantifies market intermediaries’ development and protections for producers’ interests, intellectual property rights, and consumers’ rights (He et al., 2018).

To examine the channels of mutual fund influence, we use a ‘green questions’ variable. Shareholders are offered opportunities to question the board of directors during AGMs. The boards of directors and firm representatives are obligated to answer these questions. This dialogue is often publicly available via conference transcripts (Van der Elst and Lafarre, 2019) and is collected from the CNRDS database. Green questions are defined as the proportion of all questions raised during the AGM which consider ‘green’ issues. Green questions are identified by searching for keywords, including ‘green’, ‘environment protection’, ‘sewage’, ‘energy saving’, ‘emission reduction’, and ‘ecology’. The variable 'green board' refers to the number of board members who have 'green' professional experience or an environmentally oriented academic degree. This is identified by checking for keywords (e.g., environment, ecology, energy, energy saving, green, sustainability, pollution reduction, and biological) in the working and educational backgrounds of board members in the annual reports.

The following variables are controlled in our model. First, a firm’s social performance is controlled, as firms with more social responsibilities are likely to participate in environmental protection activities, increasing corporate environmental spending (Deng et al., 2023). We also control for a firm’s governance scores as firms with robust corporate governance mechanisms generate more CSR related disclosures to address stakeholder concerns (Chan et al., 2014). We control for CEO duality, as CEOs who also hold the chairperson position may prioritize their financial benefits over stakeholders’ interests and negatively influence corporate environmental spending (Abebe and Acharya, 2022). ‘Board independence’ is measured as the proportion of independent directors on a board. We control for this variable as a higher proportion of independent directors can objectively question and evaluate management, enhancing environmental performance (De Villiers et al., 2011; Wang et al., 2019). A ‘board meeting’ variable is included to measure the frequency of board meetings per annum, as firms with frequent board meetings are more likely to discuss environmental issues (Ricart et al., 2005).

We control for a firm’s managerial ownership, as managers bear greater costs for environmental protection as their ownership increases (Withisuphakorn and Jiraporn, 2019). The Z-index, a ratio of the largest to the second largest shareholding is used to represent ownership concentration. This variable is included because higher ownership concentration enables effective monitoring by large shareholders, which may improve environmental performance as a result (Earnhart and Lizal, 2006). Financial performance variables are controlled using stock returns and Tobin’s Q variables, as firms with better financial performance are more capable of pursuing environmentally friendly business practices. We also control for leverage, as firms may increase their debt levels to finance environmental protection (Clarkson et al. 2008). We also control for firm age, as established firms with more stable cash flows can afford to invest more in environmental activities (Withisuphakorn and Jiraporn, 2019). Table 1 summarizes the definition of variables.

**INSERT Table 1**

*3.2 Research Method*

To examine the relationship between mutual fund ownership and corporate environmental spending, we use a standard fixed-effects model, following Wang and Zhang (2020):

(1)

where is the natural logarithm of firm *i*’s environmental spending *i* in year *t*. , is the firm *i*’s lagged (*t-1*) mutual fund ownership. denotes firm *i*’s control variables. is the coefficient estimate for ‘mutual fund’ variable, and are the coefficient estimates for a series of control variables. and are industry and year fixed effects controlling for the unobserved heterogeneities within the industry and the same year. is the error term. We cluster the standard errors at the industry level to account for arbitrary error autocorrelations within the industry (Petersen, 2009). To validate the inclusion of year fixed effects and industry fixed effects, we run a diagnostic test, by estimating the regression equations first and jointly testing whether the dummies for all years are equal to zero or not (Ashton and Hudson, 2014). We repeat the process for industry fixed effects. In the unreported results, all the P-values of the joint tests are less than 0.05, supporting our choice of using both the industry and year fixed effects. To test H2, H3, and H4, we incorporate an interaction term to Eq. (1):

where is firm *i*’s defining features such as SOE status, legal environment of firms’ residing provinces, green questions raised by investors and green degree or experience of board members. All other firm control variables, fixed effects, and clustered standard errors are the same as Eq. (1).

**4. Empirical Findings**

*4.1 Descriptive statistics*

Panel A of Table 2 presents the summary statistics. The mean corporate environmental spending is 3.03 million Yuan (about 420,000 USD). On average, mutual funds own 5.2% of firm stocks. In addition, 17.8% of CEOs have dual positions. The board of directors holds about ten meetings per annum, and 37.1% of board members are independent directors. Moreover, firms’ average stock returns are 3.9%, and the mean leverage is 50.1%.

Panel B presents the average legal environment score across different Chinese provinces. The level of legal development and enforcement is higher in coastal provinces (i.e., Zhejiang, Jiangsu and Guangdong) and municipalities (Beijing, Shanghai, Tianjin and Chongqing). The legal environment score is lower in the regions located in northwest China (Xizang, Qinghai, Ningxia and Xinjiang). We conduct a multicollinearity test using variance inflation factor (VIF); the mean VIF value is 1.18 suggesting multicollinearity is not a concern.[[3]](#footnote-3)

**INSERT Table 2**

*4.2 Regression results*

Model 1 in Table 3 presents results for H1. The coefficient of mutual fund ownership is significantly positive, indicating that when mutual funds own a greater proportion of a firms’ shares, corporate environmental spending is significantly higher. In terms of economic magnitude, a one percentage point increase in the mutual fund ownership, on average, increases a firm’s environmental spending by 3.99 percent.

**INSERT Table 3**

Model 2 in Table 3 reports the results for H2. Mutual funds are interacted with SOEs to capture their joint impact on environmental spending. A positive coefficient is reported for the interaction variable ‘Mutual fund\*SOEs’. This implies the positive impact of mutual funds on corporate environmental spending is more pronounced in SOEs. Model 3 in Table 3 presents the results for H3. We observe a positive association between mutual funds and environmental spending exists for firms located in the provinces with greater legal development; a result consistent with H3.

Table 4 presents the results for H4. First, mutual funds are interacted with green questions to capture their joint impact on environmental spending. The results are reported in Model 1 and align with the hypothesis. Mutual funds are also interacted with the green board variable in Model 2. The coefficient of the interaction term is positive and significant, supporting H4 and signifying the influence of green credentials of board members as a channel for shaping environmental spending decisions.

Numerous control variables are significant. In Tables 3 and 4, a firm’s social performance and governance quality are positively related to corporate environmental spending. Firm stock returns are positively associated with environmental spending, indicating firms with greater market performance increase their environmental spending. The firm leverage coefficients are positive and significant, revealing that highly leveraged firms undertake more environmental spending.

**INSERT Table 4**

*4.3 Endogeneity: a two-stage least squares (2-SLS) approach*

To address omitted variable bias, where unobserved factors could simultaneously determine mutual fund’s ownership and corporate environmental spending, we adopt an instrumental variable (IV) approach. This is important because firms with superior management styles tend to undertake more environmental spending, which could attract mutual fund investment. To examine this endogeneity concern, we choose the following three instrumental variables (IVs). First, and following Chan et al., (2014), we use the lagged (two-period) mutual fund ownership as the instrumental variable. The rationale for using this IV is that the independent variables are simultaneously determined, and the lagged variables of mutual fund ownership are related to current mutual fund holdings. The lagged variables should be unrelated to environmental spending (Bellemare et al., 2017; Wang and Bellemare, 2019), helping to mitigate endogeneity problems by reducing bias and the root mean square error relative to OLS across a common range of parameter values. Model 1 in Table 5 presents the second-stage result.[[4]](#footnote-4) The statistical significance remains, and the economic magnitude is comparable to the baseline result (*i.e.*, Model 1 of Table 3).

