The mediating role of analyst coverage in translating climate policy into investor sentiment

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Abstract

This study investigates the impact of the Low Carbon City Pilot (LCCP) policy on investor sentiment, focusing on the mediation effect of financial analyst coverage. The findings demonstrate that the LCCP policy significantly increases investor sentiment for firms located in designated pilot cities, with effects intensifying in firms that exhibit greater transparency, operate in lower-pollution industries, and are located in Eastern regions of China. In addition, financial analysts play a crucial role in amplifying the policy's positive impact by reducing information asymmetry and mitigating regulatory uncertainty. The results highlight the potential of environmental policies not only to advance sustainability goals but also to generate positive externalities, such as improved investor sentiment. The findings provide key implications for policymakers, investors, and corporate managers aiming to align financial performance with sustainability objectives.

Keyword: Environmental Regulation; Financial Analyst Coverage; Low Carbon City Pilot (LCCP) Policy; Investor Sentiment

1. Introduction

Climate change presents significant challenges to ecosystems, biodiversity, and livelihoods. Since 2010, the Chinese government has implemented a Low Carbon City Pilot (LCCP) policy to combat climate change by promoting a low-carbon economy. Although this policy has been shown to reduce energy consumption, its economic effects have not been fully explored. In this paper, we examine the impact of the LCCP policy from the perspective of individual participants in the capital market and identify a positive causal effect of the LCCP policy on investor sentiment.

China is the world's largest contributor to greenhouse gases emissions, responsible for 25.80% of global emissions in 2020,[1] and it is also the most populous country (Huang et al., 2021; Ritchie, Rosado, & Roser, 2023). The Chinese government prioritizes tackling climate change and advancing the development of green, low-carbon cities. In 2010, the National Development and Reform Commission (NDRC) released the "Notice on the Pilot of Low-carbon Provinces and Low-carbon Cities," initiating pilot projects in five provinces and eight cities to explore the construction of low-carbon cities.

There has been extensive research on the benefits of the LCCP policy and its broader implications for firm environmental and financial outcomes. For instance, some scholars have found that the LCCP policy can serve as an environmental intervention to improve firm-level carbon reduction performance (Chen, Mao, & Sun, 2022; Yang, Jahanger, & Hossain, 2023) and enhance carbon emission efficiency (Yu & Zhang, 2021). Liu et al. (2023) also investigate the effects of the LCCP policy on investment strategies, particularly in regard to green

[1] Greenhouse gas emissions consist of carbon dioxide, methane, and nitrous oxide from all sources, including land-use changes (for more information, visit: https://ourworldindata.org/co2-and-greenhouse-gas-emissions#co2-and-greenhouse-gas-emissions-country-profiles).

innovation. They find that firms covered by the LCCP policy engage in more green innovation activities than those not covered, following implementation of the policy. Moreover, Wang et al. (2023) provide evidence that firms may adopt front-end governance or end-of-pipe treatments to reduce carbon emissions, and that this policy can significantly increase the labour demand of firms in pilot regions by guiding or forcing enterprises to change their production processes. In addition, Huang et al. (2021) find that the LCCP policy is significantly correlated with firm total risk, systematic risk, and idiosyncratic risk, especially for firms with greater changes of investment in fixed assets and R&D, and for those in provinces with stronger legal enforcement. However, the impact of the LCCP policy on individual participants in the capital market remains relatively unexplored. This is particularly important given the growing interest in climate change and the potential role of climate-related policies in facilitating the low-carbon transformation.

Government environmental regulations can influence investor behaviour at the firm level. Some researchers provide evidence that investors prefer firms that adopt stringent environmental standards, leading to higher market valuations (Dowell, Hart, & Yeung, 2000). They suggest that firms can reduce pollution through changes in their production processes rather than by incurring direct costs, and that adhering to high environmental standards can bring additional benefits such as improved employee morale and productivity. In recent years, a growing number of investors have been considering environmental issues, and in particular climate change, when making investment decisions. Some scholars study government climate policy and find that investors choose and reward firms demonstrating climate responsibility, engaging in future-oriented, strategic activities geared towards the transition to a low-carbon economy (Ramelli et al., 2021; Ardia et al., 2023). However, other scholars argue that it is more cost-effective for companies to operate in regions with lenient environmental regulations, as

stricter regulations imply fines, liabilities, and potential administrative or legal actions against polluters (Stewart, 1992; Ramiah, Martin, & Moosa, 2013; Liu et al., 2022). They also state that these regulations impact productivity by requiring firms to allocate resources to non-productive activities such as environmental audits, waste management, and legal proceedings. Therefore, the relationship between environmental regulation and investor sentiment is still an open empirical question (Dowell, Hart, & Yeung, 2000; Ramiah, Martin, & Moosa, 2013). This study aims to contribute to this gap by analysing whether the LCCP policy increases the attractiveness of firms. Specifically, we investigate the relationship between the implementation of the LCCP policy and firm-level investor sentiment.

Analyst coverage can serve as a critical mechanism through which the LCCP policy influences investor sentiment. Financial analysts play an important role in reducing information asymmetry by interpreting and disseminating information, particularly when regulatory changes introduce uncertainty regarding firms' operations and future performance (Hope, 2003; Beyer et al., 2010; Yu, 2010; Ellul & Panavides, 2018). Especially, financial analysts can help investors better understand the long-term implications of environmental regulations (Ioannou & Serafeim, 2015). By providing insights into the potential impacts of the LCCP policy, analysts enable investors to make more informed decisions, thereby shaping investor sentiment. In addition, star analysts, recognized for their expertise and credibility, can intensify this effect (Xu et al., 2013; Harrison et al., 2018). Their coverage typically attracts greater market attention, improving investor confidence and further amplifying the positive influence of the LCCP policy on investor sentiment.

To achieve our research objectives, we construct a panel data sample of 11,731 Chinese public firm-year observations over the period 2007-2021 and use a difference-in-differences

specification. We compile our data from several sources. We retrieve firm-level financial data from the China Stock Market & Accounting Research Database (CSMAR). In line with Rhodes-Kropf, Robinson, and Viswanathan (2005) and Huang et al. (2021), we calculate investor sentiment towards firms using their market-to-book ratio, Tobin's Q, firm size, leverage, and return on assets. The CSMAR database also provides detailed analyst coverage data, including both the number of analysts tracking each firm and the number of reports issued. Moreover, we manually collect information related to star analysts from New Fortune's annual awards.

Our tests employ the staggered implementation of the LCCP policy by Chinese cities since 2010, which limits carbon emissions in various aspects. The setting is highly appealing from an empirical analysis standpoint for two reasons. First, the motivation behind introducing the LCCP policy centres on the Chinese government's determination to combat climate change and reduce energy consumption. This policy was not introduced with the primary intention of increasing investor sentiment; any potential effect on investor sentiment is likely to be an unintended consequence. Second, the staggered implementation of LCCP policy across cities enables us to identify its effect on investor sentiment in a difference-in-differences framework. Because multiple exogenous shocks affect different firms at different points in time, we can avoid a common identification challenge faced by studies with a single shock: the potential biases and noise coinciding with the shock that directly affect the dependent variable to be explained.