Second, following Crane *et al.* (2016), Chen *et al.* (2019), and Hillegeist and Weng (2021), we use a listed firm’s CSI 300 index status as the second instrument.[[5]](#footnote-5) The identifying assumption is that CSI 300 index assignment is exogenous to corporate environmental spending only through its effect on quasi-indexer ownership. Specifically, the annual index reconstitution could be considered random as firms around the CSI 300 threshold (i.e., those firms moving in or out the index) are assigned randomly based on their annual market capitalization. Subsequently, benchmarking mutual funds would adjust their quasi-indexer ownership around the threshold and therefore exhibit an exogenous variation. This IV design is essentially a sharp regression discontinuity design for the CSI 300 treatment assignment in the first stage to estimate the exogenous level of the quasi-indexer ownership. We use both lagged mutual fund ownership and CSI 300 index as IVs and include other control variables to run against the dependent variable of mutual fund ownership in the first stage. The second stage results are shown in Model 2 from Table 5; we observe a similar statistical significance and economic magnitude as the first IV (Model 1 of Table 5).

**INSERT Table 5**

For our third IV, we employ the industry mean mutual fund holding as listed firms in the same industry may have a similar proportion of mutual fund investment. Using an industry average mutual funding holding as an IV could leave the first stage residuals at the firm-specific level. Following Lin et al. (2011), the industry median level variable would net out firm-specific factors if the endogeneity is not at the industry level.

To maximize the validity of our IV approach, we use all the three IVs i.e., lagged mutual fund ownership, CSI 300 index and industry mean mutual fund holding. The first stage is estimated using mutual fund ownership as the dependent variable, three IVs and other control variables as the explanatory variables.[[6]](#footnote-6) We show the second stage results for H1, H2 and H3 in Model 3, 4, and 5 of Table 5, respectively. We also present the second stage results for H4 in Table 6. The results are consistent with our baseline findings.

Our instrumental variables meet the requirements of the instrument relevance and instrument exogeneity. As shown in Tables 5 and 6, the Cragg-Donal’s Wald F-statistics are above the Wang-Yogo weak identification tests of 10% critical values, enabling the rejection of the null hypothesis of weak instruments and signifying the strength of our instrumental variables (Stock and Yogo, 2005). We have also conducted Sargan-Hansen tests to examine whether our instrumental variables are correlated with the error terms in the estimated equations (1) and (2). The p-values of the Sargan-Hansen statistics are all above 0.1 across different columns in Tables 5 and 6, implying that all instruments are not correlated with the error terms (Wang et al., 2021) and our instrumental variables are valid. The second-stage estimation results indicate that all the previous conclusions hold.

To summarise, mutual fund investment increases corporate environmental spending, and this impact is amplified for state-owned enterprises and for firms from regions with stronger legal environments. Moreover, ‘green’ questions raised by investors during shareholder meetings and the board members with ‘green’ degrees or work experiences are important channels through which mutual funds affect corporate environmental spending.

**INSERT Table 6**

*4.4* *Additional analysis: Green mutual fund investments*

In this section, we examine the impact of mutual fund ownership on corporate environmental spending, whilst incorporating the moderating impact of green mutual fund investment objectives. Initially, we examine whether mutual funds with sustainable and green investment objectives have significantly higher corporate environmental spending. Funds adopting green investment principles may support their beneficiaries in achieving sustainable operational targets, including the adoption of green technology, clean energy, and green transport (Jin and Han, 2018). We first examine the investment objectives of each mutual fund. Traditionally, while most investment objectives have been financially oriented, with a dominant focus on income or growth (Wang et al., 2019b), overtime mutual funds have identified an increasing number of non-financial objectives, such as green and sustainable investments.

For each firm, multiple mutual fund investments may exist, and we examine each of these to determine whether a firm has received investment from a mutual fund identified as having green and sustainable investment objectives or otherwise. Subsequently, we divide our sample into two sub-groups and re-estimate hypothesis one: one for a group of firms receiving investment from mutual funds with green/sustainable objectives, and the other for firms associated with mutual funds without green/sustainable objectives. The green investment objectives include environmental protection, energy saving, adoption of clean energy, reduction of pollution and carbon emissions and only investing in firms which operate in an environmentally responsible manner.

We observe a significant and positive relationship between mutual fund ownership and corporate environmental spending in both sub-groups in Table 7. Firms receiving investment from a mutual fund adopting green investment principles, have greater levels of corporate environmental spending. This is evidenced by the magnitude of the coefficient estimate of ‘mutual fund’ in Model 1 (4.223), which is higher than the coefficient estimates in Model 2 (3.625) and in the baseline regression (3.990). Our results confirm that mutual funds applying green investment principles enhance corporate environmental spending.

In Models 3-4 (Table 7), we present the results of the second-stage regression using the instrumental variable approach. Three instrumental variables, namely, lagged mutual fund ownership, the CSI 300 index, and industry mean mutual fund holdings, are adopted to re-estimate the results presented in Models 1 and 2 (Table 7). These instrumental variables have met the instrumental exogeneity and relevance conditions, as evidenced by the Cragg-Donald's Wald F-statistic and Sargan-Hansen test statistic. Notably, the coefficient estimate for 'mutual fund' in Model 3 is higher than that observed in Model 4. These findings confirm that mutual funds with green investment objectives significantly enhance corporate environmental spending.

Moreover, we define a new variable, ‘green mutual fund,’ to examine the relationship between the proportion of green fund investment and corporate environmental spending. This variable captures the percentage of shareholding coming from sustainable and green mutual funds within the total shareholding of each firm. The results are presented in Model 5 (Table 7). We report that the coefficient of ‘green mutual fund’ is significantly positive, indicating that corporate environmental spending is significantly higher when green mutual funds own a greater proportion of a firm’s shares.

**INSERT Table 7**

*4.5 Robustness tests*

We conduct following robustness tests to examine the stability and reliability of the results. First, we re-estimate hypothesis 2 by dividing the sample into two sub-groups including SOEs and non-SOEs and examine the impact of mutual fund ownership on corporate environmental spending for each sub-group respectively. This is assessed considering that the influence of mutual fund ownership could be stronger in SOEs, given SOEs’ greater access to financial resources for undertaking environmental activities. The results are reported in Models 1-2 of Table 8. We observe that mutual funds positively affect corporate environmental spending in both sub-groups, with this influence pronounced in the SOE group. This is evidenced by the magnitude of the mutual fund coefficient, which is greater for the SOE group (4.578) compared to the non-SOE group (3.438). This result further confirms that mutual fund investment can significantly increase corporate environmental spending in SOEs.

Similarly, we divide the sample into firms located in provinces with a weak legal environment and those firms located in provinces with a strong legal environment to re-estimate hypothesis 3. The results are presented in Models 3-4 of Table 8. We report that a positive relationship exists between mutual fund ownership and corporate environmental spending in each sub-group. This positive impact is pronounced for firms located in provinces with a strong legal environment, with a mutual fund coefficient of 4.537, relative to the estimate recorded for firms operating in regions with a weaker legal environment (3.089). This is consistent with our baseline result.

**INSERT Table 8**

We also examine whether our results are robust to alternative dependent variable specifications. We replace ‘corporate environment spending’ with ‘environmental score’ and ‘environmental policy index’. These variables are collected from the Sustainalytics database, which quantifies corporate environmental orientation. The environmental score variable examines how a company manages environmental performance through its environmental policies, programs, targets, and certifications. The ‘Environmental policy index’ variable measures the extent to which a firm has a strong and detailed environmental policy to guide its environmental-related activities (Graafland and Smid, 2013). The results are recorded in Table 9 (Models 1-2) and display statistical significance, implying the presence of mutual fund investment enhances corporate environmental performance. In Model 3 we replace our dependent variable with the ratio of the environmental spending to total assets (Shen et al. 2019) as increasing environmental spending is challenging for smaller firms. The results are presented in Model 3 of Table 9 and are consistent with our baseline findings.

We also examine the relationship between mutual fund investment and corporate environmental spending while accounting for firms which use one of the big four auditors or otherwise. We propose the presence of big auditors encourage firms to enhance the quality of financial and CSR reporting. These results, recorded in Model 4 of Table 9, are consistent with other studies (Pucheta-Martínez *et al.* 2019). The positive relationship between mutual fund ownership and environmental spending is pronounced for firms that hire one of the big four auditors.

We also assess the impact of grey institutional investors on corporate environmental spending. Grey institutions include securities companies, insurance companies, trust companies, and pension funds. They tend to hold shares without reacting to management actions, often regarded as 'passive' investors (Aggarwal et al., 2015). In addition, as grey institutional investors in China hold a small proportion of shares in their beneficiaries relative to the holdings of mutual funds (Chi et al., 2019), grey investors should have little impact on environmental performance. Model 5 in Table 9 reports findings in line with expectations that grey institutional investment doesn’t influence corporate environmental spending.

**INSERT Table 9**

Lastly, we investigate the impact of qualified foreign institutional investors (QFII) on corporate environmental spending. The Chinese government launched the QFII scheme in 2002, allowing foreign institutional investors to access to Chinese capital markets. Previous studies report that foreign institutional investors, especially QFII from developed economies, enhance the transparency of firm information disclosure and reduce the likelihood of earnings management (Lel, 2019). We propose that QFII are independent and active institutional investors who can greatly encourage firms to fulfil their social and environmental responsibilities. The results are reported in Table 10, and suggest foreign institutional investors positively impact corporate environmental spending, and that this positive influence is pronounced for SOEs and firms operating in provinces with a stronger legal environment. These results support the conjecture that QFII are active institutional investors and display a strong commitment to environmental issues.

**INSERT Table 10**

**5. Conclusions**

This study investigates the impact of mutual fund investment on corporate environmental spending by Chinese firms. We present evidence that mutual fund investment is associated with significantly higher levels of corporate environmental spending. This influence is amplified for state-owned enterprises and for firms from regions with stronger legal environments. We also report that the ‘green’ questions raised by investors during AGMs and the ‘green’ credentials of board members both influence corporate environmental spending. We infer this outcome arises as mutual funds affect the environmental awareness of their beneficiaries. Moreover, we find that mutual funds with green investment objectives have significantly higher corporate environmental spending levels. We re-examine these results using a battery of control variables and robustness exercises. We report that firms with big auditors and qualified foreign institutional investment show a positive influence on their environmental spending. The findings also remain unchanged when we consider firm size, the proportion of green fund investment and replace the dependent variable with alternative measures of environmental performance.

We conclude that many mutual funds clearly value environmental outcomes as well as traditional market metrics. In this role, mutual funds act as ethical investors and play an important role in encouraging greater corporate environmental spending by their beneficiaries. This relationship is shaped by both the transfer of environmental awareness and institutional factors, which moderate this relationship. Through incorporating these factors, a positive association between mutual fund ownership and environmental spending emerges, in contrast with past contributions (Drobetz, et al., 2024).

*5.1 Suggestions for managers and policy makers*

The study has implications for corporate managers and policy makers. For corporate managers, higher environmental spending can have multiple outcomes, altering the firms’ image and performance. Higher environmental spending indicates a firm’s financial commitment to address pollution related issues and engage in environmentally responsible practices. This may enhance corporate reputation, customer loyalty and even result in favourable treatment from regulators and media (Battisti et al., 2023).

Alternatively, more environmental spending may reduce a firm's profitability and future cash flows, potentially placing firms under undue financial strain (Meng and Zhang, 2022). High levels of environmental spending can also be interpreted as a firms’ business model being environmentally impactful. Despite this outcome, ensuring that environmental spending is increased to mitigate the environmental costs of the firm's activities is a positive goal. Subsequently, firms should recruit candidates with ‘green’ competencies, increasing the proportion of board members with green qualifications and professional experience. It is also important for managers to reflect on the green questions raised by investors. Lastly, managers need to be cognisant of investor expectations which vary accordingly to their stated investment objectives and public commitments to achieve environmental goals.

For policy makers we advocate mutual fund investment as a policy tool for enhancing environmental protection. Just as regulatory developments are disseminated through international institutional investors (Aggarwal et al., 2011), we propose mutual fund investment can be a conduit for changing environmental decision making. Currently, Chinese financial regulators promote mutual fund investments to enhance corporate monitoring and governance quality in China. We propose this guidance is augmented to include the benefits of mutual fund ownership for enhancing environmental spending and achieving climate change goals.

*5.2 Future Research*

We encourage further research to identify and overcome the challenges faced by financial market participants in addressing environmental concerns. A primary obstacle is that personal communications and analysis within the investment world are subject to bias (Hirshleifer, 2020), with concerns as to impression management (Chen and Hwang, 2022) and the relevance and accuracy of new metrics to quantify environmental goals (Popescu et al., 2021). Developing the metrics underlying environmental decision making and performance measurement is imperative. We acknowledge that assessing environmental spending maps only part of this challenge. Considering the proportion of total environmental costs, including direct and indirect costs covered by such spending, is critical to explore in future research.