Our empirical analysis begins by examining the impact of the LCCP policy on investor sentiment and assessing whether the introduction of these policies significantly influences investor preferences. We proxy investor sentiment using the method of Rhodes-Kropf,

Robinson, and Viswanathan (2005) and Huang et al. (2021), which decomposes the market-to-book ratio into fundamental and non-fundamental components. Specifically, we estimate firm-level misvaluation by conducting cross-sectional regressions of the market-to-book ratio on key firm characteristics, including *SIZE*, *LEV*, and *ROA*. The resulting residuals capture the portion of the market-to-book ratio not explained by these fundamental variables, which serves as a proxy for misvaluation. Positive residuals reflect market overvaluation, suggesting increased investor sentiment, while negative residuals indicate undervaluation, associated with decreased investor sentiment. The results indicate a significant increase in investor sentiment among firms affected by the LCCP policy, a finding that remains robust even after controlling for a comprehensive set of firm-level covariates, as well as year and firm fixed effects. Economically, the implementation of the LCCP policy corresponds to an increase in investor sentiment by at least 15.50% of the standard deviation for both sentiment measures. Furthermore, our analysis finds no evidence of pre-existing trends, supporting the parallel trends assumption and mitigating concerns about potential measurement errors. Upon using a propensity score matching (PSM) approach combined with a difference-in-differences (DiD) analysis, the effect of the LCCP policy on investor sentiment becomes even more pronounced, indicating a stronger influence within the matched sample. In addition, we conduct permutation tests to confirm that our findings are not attributable to random chance, further supporting the robustness of my result.

Next, we investigate the mechanisms through which investor sentiment increases following the implementation of the LCCP policy. Our findings provide evidence consistent with the hypothesis that investor attention intensifies after the enactment of the LCCP policy in affected cities. A key channel driving this relationship is the role of financial analysts, whose coverage becomes increasingly critical in reducing information asymmetry, particularly after the

adoption of new environmental regulations. The introduction of the LCCP policy likely increases uncertainty for investors due to its implications for firm operations and compliance costs (Dechezleprêtre & Sato, 2017; Teeter & Sandberg, 2017). In response, analyst coverage tends to increase as analysts work to interpret and disseminate the potential impacts of these regulations on firm performance. This increased analyst coverage not only boosts the visibility of firms affected by the LCCP policy but also serves as a crucial intermediary, amplifying the positive effect of the policy on investor sentiment.

In the cross-sectional analysis, we focus on three key dimensions to assess how the LCCP policy influences investor sentiment across different firm characteristics and contexts. First, we examine information transparency, where we classify firms based on their earnings management. Firms with higher transparency show a stronger positive response in investor sentiment after the implementation of the LCCP policy. This indicates that when firms engage in less manipulation and provide more reliable financial information, investors are more likely to respond favourably to policy changes. Next, we explore industry pollution levels, categorizing firms into high- and low-pollution industries. Firms in lower-pollution industries experience a stronger positive reaction in investor sentiment, as these industries are more aligned with sustainability goals, face fewer environmental lawsuits, and are seen as less vulnerable to the risks associated with stringent environmental regulations. Third, we analyse geographic location, comparing firms in Eastern China with those in other areas. The results show that firms in Eastern regions, which are more economically advanced and better integrated with global markets, experience a more significant increase in investor sentiment following the LCCP policy. This regional difference highlights the role of local infrastructure and economic development in shaping the externalities of environmental policies.

Our findings contribute to the growing body of literature on sustainable finance and offer insights for firms, investors, and policymakers. Understanding the relationship between the LCCP policy and investor sentiment is essential for several reasons. First, it can help firms determine the potential benefits of participating in and initiating projects under the LCCP policy in terms of increasing their attractiveness to individual participants in the capital market. Second, it can inform investors about the potential risks and rewards associated with investing in firms covered by the LCCP policy. Finally, it can provide guidance to policymakers and regulators as they develop frameworks and incentives to encourage the growth of sustainable finance.

2. Literature review and hypothesis development

2.1 The shift towards sustainable finance

The increasing awareness of environmental issues and the push for sustainable practices have significantly impacted investment strategies across various sectors. Investors are progressively aligning their portfolios with firms exhibiting greater environmental conscientiousness, driven by regulatory changes, societal expectations, and the potential for long-term financial performance.

Regulatory frameworks and policies have played a crucial role in directing investors toward environmentally sustainable firms. For instance, the implementation of frameworks such as the European Union's Sustainable Finance Disclosure Regulation (SFDR) highlights the rising importance of sustainability in investment practices. According to Barko, Cremers, and Renneboog (2022), regulatory pressures and government incentives are significant drivers for investors to consider environmental factors in their decision-making process. Albuquerque,

Koskinen, and Zhang (2019) also argue that firms with strong environmental practices are less likely to face environmental liabilities, regulatory fines, and reputational damage. Therefore, investing in environmentally sustainable firms can reduce overall portfolio risk, making such investments attractive to risk-averse investors.

Moreover, investors are increasingly motivated by social and ethical considerations. Eccles, Ioannou, and Serafeim (2014) find that socially responsible investors are drawn to firms with strong environmental, social, and governance (ESG) profiles due to ethical imperatives and the desire to support sustainable development. This trend is particularly evident among institutional investors, who face pressure from stakeholders to integrate ESG criteria into their investment strategies. As a result, firms with higher environmental profiles often enjoy better market valuations and, presumably, more favourable investor perceptions. According to Flammer (2015), companies that adopt eco-friendly practices tend to receive positive assessments from analysts and investors, leading to higher stock prices and lower capital costs. This market response is driven by the perception that sustainable firms are better positioned for long-term success and resilience.

In addition, the potential for improved financial performance and risk management also drives investor interest in environmentally responsible firms. Some researchers provide evidence that firms with substantial environmental practices often exhibit higher financial performance and lower risk profiles (Friede, Busch, & Bassen, 2015). This is attributed to better resource management, regulatory compliance, and reputational benefits, which contribute to long-term value creation. Therefore, portfolios incorporating firms with high environmental profiles can achieve competitive returns (Clark, Feiner, & Viehs, 2015). This indicates that sustainable

investing does not necessarily compromise financial returns, challenging the traditional notion that ethical investments yield lower profits.

2.2 Government environmental regulation and investor sentiment

Environmental regulations are designed to mitigate environmental impacts and promote sustainability. These regulations can significantly influence investor behaviour by providing clarity and direction on environmental standards that firms must follow. For instance, Krueger, Sautner, and Starks (2020) indicate that investors increasingly factor climate-related risks and opportunities into their investment decisions. Firms that align their operations with the goals of the Paris Agreement tend to see increased investor confidence and attract more capital. Moreover, the EU Emissions Trading System (ETS) is another example of how environmental regulation impacts investor behaviour. The ETS, which sets a cap on total emissions and allows for trading of emission allowances, has led to increased transparency and accountability among firms. Bushnell, Chong, and Mansur (2013) demonstrate that firms participating in the ETS tend to receive positive investor attention, as the system provides a clear framework for managing and reducing emissions. In contrast, the Kyoto Protocol, an international agreement aimed at reducing greenhouse gas emissions, led to mixed investor reactions. Griffin, Lont, and Sun (2017) suggest that while some firms benefited from the regulatory clarity provided by the protocol, others faced increased costs and market uncertainty, leading to negative investor sentiment.

Gadenne, Kennedy, and McKeiver (2009) state that legislation does result in general environmental awareness, and that corporations are then willing to change their business processes and environmental strategies. For instance, government mandates on environmental disclosure require firms to report on their environmental impact and sustainability practices.

These disclosures can significantly improve investor attention. Clarkson et al. (2008) find that firms with better environmental performance and disclosure attract more institutional investors. Moreover, compliance with environmental regulations signals to investors that a firm is committed to sustainable practices and is managing its environmental risks effectively. Many scholars provide evidence that firms who improve their environmental performance experience positive financial performance and market reactions (Hart & Ahuja, 1996; Endrikat, 2016). This is because compliance with stringent environmental standards reduces the risk of regulatory penalties and reputational damage, thereby increasing investor confidence. In addition, Eccles, Ioannou, and Serafeim (2014) demonstrate that companies with high sustainability practices, including stringent environmental standards, enjoy higher valuations and better financial performance, since these firms are more likely (i) to have established processes for stakeholder engagement, (ii) to be more long-term oriented, and (iii) to exhibit higher measurement and disclosure of nonfinancial information. Moreover, investors will have more confidence for firms adhering to high environmental standards, since those firms can benefit from improved employee satisfaction, productivity, and subsequently investment returns (Edmans, 2011; Delmas & Pekovic, 2013).