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**Table 1** Variable definitions

|  |  |  |
| --- | --- | --- |
| Variable Type | Variable name | Definition |
| Dependent variable | Environment spending | Natural logarithm of the firm’s environmental spending. A firm’s environmental spending includes its spending on sewage discharge, cleaning, landscaping, greening and environmental protection |
| Main variables | Mutual fund | The proportion of shares held by mutual funds |
| SOEs | A dummy variable equals one if the ultimate controller of a listed firm is state or state agencies and zero otherwise |
| Legal environment | The legal environment index in a province where a listed firm is located. The index is developed by China’s National Economics Research Institute |
| Green questions | The total number of ‘green’ questions that a firm was asked to the total number of questions raised by investors during the firm’s annual general meeting. |
| Green board | The number of board members who have the ‘green’ working experience or an environmentally orientated academic degree.  Green working experience or academic degree is identified through checking the following keywords in the publicly disclosed working and educational background of board members, i.e., environment, ecology, energy, energy saving, green, sustainability, pollution reduction, and biological. |
| Control variables | Society | A firm’s overall society pillar score |
| Governance | A firm’s overall governance pillar score |
| Duality | A dummy variable equals one if a CEO also serves as the chairman and zero otherwise |
| Independence | The proportion of independent directors in the board of directors |
| Board meeting | The number of meetings held by the board of directors annually |
| Managerial ownership | The proportion of total outstanding shares held by managers |
| Z Index | The ratio of the proportion of shareholdings held by the largest shareholders to the proportion of shareholdings held by the second-largest shareholder |
| Stock returns | Annual firm stock returns (with cash dividend reinvested) |
| Tobin Q | The ratio of the market value of common equity divided by the book value of total assets |
| Firm age | The number of years since the establishment of a firm |
| Leverage | The ratio of total liabilities to the company’s total assets |

**Table 2.** Descriptive statistics

**Panel A** Summary statistics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | Mean | SD | Minimum | Maximum |
| Environment spending | 14.925 | 1.614 | 12.903 | 20.147 |
| Mutual fund | 0.052 | 0.051 | 0.010 | 0.469 |
| SOEs | 0.553 | 0.497 | 0.000 | 1.000 |
| Legal environment | 7.710 | 4.498 | 0.448 | 14.854 |
| Green questions (%) | 1.962 | 5.535 | 0.000 | 48.284 |
| Green board | 0.839 | 1.674 | 0.000 | 13.000 |
| Society | 71.539 | 10.654 | 4.880 | 100.000 |
| Governance | 79.434 | 6.964 | 23.870 | 97.330 |
| Duality | 0.178 | 0.383 | 0.000 | 1.000 |
| Independence | 0.371 | 0.055 | 0.200 | 0.750 |
| Board meeting | 9.783 | 4.074 | 1.000 | 40.000 |
| Managerial ownership | 0.064 | 0.147 | 0.000 | 0.822 |
| Z Index | 9.385 | 9.631 | 1.246 | 28.903 |
| Stock returns | 0.039 | 0.497 | -0.706 | 5.107 |
| Tobin Q | 1.639 | 1.468 | 0.067 | 13.429 |
| Firm age | 17.234 | 5.359 | 3.093 | 35.136 |
| Leverage | 0.501 | 0.315 | 0.007 | 2.992 |

**Panel B** The average legal environment score among different provinces in China

|  |  |  |  |
| --- | --- | --- | --- |
| Province | Legal environment score | Province | Legal environment score |
| Zhejiang | 14.854 | Hunan | 3.946 |
| Jiangsu | 13.980 | Henan | 3.805 |
| Beijing | 12.280 | Guangxi | 3.560 |
| Shanghai | 11.742 | Hainan | 3.232 |
| Tianjin | 10.298 | Shanxi | 2.969 |
| Guangdong | 9.769 | Jiangxi | 2.831 |
| Chongqing | 6.893 | Hebei | 2.698 |
| Fujian | 6.801 | Yunnan | 2.599 |
| Anhui | 6.303 | Neimenggu | 2.288 |
| Shandong | 5.208 | Guizhou | 2.222 |
| Sichuan | 5.152 | Gansu | 2.141 |
| Heilongjiang | 4.888 | Xinjiang | 2.006 |
| Liaoning | 4.718 | Ningxia | 1.588 |
| Shaanxi | 4.518 | Qinghai | 1.447 |
| Hubei | 4.120 | Xizang | 0.447 |
| Jilin | 4.044 |  |  |

**Table 3** Main regression

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Model 1 | Model 2 | Model 3 |
| Mutual fund | 3.990\*\*\* | 4.323\*\*\* | 4.442\*\*\* |
|  | (0.585) | (0.465) | (0.750) |
| Mutual fund\*SOEs |  | 3.233\*\*\* |  |
|  |  | (0.415) |  |
| Mutual fund\* Legal environment |  |  | 0.416\*\*\* |
|  |  |  | (0.034) |
| SOEs |  | 0.127 |  |
|  |  | (0.167) |  |
| Legal environment |  |  | 0.021\*\* |
|  |  |  | (0.010) |
| Society | 0.015\*\*\* | 0.015\*\*\* | 0.015\*\*\* |
|  | (0.005) | (0.005) | (0.005) |
| Governance | 0.024\*\*\* | 0.023\*\*\* | 0.023\*\* |
|  | (0.008) | (0.008) | (0.008) |
| Duality | 0.192 | 0.209 | 0.177 |
|  | (0.141) | (0.122) | (0.137) |
| Independence | 1.004 | 1.015 | 0.972 |
|  | (1.119) | (1.125) | (1.108) |
| Board meeting | 0.035\*\*\* | 0.035\*\*\* | 0.036\*\*\* |
|  | (0.009) | (0.009) | (0.010) |
| Managerial ownership | -0.462\*\*\* | -0.345 | -0.532\*\*\* |
|  | (0.123) | (0.216) | (0.127) |
| Z Index | 0.010\*\*\* | 0.009\*\* | 0.010\*\*\* |
|  | (0.003) | (0.003) | (0.003) |
| Stock returns | 0.475\*\*\* | 0.472\*\*\* | 0.471\*\*\* |
|  | (0.034) | (0.031) | (0.034) |
| Tobin Q | -0.458\*\*\* | -0.454\*\*\* | -0.458\*\*\* |
|  | (0.042) | (0.044) | (0.042) |
| Firm age | -0.020\* | -0.021\* | -0.018\* |
|  | (0.010) | (0.010) | (0.010) |
| Leverage | 0.603\*\*\* | 0.589\*\*\* | 0.617\*\*\* |
|  | (0.139) | (0.124) | (0.147) |
| Year FE | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Observations | 6,560 | 6,560 | 6,560 |
| Adjusted R-squared | 0.200 | 0.200 | 0.211 |