Furthermore, green certification, driven by environmental regulations, can significantly affect investor perceptions. For instance, firms that achieve certifications like LEED (Leadership in Energy and Environmental Design) often see a boost in investor confidence (Eichholtz, Kok, & Quigley, 2010). Eichholtz, Kok, and Quigley (2010) further demonstrate that green-certified buildings are associated with higher occupancy rates and rental income, which in turn attract more investment. In addition, institutional investors, such as pension funds and insurance companies, are increasingly prioritizing environmental sustainability in their investment strategies. Amel-Zadeh and Serafeim (2018) provide evidence that environmental, social, and

governance (ESG) factors, often influenced by regulatory frameworks, are becoming central to institutional investment decisions. This shift reflects the recognition that environmentally responsible firms are better positioned for long-term success.

However, government environmental regulations can impose significant compliance costs on firms, which may affect their financial performance and investor confidence. Dechezleprêtre and Sato (2017) indicate that environmental regulations can lead to adverse effects on trade, productivity, and operational costs, which may caution investors concerned about short-term profitability. Gadenne, Kennedy, and McKeiver (2009) also indicate that corporations have little awareness of the benefits that might arise from cost reductions to their environmentally friendly practices. Greenstone, List, and Syverson (2012) demonstrate that stringent environmental regulations can lead to significant compliance costs, negatively impacting firm profitability and investor perception. Furthermore, some researchers indicate that strict environmental regulations can reduce productivity by requiring firms to allocate resources to non-productive activities, which can reduce their attractiveness to investors. This is because firms must manage higher pollution abatement costs and divert resources to compliance activities. Moreover, uncertainty surrounding the implementation and future changes in environmental regulations can create market volatility and reduce investor confidence. Pindyck (2007) argues that regulatory uncertainty can lead to increased risk premiums, as investors demand higher returns to compensate for the perceived risks associated with regulatory changes. This can result in reduced investor attention and lower stock prices for affected firms. In addition, some investors may exhibit myopic behaviour, focusing on short-term gains rather than long-term sustainability. This can lead to negative reactions to environmental regulations perceived as costly. As a result, investor short-termism can diminish the intended benefits of

environmental regulations, as firms may face pressure to prioritize immediate financial performance over a focus on sustainability.

While the results have been mixed, recent studies suggest that the overall trend points toward a positive relationship between government environmental regulation and investor sentiment. The increasing focus on sustainability, combined with enhanced corporate transparency due to regulatory compliance, creates a more favourable environment for investors. Therefore, despite some variability in specific outcomes, it is likely that environmental regulations contribute to improving investor sentiment. This leads to our primary hypothesis:

H1: The Low Carbon City Pilot (LCCP) policy increases investor sentiment towards firms located in designated pilot cities.

2.3 Government environmental regulation and analyst coverage

As global environmental concerns intensify, regulatory frameworks aimed at mitigating environmental impact have become more stringent. This implies firms can face substantial initial investments in pollution control technologies and ongoing operational costs to meet regulatory standards. This kind of unpredictable regulatory change can disrupt firm operations, increase compliance costs, and lead to volatile cash flows (Wang, Xu, & Liang, 2021). As a result, government environmental regulations have the potential to increase firm risk by introducing uncertainty in operational and strategic decision-making. For instance, Dechezleprêtre and Sato (2017) found that stringent environmental policies lead to increased production or regulation costs, which can adversely affect profitability and induce financial risk. Moreover, firms facing regulatory uncertainty may delay or forego investment decisions due to the flexibility value of waiting for more information (Chen et al., 2024). For instance,

Bloom, Bond, and Van Reenen (2007) also provide evidence that firms will adopt a wait-and-see approach to mitigate risk, which can delay investment and impact long-term growth.

Based on information asymmetry theory and agency theory, financial analysts play a crucial role in financial markets by providing information and insights that can help mitigate various types of firm-level uncertainty, and serve as monitors ensuring that managers act in the best interests of shareholders, particularly in complex regulatory environments (Hope, 2003; Beyer et al., 2010; Yu, 2010; Ellul & Panayides, 2018). Derrien and Kecskés (2013) find that increased analyst coverage leads to reduced stock return volatility, which is particularly beneficial in the context of environmental regulation, where uncertainty is high. Kim, Lu, and Yu (2019) also find a significant increase in a firm's crash risk subsequent to an exogenous drop in analyst coverage. For firms facing environmental regulations, analyst forecasts incorporate potential compliance costs and operational impacts, providing a more accurate picture of future performance. Moreover, Yu (2010) shows that firms with greater analyst coverage tend to exhibit better governance practices, as analysts scrutinize managerial decisions more closely. The growing importance of environmental factors has led analysts to integrate these considerations into their evaluations. Ioannou and Serafeim (2015) find that analysts who incorporate environmental impacts into their analyses help investors better understand the long-term implications of environmental regulations. This reduces uncertainty by highlighting the strategic advantages of compliance with sustainability initiatives. Further research indicates that firms covered by reputable analysts are perceived as less risky, as analyst coverage signals firm quality and reliability (Jackson, 2005; Hilary & Hsu, 2013).

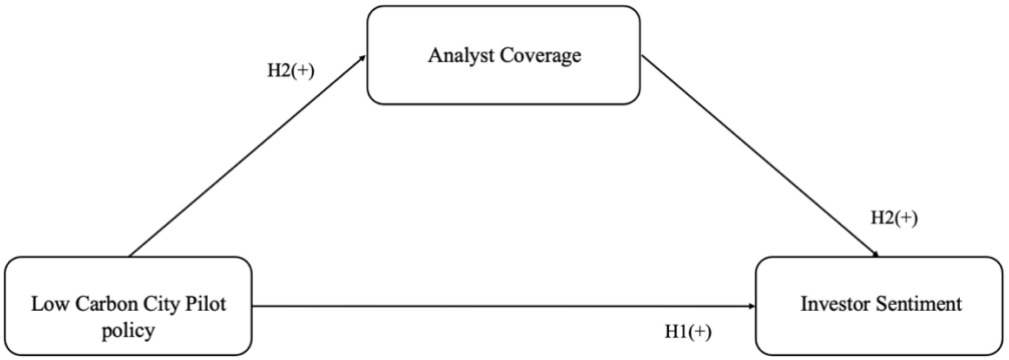
Analyst coverage has been shown to positively affect firm valuations by reducing perceived risks and highlighting growth opportunities. Huang et al. (2018) find that increased analyst

coverage leads to lower information asymmetry, particularly for firms facing regulatory changes. By offering detailed assessments of the impact of environmental regulations, analysts help investors make more informed decisions and improve their confidence. Chen, Harford, and Lin (2015) demonstrate that positive analyst coverage can significantly improve investor sentiment, especially in periods of regulatory uncertainty. This is because analyst reports that clarify the implications of environmental regulations help alleviate investor concerns. By offering insights into the potential benefits of environmental compliance, analysts can enhance investor perceptions of firm value. Accurate earnings forecasts provided by analysts are instrumental in shaping investor expectations and confidence. Hong and Kacperczyk (2010) show that firms with high analyst coverage experience less forecast dispersion and greater forecast accuracy, which in turn improves investor confidence. This is particularly important for firms navigating the complexities of environmental regulations.

Therefore, we expect that analyst coverage serves as a channel that explains how environmental regulation can shape investor sentiment. The resulting hypothesis is as follows:

H2: Analyst coverage partially mediates the positive effect of the Low Carbon City Pilot (LCCP) policy on investor sentiment, such that the introduction of the LCCP policy increases analyst coverage which, in turn, is associated with improved investor sentiment.

Figure 1. Conceptual framework



Note: Investor sentiment is assessed through two measures, *SENTIMENT1* and *SENTIMENT2*, which capture the misvaluation for each firm. Analyst coverage is measured using three indicators: the number of analysts covering a firm (*ANALYST*), the number of research reports published (*REPORT*), and the number of star analysts involved (*STARANALYST*).

3. Method

3.1 Data and sample

The sample comprises Chinese publicly traded firms spanning the period from 2007 to 2021. The primary data source is the China Stock Market & Accounting Research database (CSMAR), which includes firm-level financial information. Firm-level sentiment data are then manually calculated. The CSMAR database also provides detailed analyst coverage data, including both the number of analysts tracking each firm and the number of reports issued. In addition, the New Fortune, recognized as the most authoritative financial magazine in China, annually selects star analysts based on their performance. It allows us to manually collect information on star analysts and identify firms tracked by these star analysts. Given that China's IFRS-based accounting standards became mandatory for all listed firms in 2007, the sample period starts from 2007. Financial services firms are excluded due to their different business environment. The final sample consists of 11,731 firm-year observations from 2007 to 2021. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate any potential impacts stemming from outliers.

3.2 Dependent variables

Rhodes-Kropf, Robinson, and Viswanathan (2005) define investor sentiment as the discrepancy between the market value of a firm and its fundamental value, which can result from misvaluation driven by behavioural anomalies or asymmetric information. The fundamental value is derived from firm-specific accounting information and industry-level valuation multiples. Industries have unique characteristics that affect how the market values their firms, including growth prospects, risk profiles, and economic conditions. By conducting regressions within each industry, we can account for these industry-specific factors, ensuring that the valuation models are tailored to the particularities of each industry. In addition, valuation multiples can change over time due to macroeconomic conditions, technological advancements, regulatory changes, and other factors. By performing annual regressions, we can capture these time-varying effects, which ensures that the valuation model reflects the current economic environment and market conditions. Therefore, in line with Rhodes-Kropf, Robinson, and Viswanathan (2005) and Huang et al. (2021), we first conduct cross-sectional regressions within each industry by year[2] as follows:

$$Q_{i,t,j} = \alpha + \beta_1 SIZE_{i,t,j} + \beta_2 LEV_{i,t,j} + \beta_3 ROA_{i,t,j} + \varepsilon_{i,t,j} \qquad \textit{(Equation 1)}$$

Where $Q_{i,t,j}$ is the market-to-book ratio for firm i in year t and industry j, representing the firm's market value relative to its book value; $SIZE_{i,t,j}$ represents firm size, measured as the natural logarithm of total assets; $LEV_{i,t,j}$ represents the total liabilities divided by total assets;

[2] We employ cross-sectional regressions within each industry by year to directly capture industry-specific conditions and time-varying macroeconomic factors at the firm level. While using industry and year fixed effects can control for broader trends, this method allows for a more direct estimation of firm-specific misvaluation by focusing on annual variations in market-to-book ratios within each industry.

$ROA_{i,t,j}$ is the return on assets. These cross-sectional regressions are repeated annually for each industry to capture time-varying industry-specific valuation multiples.

This step estimates the misvaluation for each firm based on its accounting information, such as *SIZE*, *LEV*, and *ROA*. The residuals ($\varepsilon_{i,t,j}$) represent the part of the market-to-book ratio that cannot be explained by these independent variables in the regression. Positive residuals indicate that the firm's market-to-book ratio is higher than what its fundamentals would suggest, implying overvaluation and positive investor sentiment. Negative residuals suggest that the firm's market-to-book ratio is lower than expected, indicating undervaluation and negative investor sentiment. After that, we perform the second step to standardise firm-level sentiment using the formula:

$$SENTIMENT = (\varepsilon_{i,t,j} - \bar{\varepsilon}_{t,j})/\sigma_{\varepsilon_{t,j}} \qquad \textit{(Equation 2)}$$

By subtracting the mean of the residuals and dividing by the standard deviation, we standardize the residuals. This standardization allows for comparison across different firms and time periods, even if the scales of the residuals are different. We use both the market-to-book ratio and Tobin's Q to measure M/B value, recorded as *SENTIMENT1* and *SENTIMENT2*, separately. A firm with a high positive Sentiment is significantly overvalued compared to its peers, indicating strong positive investor sentiment.

3.3 Independent variables

China's Low-Carbon City Pilot Policy (LCCP) aims to promote low-carbon development by designating specific cities to test and implement measures to reduce carbon emissions and enhance energy efficiency. The policy was launched in three phases: 2010, 2012, and 2017. It

encourages cities to adopt low-carbon technologies, adjust industrial structures, and improve urban planning to reduce greenhouse gas emissions. If a province has been designated as a low-carbon pilot area, all cities within that province are considered low-carbon pilot cities.

$TREAT_i$ is the indicator variable for whether firm i is located in a low-carbon pilot city during the sample period. $TREAT_i$ takes the value 1 if firm i is designated as a firm located in a low-carbon pilot city, and 0 otherwise. $POST_t$ represents the dummy variable for the period before and after the low-carbon pilot city designation. $POST_t$ takes the value 1 if firm i is designated as a firm covered by the low-carbon pilot city policy in year t or thereafter, and 0 otherwise. The interaction term $POLICY_{it}$ is the main explanatory variable in this chapter, and its coefficient represents the net effect of the low-carbon pilot city's designation on firm-level sentiment.

3.4 Mediating variables

We propose that financial analysts play a crucial role in financial markets by providing information and insights that can help mitigate various types of firm-level uncertainty and serve as monitors to ensure that managers act in the best interests of shareholders, particularly in complex regulatory environments. In this section, we use the number of analysts (teams) that have tracked and analysed the firm within a year to measure analyst coverage. Alternatively, we also use the number of research reports that have tracked and analysed the firm within a year. Research indicates that firms covered by reputable analysts are perceived as less risky, as analyst coverage signals firm quality and reliability (Xu et al., 2013; Harrison et al., 2018), so we also use the number of star analysts that have tracked and analysed the firm within a year to measure analyst coverage. In addition, we take the natural logarithm of all the variables and denote them as *ANALYST, REPORT, and STAR_ANALYST*, respectively.

3.5 Control variables

In constructing the empirical model, we include a range of control variables that align with the existing literature (Huang et al., 2021; Chen, Mao, & Sun, 2022) on corporate behaviour. These variables are essential for isolating the effects of the main variables of interest on firm-level investor sentiment. Specifically, we account for fundamental characteristics and financial performance, recognizing their influence on a firm's sentiment. Firm size (*SIZE*) is measured by the natural logarithm of the book value of total assets, which provides a scale-adjusted measure of the firm's size. Financial leverage (*LEV*) is defined as the ratio of total liabilities to total assets, offering insights into the firm's capital structure. Return on assets (*ROA*) is calculated as the ratio of net income to total assets, reflecting the firm's overall financial efficiency. We also include control variables related to a firm's operational characteristics, such as cost ratios (*COST*), investment levels (*INVEST*), growth potential (*GROWTH*), and short-term liquidity (*QUICK*). Additionally, we control for the number of years since the firm's initial public offering (*LISTAGE*) and the firm's ownership structure (*SOE*), as these factors are particularly relevant for investor sentiment and are critical in shaping investor perceptions.