Year and industry fixed effects are included in all specifications. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 4**: Channels of mutual fund influence

|  |  |  |  |
| --- | --- | --- | --- |
|  | Model 1 | Model 2 | |
| Variables | Green Question | Green Board | |
| Mutual fund | 3.664\*\*\* | 2.704\*\*\* |
|  | (0.643) | (0.722) |
| Mutual fund\* Green Question | 0.259\*\*\* |  |
|  | (0.076) |  |
| Mutual fund\* Green board |  | 0.715\*\*\* |
|  |  | (0.295) |
| Green Question | 0.016\* |  |
|  | (0.008) |  |
| Green board |  | 0.116\*\*\* |
|  |  | (0.034) |
| Society | 0.014\*\*\* | 0.015\*\*\* |
|  | (0.005) | (0.005) |
| Governance | 0.026\*\*\* | 0.030\*\*\* |
|  | (0.008) | (0.009) |
| Duality | 0.187 | 0.249 |
|  | (0.140) | (0.151) |
| Independence | 0.993 | 0.721 |
|  | (1.136) | (0.942) |
| Board meeting | 0.034\*\*\* | 0.028\*\*\* |
|  | (0.009) | (0.008) |
| Managerial ownership | -0.602\*\*\* | -0.298\*\* |
|  | (0.144) | (0.136) |
| Z Index | 0.010\*\*\* | 0.008\*\* |
|  | (0.003) | (0.003) |
| Stock returns | 0.462\*\*\* | 0.394\*\*\* |
|  | (0.042) | (0.035) |
| Tobin Q | -0.457\*\*\* | -0.385\*\*\* |
|  | (0.041) | (0.035) |
| Firm age | -0.016 | -0.019\*\* |
|  | (0.011) | (0.009) |
| Leverage | 0.613\*\*\* | 1.564\*\*\* |
|  | (0.137) | (0.203) |
| Year FE | Yes | Yes |
| Industry FE | Yes | Yes |
| Observations | 6,560 | 6,560 |
| Adjusted R-squared | 0.180 | 0.186 |

‘Green question’ is identified by checking whether the investor queries on annual general meetings include the following keywords, i.e., green, environmental protection, energy, energy saving, emission reduction, and ecology. ‘Green board’ is recorded by verifying the number of board members who have the ‘green’ working experience or an environmentally orientated academic degree. Green working experience or academic degree is documented through identifying the following keywords within the board members’ background: environment, ecology, energy, energy saving, green, sustainability, pollution reduction, and biological. Year and industry fixed effects are included in all specifications. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The variable definitions are summarized in Table 1.

**Table 5** Endogeneity: Two-stage least squares method (2-SLS)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| Mutual fund | 4.213\*\*\* | 4.236\*\*\* | 4.273\*\*\* | 2.618\* | 2.604\* |
|  | (1.248) | (1.251) | (1.225) | (1.403) | (1.331) |
| Mutual fund\*SOEs |  |  |  | 3.361\*\*\* |  |
|  |  |  |  | (0.676) |  |
| Mutual fund\* Legal environment |  |  |  |  | 0.521\* |
|  |  |  |  | (0.250) |
| Society | 0.014\*\* | 0.014\*\* | 0.014\*\* | 0.014\*\* | 0.014\*\* |
|  | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) |
| Governance | 0.031\*\*\* | 0.031\*\*\* | 0.031\*\*\* | 0.030\*\*\* | 0.031\*\*\* |
|  | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) |
| Duality | 0.250 | 0.250 | 0.250 | 0.264\* | 0.235 |
|  | (0.162) | (0.162) | (0.162) | (0.148) | (0.165) |
| Independence | 0.897 | 0.897 | 0.897 | 0.896 | 0.825 |
|  | (1.022) | (1.021) | (1.022) | (1.019) | (1.027) |
| Board meeting | 0.031\*\*\* | 0.031\*\*\* | 0.031\*\*\* | 0.032\*\*\* | 0.032\*\*\* |
|  | (0.008) | (0.008) | (0.008) | (0.008) | (0.009) |
| Managerial ownership | -0.197 | -0.197 | -0.197 | -0.034 | -0.304 |
|  | (0.177) | (0.177) | (0.177) | (0.333) | (0.195) |
| Z Index | 0.006\* | 0.006\* | 0.006\* | 0.006\* | 0.007\* |
|  | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| Stock returns | 0.389\*\*\* | 0.389\*\*\* | 0.390\*\*\* | 0.388\*\*\* | 0.392\*\*\* |
|  | (0.032) | (0.032) | (0.032) | (0.031) | (0.033) |
| Tobin Q | -0.404\*\*\* | -0.404\*\*\* | -0.404\*\*\* | -0.401\*\*\* | -0.402\*\*\* |
|  | (0.038) | (0.038) | (0.038) | (0.040) | (0.038) |
| Firm age | -0.025\*\* | -0.025\*\* | -0.025\*\* | -0.025\*\* | -0.023\*\* |
|  | (0.008) | (0.008) | (0.008) | (0.009) | (0.008) |
| Leverage | 1.535\*\*\* | 1.535\*\*\* | 1.535\*\*\* | 1.506\*\*\* | 1.541\*\*\* |
|  | (0.243) | (0.243) | (0.243) | (0.234) | (0.242) |
| Year FE and Industry FE | Yes | Yes | Yes | Yes | Yes |
| Sargan statistic test (p-value) (overidentification test of all instruments) | Exactly identified | 0.154 | 0.156 | 0.182 | 0.194 |
| Cragg-Donald (CD) Wald F-statistic | 546.499 | 240.049 | 184.468 | 50.781 | 74.614 |
| Stock and Yogo (2005) ID test for critical values: 10% maximal IV | 19.93 | 18.37 | 11.12 | 9.92 | 9.92 |
| Observations | 4,980 | 4,980 | 4,980 | 4,980 | 4,980 |
| Adjusted R-squared | 0.197 | 0.199 | 0.996 | 0.996 | 0.996 |

Table 5 reports the instrumental variable (IV) regression results. Variable ‘SOEs’ is controlled in Model 4, and variable ‘legal environment’ is controlled in Model 5. The endogenous variable is the mutual fund. The instrumental variables include lagged mutual fund, CSI 300 membership, and industry median levels of the mutual fund. Lagged mutual fund is defined as the proportion of shares held by mutual funds at the time t-2. CSI 300 membership is defined as a dummy variable that equals one if a firm’s stock is included in the CSI 300 index and zero otherwise. Industry median levels of mutual funds refer to the proportion of shares held by mutual funds in the firm's 2-digit China Securities Regulatory Commission (CSRC) coded industry per year. Model 1 includes the instrument variable of lagged mutual funds. Model 2 includes instrument variables of lagged mutual fund and CSI 300 membership. Models 3-5 include instrument variables of lagged mutual fund, CSI 300 membership, and the industry median level of mutual funds. Year and industry fixed effects are included in all specifications. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 6**: Endogeneity: Two-stage least squares method (continued)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Model 1 | Model 2 | |
| Variables | Green Question | Green Board | |
| Mutual fund | 2.680\*\* | 6.441\* |
|  | (1.203) | (3.377) |
| Mutual fund\* Green Question | 4.478\*\* |  |
|  | (1.750) |  |
| Mutual fund\* Green board |  | 4.689\*\*\* |
|  |  | (1.594) |
| Society | 0.019\*\*\* | 0.019\*\*\* |
|  | (0.004) | (0.004) |
| Governance | 0.034\*\*\* | 0.034\*\*\* |
|  | (0.010) | (0.010) |
| Duality | 0.664 | 0.362\* |
|  | (0.492) | (0.175) |
| Independence | 0.267 | 0.947 |
|  | (0.318) | (1.161) |
| Board meeting | 0.011\*\* | 0.021 |
|  | (0.005) | (0.013) |
| Managerial ownership | -0.452\*\*\* | -0.490 |
|  | (0.108) | (0.357) |
| Z Index | 0.003 | 0.003 |
|  | (0.002) | (0.005) |
| Stock returns | 0.417\*\* | 0.375\*\*\* |
|  | (0.182) | (0.076) |
| Tobin Q | -0.862\*\*\* | -0.428\*\*\* |
|  | (0.174) | (0.042) |
| Firm age | -0.039\* | -0.020 |
|  | (0.015) | (0.012) |
| Leverage | 1.592 | 1.424\*\*\* |
|  | (1.212) | (0.466) |
| Year FE | Yes | Yes |
| Industry FE | Yes | Yes |
| Sargan statistic test (p-value) (overidentification test of all instruments) | 0.145 | 0.137 |
| Cragg-Donald (CD) Wald F-statistic | 10.155 | 10.878 |
| Stock and Yogo (2005) ID test for critical values: 10% maximal IV | 9.01 | 9.48 |
| Observations | 4,980 | 4,980 |
| Adjusted R-squared | 0.272 | 0.289 |