Institutional holding (*INST*) represents the ownership stake of institutional investors, which can indicate the level of professional scrutiny and support a firm receives. Moreover, we use the natural logarithm of audit fees to measure the cost and extent of audit services, indicating the firm complexity (*AUDITFEE*). We use the natural logarithm of executive compensation to account for the remuneration of top management, reflecting their incentives and potential influence on firm performance *(TMTPAY). BIG4* is a dummy variable equal to 1 if the firm is audited by a Big 4 firm, 0 otherwise. It indicates whether a firm is audited by one of the Big 4 accounting firms, which can signal higher audit quality and credibility.

3.6 Regression models

We employ a Difference-in-Differences (DiD) approach to investigate the influence of LCCP on firm-level investor sentiment. We use the following regression setup:

$$SENTIMENT_{i,t} = \alpha + \theta_1 POLICY_{i,t} + \phi X_{i,t} + YEAR_t + FIRM_i + \varepsilon_{i,t} \qquad \textit{(Equation 3)}$$

In the model, as shown in Equation 4.3, we define $SENTIMENT_{i,t}$ as a proxy quantifying the extent of investor sentiment for a specific firm *i* in calendar year *t*. At the core of the empirical investigation is the interaction term $POLICY_{i,t}$, which serves as a dummy variable. This variable takes a value of one in periods where firm *i* has been designated as being covered by the LCCP policy, and zero otherwise. The coefficient of interest, θ_1, is crucial for quantifying the impact of the LCCP policy on firm-level sentiment. A positive and statistically significant θ_1 coefficient would indicate a positive link between the enactment of the LCCP Policy and investor sentiment. Such a result would be indicative of the effectiveness of this policy in influencing investor behaviour, thereby guiding corporate conduct and government policies toward more environmentally sustainable practices.

In addition, to examine the potential mediating mechanism of the LCCP Policy on investor sentiment, we construct a standardized mediating effect test model to empirically assess whether analyst coverage acts as an intermediary between the LCCP Policy and investor sentiment. Following Baron and Kenny (1986) and Jollineau and Bowen (2023), we employ the stepwise method to explore the intermediary role of analyst coverage between the LCCP Policy and investor sentiment. The specific regression model is set as follows:

$$COVERAGE_{i,t} = \alpha^* + \delta_1^* POLICY_{i,t} + \phi X_{i,t} + YEAR_t + FIRM_i + \varepsilon_{i,t} \qquad \textit{(Equation 4)}$$

$$SENTIMENT_{i,t} = \alpha + \delta_1 POLICY_{i,t} + \delta_2 COVERAGE_{i,t} + \phi X_{i,t} + YEAR_t + FIRM_i + \varepsilon_{i,t}$$

(Equation 5)

Equations 4 and 5 collectively constitute a mediation effect test model. Specifically, Equation 4 evaluates whether the LCCP policy significantly influences analyst coverage. This is the first step in identifying the indirect effect, where the policy is expected to increase analyst coverage on the firms. Equation 5 then evaluates whether the LCCP policy directly influences sentiment even after accounting for analyst coverage. The product of the coefficients δ_1^* and δ_2 from Equations 4 and 5 provides an estimate of the indirect effect of the LCCP policy on investor sentiment through analyst coverage.

4. Empirical results

4.1 Summary statistics

Table 1 presents summary statistics for the sample of 11,731 firm-year observations from 2007 to 2021. The averages of *SENTIMENT1* and *SENTIMENT2* are 0.050 and -0.050, respectively. The two sentiment measures capture different aspects of investor sentiment, which means investors might have differing views depending on the financial metric used, i.e., market-to-book ratio vs. Tobin's Q. A large standard deviation indicates a relatively wide variation in investor sentiment across firms, reflecting differing market perceptions and valuation relative to their fundamentals. Moreover, we observe that for many firms, investor sentiment tends to range from slightly negative to slightly positive, but is mostly around the neutral point. The mean of 0.375 for our *POLICY* variable suggests that a significant portion of the sample firms

are affected by this policy, which allows the analysis to capture the policy's impact on firm-level sentiment.

Table 1 Summary statistics

Variable	Mean	SD	P10	P25	Median	P75	P90
SENTIMENT1	0.050	0.897	-0.797	-0.459	-0.116	0.345	1.018
SENTIMENT2	-0.050	0.826	-0.882	-0.552	-0.185	0.273	0.886
POLICY	0.375	0.484	0.000	0.000	0.000	1.000	1.000
SIZE	22.130	1.273	20.647	21.193	21.942	22.865	23.869
LEV	0.463	0.204	0.177	0.305	0.471	0.623	0.733
ROA	0.040	0.049	0.003	0.014	0.035	0.063	0.098
COST	0.737	0.164	0.508	0.654	0.771	0.853	0.916
GROWTH	0.404	1.127	-0.214	-0.047	0.117	0.400	1.044
SOE	0.510	0.500	0.000	0.000	1.000	1.000	1.000
QUICK	1.613	2.044	0.402	0.611	0.978	1.667	3.257
INVEST	0.071	0.084	0.002	0.018	0.048	0.099	0.173
LISTAGE	2.219	0.673	1.099	1.792	2.398	2.773	2.944
INST	50.969	24.164	14.690	34.121	53.040	69.097	81.604
AUDITFEE	13.495	0.665	12.766	13.017	13.385	13.816	14.403
TMTPAY	14.218	0.735	13.305	13.747	14.196	14.658	15.140
BIG4	0.052	0.221	0.000	0.000	0.000	0.000	0.000

Note: This table presents summary statistics for the variables utilized in the baseline regressions of this study. The analysis is based on a sample 11,731 firm-year observations spanning the period from 2007 to 2021. Definitions for all variables are provided in Appendix 4A. Continuous variables have been winsorized at the 1% and 99% levels to reduce the potential influence of outliers. We note that the medians for both *SENTIMENT1* and *SENTIMENT2* are negative; however, the mean for *SENTIMENT1* is positive. We winsorized at the 1st and 99th percentiles to minimize the influence of skewness in the underlying *SENTIMENT1* distribution. Our results are similarly robust when winsorizing at the 5th and 95th percentiles.

Table 2 Variable correlations

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1)	*SENTIMENT1*															
(2)	*SENTIMENT2*	0.786														
(3)	*POLICY*	0.107	0.125													
(4)	*SIZE*	-0.020	0.032	0.188												
(5)	*LEV*	-0.076	-0.033	-0.006	0.501											
(6)	*ROA*	0.118	0.097	-0.039	-0.048	-0.364										
(7)	*COST*	-0.148	-0.125	-0.046	0.119	0.358	-0.448									
(8)	*GROWTH*	0.006	0.008	0.063	0.044	0.108	-0.003	-0.123								
(9)	*SOE*	0.015	-0.013	-0.074	0.266	0.274	-0.111	0.172	-0.003							
(10)	*QUICK*	0.096	0.105	0.064	-0.299	-0.641	0.225	-0.312	-0.039	-0.238						
(11)	*INVEST*	-0.032	0.013	-0.065	0.011	-0.065	0.148	-0.084	-0.041	-0.100	-0.007					
(12)	*LISTAGE*	0.072	0.018	0.123	0.350	0.391	-0.166	0.142	0.095	0.398	-0.369	-0.233				
(13)	*INST*	0.151	0.125	-0.079	0.363	0.215	0.159	0.008	0.032	0.368	-0.184	0.082	0.189			
(14)	*AUDITFEE*	0.040	0.097	0.270	0.764	0.317	-0.030	0.085	-0.009	0.076	-0.213	0.010	0.241	0.228		
(15)	*TMTPAY*	0.067	0.073	0.317	0.487	0.092	0.197	-0.120	0.036	-0.045	-0.031	0.001	0.152	0.140	0.493	
(16)	*BIG4*	0.052	0.086	0.102	0.342	0.096	0.031	-0.009	-0.024	0.109	-0.074	0.010	0.087	0.187	0.429	0.221

Note: This table presents Pearson correlation coefficients for all variables used in this research. Definitions for all variables are provided in Appendix A. Correlations with an absolute value greater than 0.020 are statistically significant at the 5% level.