Table 6 presents the results for the instrumental variable regression. Variable ‘Green question’ is controlled in Model 1, and variable ‘Green board’ is controlled in Model 2. The instrumental variables include lagged mutual fund, CSI 300 membership, and industry median levels of the mutual fund. Lagged mutual fund is defined as the proportion of shares held by mutual funds at the time t-2. CSI 300 membership is defined as a dummy variable that equals one if a firm’s stock is included in the CSI 300 index and zero otherwise. Industry median levels of mutual funds refer to the proportion of shares held by mutual funds in the firm's 2-digit CSRC coded industry per year. Year and industry fixed effects are included in all specifications. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 7** Additional analysis: green mutual fund investments

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | Model 1  Firms with green fund investment | Model 2  Firms without green fund investment | Model 3  Firms with green fund investment  2SLS | Model 4  Firms without green fund investment  2SLS | Model 5 Green mutual fund investment proportion |
| Mutual fund | 4.223\*\*\* | 3.625\*\*\* | 4.524\*\*\* | 2.723\*\*\* |  |
|  | (0.585) | (0.423) | (0.442) | (0.323) |  |
| Green mutual fund |  |  |  |  | 3.517\*\*\* |
|  |  |  |  |  | (0.893) |
| Society | 0.013\* | 0.016\*\* | 0.006\*\* | 0.006\*\*\* | 0.017\*\* |
|  | (0.006) | (0.006) | (0.002) | (0.001) | (0.007) |
| Governance | 0.023\* | 0.025\*\* | 0.001 | 0.005\* | 0.026\*\* |
|  | (0.012) | (0.010) | (0.004) | (0.002) | (0.010) |
| Duality | 0.258 | 0.240 | 0.002 | 0.049 | 0.234 |
|  | (0.152) | (0.166) | (0.083) | (0.066) | (0.164) |
| Independence | 0.217 | 0.735 | 0.492 | 0.030 | 0.700 |
|  | (1.063) | (1.094) | (0.300) | (0.293) | (1.119) |
| Board meeting | 0.017 | 0.029\*\* | 0.001 | 0.003 | 0.029\*\* |
|  | (0.012) | (0.012) | (0.006) | (0.006) | (0.013) |
| Managerial ownership | -0.548\*\* | -0.768\*\*\* | -0.120 | -0.199\* | -0.733\*\*\* |
|  | (0.230) | (0.167) | (0.148) | (0.095) | (0.180) |
| Z Index | 0.004 | 0.008\*\* | 0.004\*\* | 0.002 | 0.008\*\* |
|  | (0.004) | (0.003) | (0.002) | (0.002) | (0.003) |
| Stock returns | 0.698\*\*\* | 0.482\*\*\* | 0.252\*\*\* | 0.253\*\*\* | 0.479\*\*\* |
|  | (0.049) | (0.044) | (0.060) | (0.065) | (0.043) |
| Tobin Q | -0.398\*\*\* | -0.454\*\*\* | -0.052 | -0.029 | -0.452\*\*\* |
|  | (0.033) | (0.045) | (0.032) | (0.020) | (0.044) |
| Firm age | -0.019 | -0.017 | -0.003 | -0.001 | -0.017 |
|  | (0.014) | (0.015) | (0.004) | (0.003) | (0.015) |
| Leverage | 2.093\*\*\* | 0.761\*\*\* | 0.133 | 0.190\*\* | 0.757\*\*\* |
|  | (0.336) | (0.166) | (0.142) | (0.083) | (0.167) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes |
| Sargan statistic test (p-value) (overidentification test of all instruments) |  |  | 0.304 | 0.421 |  |
| Cragg-Donald (CD) Wald F-statistic |  |  | 114.121 | 27.24 |  |
| Stock and Yogo (2005) ID test for critical values: 10% maximal IV |  |  | 31.50 | 11.29 |  |
| Observations | 1,722 | 4,838 | 1,722 | 4,838 | 1,722 |
| Adjusted R-squared | 0.196 | 0.181 | 0.962 | 0.972 | 0.179 |

Green mutual funds include funds with the objectives of environmental protection, energy saving, adoption of clean energy, reduction of pollution and carbon emission. Models 3-4 reports the instrumental variable (IV) regression results, and three instrumental variables are included i.e., lagged mutual fund ownership, the CSI 300 index, and industry mean mutual fund holdings. In Model 5, green mutual fund is the percentage of shareholding coming from sustainable and green mutual funds in total shareholding for each firm. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 8** Robustness tests: sub-group analysis by state ownership and legal environment

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | Model 1  non-SOEs | Model 2  SOEs | Model 3  Weak legal environment | Model 4  Strong legal environment |
| Mutual fund | 3.438\*\*\* | 4.578\*\*\* | 3.089\*\* | 4.537\*\*\* |
|  | (0.462) | (0.696) | (1.319) | (0.346) |
| Society | 0.022\*\*\* | 0.009\* | 0.017 | 0.013\*\* |
|  | (0.007) | (0.005) | (0.010) | (0.004) |
| Governance | 0.010 | 0.041\*\* | 0.033\*\*\* | 0.020 |
|  | (0.007) | (0.017) | (0.011) | (0.014) |
| Duality | 0.162 | 0.235 | 0.230\*\* | 0.152 |
|  | (0.096) | (0.253) | (0.103) | (0.189) |
| Independence | 1.729\* | 0.863 | 0.957 | 1.546 |
|  | (0.905) | (1.275) | (0.966) | (1.309) |
| Board meeting | 0.058\*\*\* | 0.012 | 0.037\*\* | 0.021\*\*\* |
|  | (0.015) | (0.013) | (0.015) | (0.005) |
| Managerial ownership | -0.518\*\*\* | -1.684\*\* | -0.136 | -0.962\*\*\* |
|  | (0.096) | (0.779) | (0.176) | (0.190) |
| Z Index | 0.011\* | 0.006 | -0.005 | 0.019\*\*\* |
|  | (0.005) | (0.004) | (0.005) | (0.004) |
| Stock returns | 0.294\*\*\* | 0.660\*\*\* | 0.348\*\*\* | 0.560\*\*\* |
|  | (0.065) | (0.104) | (0.060) | (0.068) |
| Tobin Q | -0.364\*\*\* | -0.518\*\*\* | -0.418\*\*\* | -0.439\*\*\* |
|  | (0.053) | (0.029) | (0.032) | (0.043) |
| Firm age | -0.022\*\* | -0.022 | -0.046\*\*\* | -0.005 |
|  | (0.009) | (0.016) | (0.012) | (0.009) |
| Leverage | 0.314\*\*\* | 1.313\*\*\* | 0.377\*\*\* | 1.192\*\*\* |
|  | (0.067) | (0.271) | (0.124) | (0.303) |
| Year FE | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes |
| Observations | 2,933 | 3,627 | 2,826 | 3,734 |
| Adjusted R-squared | 0.123 | 0.225 | 0.185 | 0.197 |

Year and industry fixed effects are included in all specifications. SOE is a dummy variable that equals one if the ultimate controller of a listed firm is state or state agencies and zero otherwise. The legal environment index is developed by China’s National Economics Research Institute. The classification of strong and weak legal environment sub-groups is based on the sample median value of this variable. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 9** Robustness tests: Alternative dependent variables, grey investors and big auditors.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| Variables | Environmental Score | Environmental policy index | Scaled by total assets | Big auditors | Grey investors |
| Mutual fund | 1.045\*\*\* | 3.900\*\*\* | 0.567\*\*\* | 3.896\*\*\* |  |
|  | (0.162) | (1.094) | (0.165) | (0.398) |  |
| Mutual fund\*Big auditor |  |  |  | 4.303\*\*\* |  |
|  |  |  |  | (0.683) |  |
| Big auditor |  |  |  | 0.592\*\*\* |  |
|  |  |  |  | (0.192) |  |
| Grey investors |  |  |  |  | -0.264 |
|  |  |  |  |  | (2.200) |
| Society | 0.003\*\* | 0.014\*\* | 0.005\*\* | 0.015\*\*\* | 0.018\*\*\* |
|  | (0.001) | (0.004) | (0.002) | (0.005) | (0.005) |
| Governance | 0.004\* | 0.004 | 0.002 | 0.023\*\* | 0.026\*\*\* |
|  | (0.002) | (0.002) | (0.004) | (0.008) | (0.008) |
| Duality | -0.058\*\* | -0.324\*\* | -0.323\*\*\* | 0.186 | 0.205 |
|  | (0.018) | (0.130) | (0.076) | (0.141) | (0.140) |
| Independence | -0.157 | -0.036 | -0.668 | -1.089 | -0.993 |
|  | (0.260) | (0.945) | (0.555) | (1.100) | (1.086) |
| Board meeting | 0.002 | 0.030\*\*\* | 0.017\*\*\* | 0.034\*\*\* | 0.038\*\*\* |
|  | (0.002) | (0.006) | (0.004) | (0.009) | (0.010) |
| Managerial ownership | -0.668\*\* | -2.464 | -0.418\*\*\* | -0.386\*\*\* | -0.490\*\*\* |
|  | (0.241) | (2.271) | (0.099) | (0.127) | (0.131) |
| Z Index | -0.001 | 0.002 | -0.001 | 0.010\*\*\* | 0.009\*\*\* |
|  | (0.001) | (0.002) | (0.004) | (0.003) | (0.003) |
| Stock returns | 0.007 | 0.033 | 0.003 | 0.457\*\*\* | 0.450\*\*\* |
|  | (0.022) | (0.050) | (0.103) | (0.034) | (0.036) |
| Tobin Q | -0.045 | -0.258\*\*\* | -0.040 | -0.448\*\*\* | -0.448\*\*\* |
|  | (0.025) | (0.044) | (0.069) | (0.044) | (0.042) |
| Firm age | -0.006 | -0.017 | -0.015\*\* | -0.019\*\* | -0.018 |
|  | (0.005) | (0.012) | (0.007) | (0.008) | (0.011) |
| Leverage | 0.029 | 0.227 | 0.032 | 0.587\*\*\* | 0.599\*\*\* |
|  | (0.113) | (0.201) | (0.078) | (0.130) | (0.143) |
| Year FE | Yes | Yes | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes | Yes | Yes |
| Observations | 225 | 224 | 6,560 | 6,560 | 6,560 |
| Adjusted R-squared | 0.352 | 0.436 | 0.181 | 0.186 | 0.173 |

In Model 1, environment score refers to the environmental management score (0-100 points) compiled by the Sustainalytics database. The score assesses how a company manages its environmental performance through environmental policies, programs, targets, certifications, etc., based on company operations, suppliers, contractors, and products and services. In Model 2, environmental policy is an index that measures the extent to which a firm has a strong and detailed environmental policy to guides its environmental activities (Graafland and Smid, 2013). In Model 3, the dependent variable is replaced with the environmental spending to total assets. In Model 4, ‘Big auditor’ is a dummy variable, which equals one if a firm’s annual report is audited by one of the top four accounting firms and zero otherwise. In Model 5, grey investors refer to the number of shares held by securities firms, insurance firms, pension funds, and trusts firms to the total firm outstanding shares. Year and industry fixed effects are included in all specifications. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Table 10** Robustness tests: Qualified foreign institutional investors (QFII)

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | Model 1 | Model 2 | Model 3 |
| QFII | 6.801\*\* | 7.964\*\*\* | 2.545\*\*\* |
|  | (2.530) | (2.296) | (5.951) |
| QFII\*SOEs |  | 2.683\* |  |
|  |  | (1.161) |  |
| QFII\* Legal environment |  |  | 3.180\*\*\* |
|  |  |  | (0.317) |
| SOEs |  | 0.008\*\* |  |
|  |  | (0.003) |  |
| Legal environment |  |  | 0.043\*\*\* |
|  |  |  | (0.008) |
| Society | 0.003\* | 0.003\* | 0.003\* |
|  | (0.001) | (0.001) | (0.001) |
| Governance | 0.026\*\*\* | 0.025\*\*\* | 0.025\*\*\* |
|  | (0.008) | (0.008) | (0.008) |
| Duality | 0.153 | 0.142 | 0.117 |
|  | (0.126) | (0.115) | (0.109) |
| Independence | -0.030 | -0.063 | -0.159 |
|  | (0.787) | (0.805) | (0.730) |
| Board meeting | 0.038\*\*\* | 0.039\*\*\* | 0.038\*\*\* |
|  | (0.010) | (0.009) | (0.010) |
| Managerial ownership | -0.444 | -0.561 | -0.547 |
|  | (0.460) | (0.370) | (0.477) |
| Z Index | 0.009\*\* | 0.010\*\*\* | 0.009\*\* |
|  | (0.003) | (0.003) | (0.003) |
| Stock returns | 0.232\*\*\* | 0.238\*\*\* | 0.229\*\*\* |
|  | (0.060) | (0.060) | (0.058) |
| Tobin Q | -0.291\*\*\* | -0.285\*\*\* | -0.286\*\*\* |
|  | (0.030) | (0.026) | (0.028) |
| Firm age | -0.001 | -0.001 | -0.003 |
|  | (0.020) | (0.020) | (0.018) |
| Leverage | 1.077\*\*\* | 1.122\*\*\* | 1.174\*\*\* |
|  | (0.183) | (0.218) | (0.176) |
| Year FE | Yes | Yes | Yes |
| Industry FE | Yes | Yes | Yes |
| Observations | 6,560 | 6,560 | 6,560 |
| Adjusted R-squared | 0.178 | 0.182 | 0.182 |

QFII refers to the total shares held by the qualified foreign institutional investors to the firm total outstanding shares. Year and industry fixed effects are included in all specifications. Robust standard errors, clustered at the industry level, are reported in parentheses. \*, \*\*, and \*\*\* represent significance at the 0.10, 0.05, and 0.01 levels, respectively. The definitions of the variables are summarized in Table 1.