4.2 Baseline result analysis

Our primary analysis focuses on the effect of the Low Carbon City Pilot (LCCP) Policy on investor sentiment. We utilize a difference-in-differences (DiD) approach to identify the policy's impact, with results presented in Table 3. We regress the two investor sentiment measures against the variable of interest, *POLICY*, initially incorporating fixed effects in Columns 1 and 2. Columns 3 and 4 expand the analysis by introducing a comprehensive set of control variables. Consistent with my hypothesis, the coefficients on *POLICY* are positive and statistically significant, showing significance at the 1% level for both *SENTIMENT1* and *SENTIMENT2*. To evaluate economic significance, we examine the proportional increase in investor sentiment attributable to the LCCP policy, relative to the dispersion of each sentiment measure. Based on the coefficients in Columns 3 and 4, the enactment of the LCCP policy corresponds to an increase in investor sentiment by 15.83% of the standard deviation for *SENTIMENT1* and 15.50% of the standard deviation for *SENTIMENT2*.

The baseline results indicate a significant positive impact of the LCCP Policy on investor sentiment, suggesting that environmental regulations can enhance market perceptions of firms located in pilot cities. This finding has important implications for both policymakers and corporate managers. For policymakers, the results provide evidence that environmental initiatives not only contribute to sustainability goals but also improve the attractiveness of firms in the capital market, thereby supporting economic growth through increased investor sentiment. For corporate managers, the findings suggest that proactive engagement with environmental policies can yield financial benefits by improving investor sentiment, which could translate into higher firm valuations and lower capital costs. These results highlight the potential for environmental regulations to align market incentives with sustainable practices, promoting a positive feedback loop between regulatory compliance and market performance.

Table 3 The effect of low-carbon city pilot policy on investor sentiments

	(1)	(2)	(3)	(4)
Variable	$SENTIMENT1_{t+1}$	$SENTIMENT2_{t+1}$	$SENTIMENT1_{t+1}$	$SENTIMENT2_{t+1}$
POLICY	0.142***	0.126**	0.142***	0.128***
	(3.643)	(3.435)	(3.667)	(3.495)
Constant	-0.003	-0.097***	1.810***	2.287***
	(-0.192)	(-7.055)	(2.300)	(3.281)
Controls	NO	NO	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	11,731	11,731	11,731	11,731
R-squared	0.491	0.491	0.502	0.499

Note: This table presents the regression results demonstrating the effect of the LCCP policy on investor sentiment, as specified in Equation 3. The sample includes firm-year observations from 2007 to 2021. Columns 1 & 2 report fixed effects models, while Columns 3 & 4 include control variables. Definitions for all variables are provided in Appendix A. Standard errors, clustered at the city level, are shown in parentheses.
***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

4.3 Pre-treatment trend test

The primary purpose of pre-treatment tests is to check whether there were any significant differences in investor sentiment between treated and control firms before the implementation of the LCCP policy. The parallel trends assumption is a key requirement for the DiD analysis, which supposes that in the absence of the LCCP Policy, the treated and control groups would have followed similar paths over time. If this assumption holds, any post-treatment differences are likely attributable to the policy rather than other confounding factors. We examine investor sentiment in the three years before and after the policy implementation. Specifically, we conduct a parallel trends analysis to compare the treated and control clusters both before and after the intervention. As per Table 4, the coefficients for $POLICY_{t=-3}$, $POLICY_{t=-2}$, and $POLICY_{t=-1}$ are not statistically significant, indicating no significant differences in investor sentiment trends between firms in pilot and non-pilot cities prior to the policy's implementation.

The positive and significant coefficients in the post-treatment period further confirm that the LCCP Policy has a positive impact on investor sentiment.

Table 4 Pre-treatment trends

Variable	(1) $SENTIMENT1_{t+1}$	(2) $SENTIMENT2_{t+1}$
$POLICY_{t=-3}$	-0.001	-0.039
	(-0.032)	(-0.911)
$POLICY_{t=-2}$	-0.032	-0.042
	(-0.923)	(-1.113)
$POLICY_{t=-1}$	0.000	0.004
	(0.010)	(0.092)
$POLICY_{t=0}$	0.069	0.045
	(1.518)	(1.007)
$POLICY_{t=1}$	0.155***	0.116**
	(2.635)	(2.189)
$POLICY_{t=2}$	0.175**	0.151**
	(2.378)	(2.184)
$POLICY_{t\geq3}$	0.154**	0.145**
	(2.567)	(2.296)
Constant	1.830**	2.308***
	(2.321)	(3.325)
Controls	YES	YES
Firm FE	YES	YES
Year FE	YES	YES
Observations	11,731	11,731
R-squared	0.502	0.500

Note: This table presents the trend analysis, where *POLICY* in Equation 3 is replaced with a set of indicator variables to capture the effects before and after the enactment of the LCCP policy. Specifically, $POLICY_{t=0}$, $POLICY_{t=-1}$, $POLICY_{t=-2}$,and $POLICY_{t=-3}$ equal one during the year of a city's LCCP policy enactment, and one, two, and three years prior to enactment, respectively, and zero otherwise. $POLICY_{t=1}$ and $POLICY_{t=2}$ are set to one in the year following enactment and two years following enactment, respectively, and zero otherwise. $POLICY_{t\geq3}$ equals one for three years onward from enactment, and zero otherwise. Standard errors, clustered at the city level, are shown in parentheses. ***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

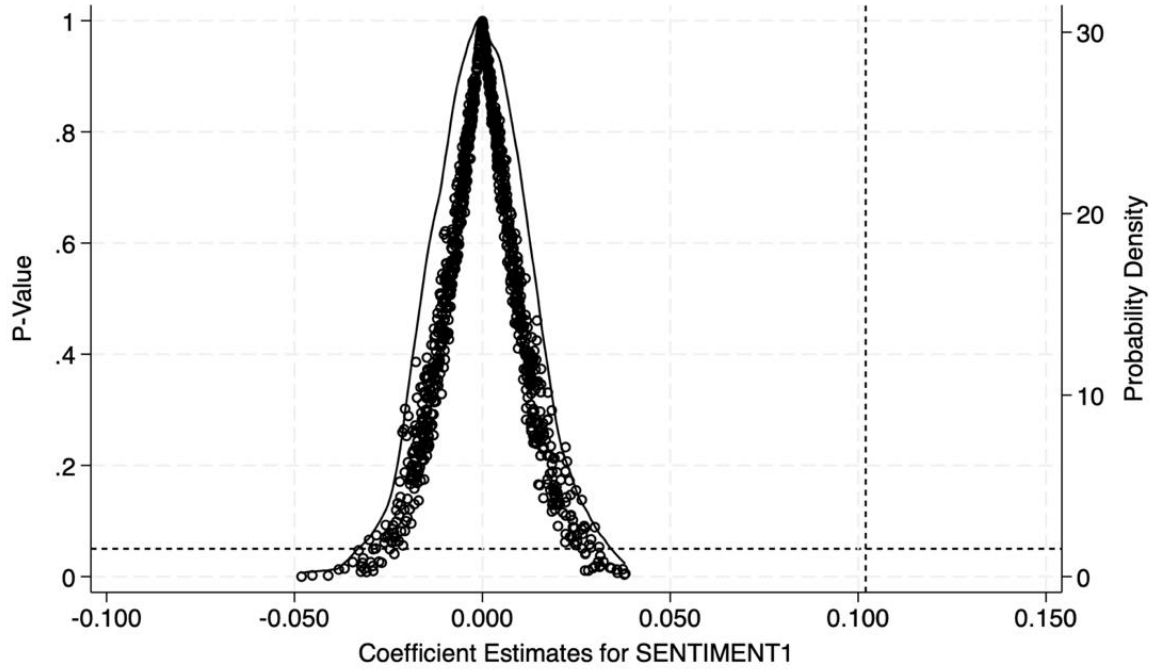
4.4 Permutation inference test

To confirm that our baseline results are directly attributable to the implementation of the LCCP policy in the cities where firms are headquartered, we perform permutation inference tests. Following Liu and Lu (2015), we randomly select a year for LCCP policy enactment and randomly assign cities as implementation sites. From these random selections, we generate a false *POLICY* variable, which is then again used as the key independent variable in the baseline regression model. To enhance the robustness of this test, we repeat the experiment 1,000 times, recording the coefficient and p-values of *POLICY* for each iteration. If Equation 4.3 is correctly specified, the majority of these 1,000 coefficients should cluster around zero and not show any systematic deviation from zero overall.

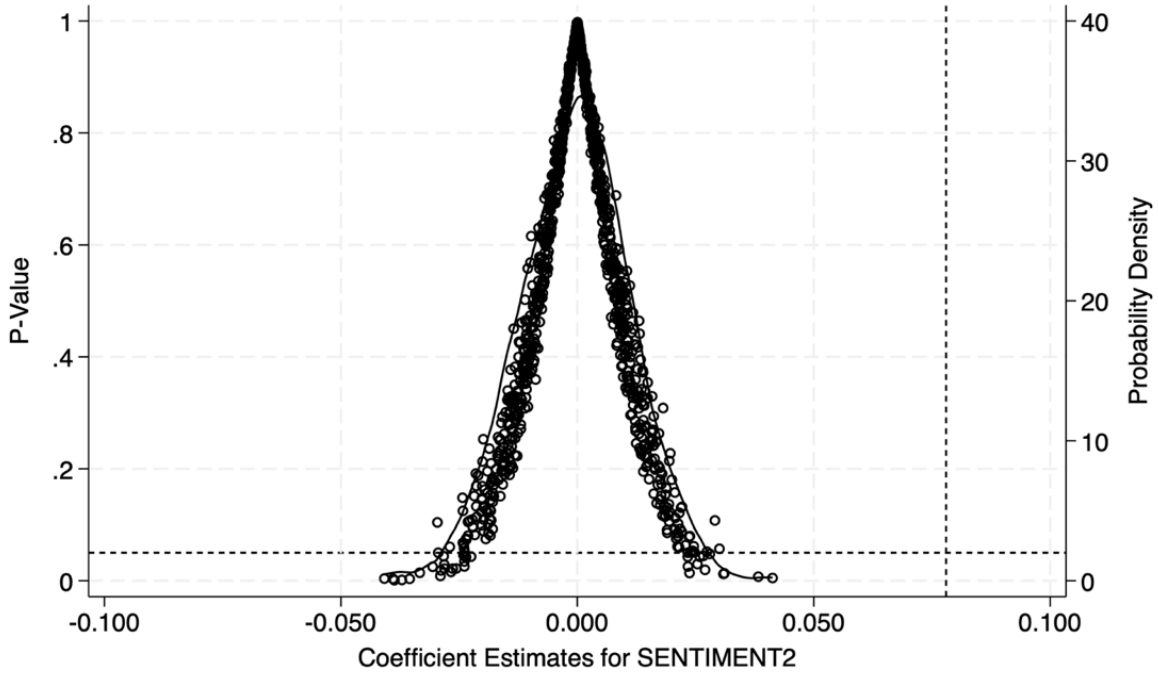
Figure 2 illustrates the density distribution of the 1,000 estimates derived from the random assignments of the LCCP policy implementation year and cities. Panel A, focusing on the *SENTIMENT1* variable, demonstrates that the distribution of these estimates is centred around zero (mean = -0.00023), with the actual estimate using the true LCCP policy year and cities (0.142) exceeding the 95th percentile of the placebo estimates (95th percentile = 0.00058). Similarly, Panel B, which examines the *SENTIMENT2* variable, shows a distribution also centred around zero (mean = -0.00046), where the true estimate (0.128) surpasses the 95th percentile of the placebo estimates (95th percentile = 0.00027). These results support our findings, indicating that they are unlikely to be due to random variations in the underlying data.

Figure 2 Placebo test

Panel A. This panel reports the distribution of estimated coefficients with placebo years and cities of LCCP policy enactment, using *SENTIMENT1* as the dependent variable.



Panel B. This panel reports the distribution of estimated coefficients with placebo years and cities of LCCP policy enactment, using *SENTIMENT2* as the dependent variable



4.5 Cross-sectional analysis

We conduct a cross-sectional analysis by dividing the full sample into two groups based on a firm's information transparency. Information transparency is measured using the moving sum of the absolute values of discretionary accruals over the prior three years, with lower values indicating higher transparency. Discretionary accruals are calculated using the Jones Model (Jones, 1991). The rationale for this analysis lies in the expectation that firms with higher transparency may exhibit a stronger market response to policy interventions, as reduced information asymmetry allows investors to more accurately assess the potential benefits of the policy.

We divide the full sample into two groups based on the median of discretionary accruals, with firms categorized as having higher or lower information transparency. The results, as presented in Table 5, Columns (1) – (4), indicate a significant difference in the coefficients of the *POLICY* interaction term across the two sentiment measures. Specifically, the coefficient is positive and statistically significant at the 1% level for firms with higher information transparency (see Columns 2 and 4), while it is not significant for firms with lower information transparency (see Columns 1 and 3). The test for the difference in coefficients between the two groups is statistically significant at the 1% level for *SENTIMENT1* and at the 5% level for *SENTIMENT2*, respectively. This suggests that the LCCP policy has a more pronounced effect on investor sentiment in firms that are already more transparent. One potential explanation for this finding is that transparent firms are better able to convey the anticipated benefits of the policy to the market, leading to more favourable investor reactions. While the results may suggest that the policy has a reduced influence on investor sentiment in firms with lower transparency, it is important to consider that information asymmetry could limit the market's ability to fully appreciate the policy's effects on market participants' opinions. These findings imply that the

policy's influence on investor sentiment is contingent upon the degree of transparency. Thus, enhancing transparency may be a critical factor in ensuring the policy's externality in driving positive investor sentiment across a broader range of firms.

We subsequently divide the full sample into two groups based on the industry in which firms operate, specifically distinguishing between lower and higher pollution industries.[3] This analysis is motivated by the hypothesis that firms in lower pollution industries might attract more favourable investor sentiment due to their closer alignment with environmental sustainability and compliance with regulatory trends. As shown in Table 5, Columns (5) – (8), there is a notable difference in the coefficients of the *POLICY* interaction term across the two sentiment measures. For firms in lower pollution industries, the coefficients are positive and statistically significant at the 1% level (see Columns 6 and 8), suggesting that the LCCP policy exerts a more substantial positive influence on investor sentiment within these industries. In contrast, the coefficient is not significant for firms in higher pollution industries (see Columns 5 and 7). The test for the difference in coefficients between the two groups is statistically significant at the 1% and 5% level for both sentiment measures. These results suggest that the ability of the LCCP policy to enhance investor sentiment is significantly stronger in industries with lower pollution levels. This implies that investors may attribute higher value to the environmental performance and regulatory compliance of firms in less polluting industries, resulting in a more pronounced positive sentiment for those covered by the LCCP policy.