**Appendix 1.** Past studies examining ESG performance and institutional investment

|  |  |  |  |
| --- | --- | --- | --- |
| **Past Assessments using CSR/ESG Indices** | | | |
| Authors | Area | Institutional investors (II) | Relationship: investment and ESG/CRS indices |
| Alda, 2018. | UK | Domestic equity/pension funds | ‘+’ve relationship |
| Aluchna et al 2022. | Poland | II | ‘-’ve relationship |
| Cheng et al., 2022. | North America | II | ‘-’ve relationship |
| Erhemjamts and Haung, 2019. | USA | II | ‘+’ve relationship for long term investors. |
| Harjoto et al., 2017. | USA | II | indeterminant relationship |
| Jia et al., 2022. | China | II | ‘+’ve relationship |
| Li et al., 2021. | USA | Mutual funds | ‘+’ve relationship |
| McGuniness et al., 2017. | International | Foreign II | ‘+’ve relationship |
| Nofsinger et al., 2019. | USA | II | indeterminant relationship |
| Utza et al., 2015. | USA | Mutual funds | ‘+’ve relationship |
| Wang et al 2023. | China | II | ‘+’ve relationship |
| Yahia et al., 2023. | International | Foreign II | ‘+’ve relationship |
| Yan et al., 2021. | International | Green II. | ‘+’ve relationship |
| **Past Assessments using alternative metrics** | | | |
| Authors | Area | Institutional investors (II) | Metrics, links with investment, relationship. |
| Choy et al., 2023. | International | Mutual funds | Social capital.  ‘+’ve relationship |
| Drobetz et al., 2024. | International | II | Corporate environmental spending.  ‘-’ve relationship’ |
| García-Sánchez et al., 2020. | International | International II | Firms’ sustainability reports.  ‘+’ve relationship |
| Jiang et al., 2022. | China | II | Corporate site visits by II ‘+’ve relationship |
| Matallín-Salez et al., 2019. | International | Mutual funds | Voluntary corporate social performance. Indeterminant relationship. |
| McCahery et al., 2022. | USA | Private and venture capital | Using interview data.  ‘+’ve relationship. |
| Raghunandan and Rajgopal, 2022. | USA | Mutual funds | Compliance violations.  ‘-’ve relationship |
| Wang and Chen, 2017. | China | Foreign II | Sustainability reports  ‘+’ve relationship |
| Xu et al., 2023. | China | II | Patent data  ‘+’ve relationship |

**Appendix 2.** Correlation matrix

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| (1) Mutual fund | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (2) SOEs | -0.015 | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (3) Legal environment | 0.009 | -0.224 | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |  |
| (4) Green questions | -0.021 | -0.241 | 0.132 | 1.000 |  |  |  |  |  |  |  |  |  |  |  |  |
| (5) Green board | -0.032 | 0.075 | 0.008 | 0.024 | 1.000 |  |  |  |  |  |  |  |  |  |  |  |
| (6) Society | 0.123 | -0.070 | 0.094 | 0.038 | 0.015 | 1.000 |  |  |  |  |  |  |  |  |  |  |
| (7) Governance | 0.104 | 0.178 | 0.035 | -0.084 | -0.003 | 0.079 | 1.000 |  |  |  |  |  |  |  |  |  |
| (8) Duality | 0.029 | -0.238 | 0.083 | 0.060 | -0.037 | 0.003 | -0.046 | 1.000 |  |  |  |  |  |  |  |  |
| (9) Independence | 0.017 | -0.011 | 0.008 | -0.008 | -0.047 | 0.010 | 0.135 | 0.097 | 1.000 |  |  |  |  |  |  |  |
| (10) Board meeting | 0.020 | -0.059 | -0.010 | 0.022 | 0.067 | 0.062 | -0.100 | 0.034 | 0.037 | 1.000 |  |  |  |  |  |  |
| (11) Managerial ownership | 0.009 | -0.457 | 0.174 | 0.244 | -0.055 | 0.091 | -0.020 | 0.183 | 0.047 | -0.001 | 1.000 |  |  |  |  |  |
| (12) Z index | -0.045 | 0.241 | -0.087 | -0.102 | -0.034 | -0.067 | 0.042 | -0.066 | 0.019 | -0.086 | -0.177 | 1.000 |  |  |  |  |
| (13) Stock returns | 0.152 | -0.043 | 0.033 | 0.029 | -0.013 | -0.056 | -0.014 | 0.027 | 0.004 | 0.019 | 0.008 | 0.003 | 1.000 |  |  |  |
| (14) Tobin Q | 0.120 | -0.226 | 0.036 | 0.034 | -0.091 | -0.094 | -0.068 | 0.081 | 0.032 | -0.053 | 0.147 | -0.103 | 0.283 | 1.000 |  |  |
| (15) Firm age | -0.039 | 0.151 | -0.099 | -0.203 | 0.034 | 0.005 | -0.109 | -0.057 | -0.022 | 0.091 | -0.242 | -0.020 | -0.056 | 0.001 | 1.000 |  |
| (16) Leverage | -0.029 | 0.210 | -0.092 | -0.078 | 0.076 | -0.021 | -0.160 | -0.074 | -0.013 | 0.125 | -0.197 | 0.065 | -0.005 | -0.276 | 0.091 | 1.000 |

1. Appendix 1 presents past studies that examine ESG performance and institutional investment. [↑](#footnote-ref-1)
2. Some of these expense items are found in the notes to the ‘general and administrative expenses’ within corporate annual reports. [↑](#footnote-ref-2)
3. A correlation matrix is presented in the Appendix 2. The correlation coefficients among all variables are less than 0.46, indicating that multicollinearity is not a concern for our analysis. [↑](#footnote-ref-3)
4. The dependent variable in the second stage is corporate environmental spending. For brevity, the standalone coefficients for the interaction variables in the second stage are controlled but not reported. These results are available upon request. [↑](#footnote-ref-4)
5. The CSI 300 is a capitalization-weighted for the top 300 stocks of the Shanghai Stock Exchange and the Shenzhen Stock Exchange. CSI 300 index is defined as a dummy variable that equals one if a firm’s stock is included in the CSI 300 index and zero otherwise. [↑](#footnote-ref-5)
6. For brevity, the first-stage regression results in Tables 5-6 are available upon request. All three instruments are positively and significantly related to the mutual fund ownership at the 1% level. [↑](#footnote-ref-6)