[3] Higher-pollution industries are defined as industries with significant environmental impact, including chemical manufacturing, textile production, coal mining, oil and gas extraction, metal smelting and refining, power generation, and rubber and plastics manufacturing. These industries are associated with high levels of greenhouse gas emissions and other pollutants. Other industries are classified as Lower-pollution industries, typically those with lower environmental footprints, such as technology, finance, and various service-oriented industries.

However, the lack of statistical significance in higher-pollution industries does not necessarily mean the policy has no influence in these sectors. It may reflect that higher-pollution industries face more complex challenges, where environmental performance improvements take longer to materialize, and investor sentiment may respond more gradually to sustainability policies. Therefore, rather than dismissing the lack of short-term significance, the long-term incremental improvements in these high-pollution sectors may represent the most meaningful opportunity for the LCCP policy to influence both environmental outcomes and investor sentiment.

We then divided the sample into two groups based on the geographic location of the firms, specifically comparing those situated in eastern regions of China with those in other areas[4]. The rationale for this approach is grounded in the belief that firms in Eastern regions, which include economically advanced areas with stronger infrastructure and greater market integration, will exhibit different investor sentiment responses to the LCCP policy compared to firms in other regions. In addition, firms in these areas are likely more aligned with global environmental standards, making investor sentiment more sensitive to policy interventions. This differentiation enables a more detailed analysis of how the policy's impact varies under different economic and environmental contexts.

As depicted in Table 5, Columns (9) – (12), there is a clear difference in the *POLICY* interaction coefficients across the two sentiment measures. For firms in the eastern region, the coefficients are positive and statistically significant at the 1% level (see Columns 9 and 11), suggesting that the LCCP policy has a more substantial positive effect on investor sentiment in these areas. In addition, the test for differences in coefficients between the two groups is statistically

[4] Firms located in the following provinces are classified as being in the Eastern regions: Hebei, Beijing, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, and Hainan. Firms located in all other provinces are categorized as non-Eastern regions.

significant at the 5% level for *SENTIMENT1* and at the 1% level for *SENTIMENT2*. These results imply that the ability of the LCCP policy to enhance investor sentiment is considerably stronger in firms located in eastern China, likely due to the region's more developed infrastructure, supportive policy framework, and heightened investor focus on sustainability. However, this does not imply that the policy lacks potential in non-Eastern regions. The absence of statistical significance for firms in non-Eastern regions could reflect structural economic differences or lower levels of market integration, which may delay investor response to sustainability-focused policies. Therefore, the long-term benefits of the LCCP policy in driving both environmental performance and investor sentiment in these regions should not be discounted, despite the immediate differences in impact.

Table 5 Cross-sectional analysis

	Information transparency				Operating industry				Geographical location			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variable	$SENTIMENT1_{t+1}$		$SENTIMENT2_{t+1}$		$SENTIMENT1_{t+1}$		$SENTIMENT2_{t+1}$		$SENTIMENT1_{t+1}$		$SENTIMENT2_{t+1}$	
	Low Trans	*High Trans*	*Low Trans*	*High Trans*	*Pollution*	*Non-Pollution*	*Pollution*	*Non-Pollution*	*Eastern*	*Non-Eastern*	*Eastern*	*Non-Eastern*
POLICY	0.074	0.189***	0.068	0.154***	0.067	0.193***	0.098	0.140***	0.165***	0.050	0.144***	0.029
	(1.433)	(3.746)	(1.359)	(3.470)	(1.151)	(4.142)	(1.594)	(2.965)	(3.695)	(0.690)	(3.396)	(0.427)
Constant	1.262	2.006	2.586**	0.747	0.306	1.648**	1.428	2.209***	1.984**	2.108	2.343***	2.704**
	(1.331)	(1.358)	(2.419)	(0.683)	(0.269)	(2.108)	(1.102)	(2.735)	(2.528)	(1.469)	(2.687)	(2.241)
Coefficient Difference Test (p-value)	0.005***		0.035**		0.000***		0.035**		0.015**		0.010***	
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	6,852	4,361	6,852	4,361	4,200	7,478	4,200	7,478	7,862	3,863	7,862	3,863
R-squared	0.510	0.564	0.505	0.577	0.533	0.509	0.530	0.498	0.507	0.500	0.494	0.513

Note: Panel A. presents cross-sectional results after dividing the full sample into two groups based on earnings management. Columns 1 & 3 report the results for firms with higher earnings management (i.e., low transparency), while Columns 2 & 4 report the results for firms with lower earnings management (i.e., high transparency). Panel B. presents cross-sectional results after dividing the full sample into two groups based on operating industries. Columns 5 & 7 report the results for firms operating in industries with higher pollution levels, while Columns 6 & 8 report the results for firms operating in industries with lower pollution levels. Panel C. presents cross-sectional results after dividing the full sample into two groups based on headquarters locations. Columns 9 & 11 report the results for firms operating in eastern areas, while Columns 10 & 12 report the results for firms operating in other areas. The sample includes firm-year observations from 2007 to 2021. Standard errors, clustered at the city level, are shown in parentheses.

***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

4.6 PSM DiD results

To further validate the robustness of our findings, we employed a propensity score matching (PSM) analysis in conjunction with a difference-in-differences (DiD) approach. Firms in the treatment and control groups were matched on key firm characteristics, including *SIZE*, *LEV*, *ROA*, *COST*, *GROWTH*, *QUICK*, *INVEST*, *LISTAGE*, *INST*, *AUDITFEE*, and *TMTPAY*. Additionally, we ensured that firms were matched within the same industry to control for industry-specific factors that could potentially affect investor sentiment. After constructing the matched sample, we re-estimated my baseline regression using the PSM-DiD approach. This method improves the precision of our analysis by ensuring that the treatment and control groups are closely comparable across key observable characteristics, thereby providing a more reliable assessment of the LCCP policy impact on investor sentiment.

As shown in Table 6, we examine the impact of the *POLICY* variable on the two measures of investor sentiment. Initially, in Columns 1 and 2, we include only fixed effects in the model. Columns 3 and 4 extend the analysis by incorporating a full set of control variables. Consistent with my baseline findings, the coefficients for *POLICY* remain positive and statistically significant at the 1% level for both sentiment measures. To assess the economic significance, we calculate the proportional increase in investor sentiment attributable to the LCCP policy, relative to the dispersion of each sentiment measure. The coefficients from Columns 3 and 4 suggest that the implementation of the LCCP policy leads to an increase in investor sentiment equivalent to 16.95% of the standard deviation for *SENTIMENT1* and 15.62% for *SENTIMENT2*. Notably, following the application of the matching procedure, the impact of the LCCP policy on *SENTIMENT1* becomes even more pronounced, demonstrating a stronger effect within the matched sample.

Table 6 PSM DiD

	(1)	(2)	(3)	(4)
Variable	$SENTIMENT1_{t+1}$	$SENTIMENT2_{t+1}$	$SENTIMENT1_{t+1}$	$SENTIMENT2_{t+1}$
POLICY	0.152***	0.121***	0.152***	0.129***
	(3.555)	(3.092)	(3.656)	(3.411)
Constant	0.007	-0.113***	1.628*	1.938**
	(0.489)	(-8.181)	(1.742)	(2.498)
Controls	NO	NO	YES	YES
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	7,889	7,889	7,889	7,889
R-squared	0.496	0.500	0.506	0.507

Note: This table presents the regression results using a PSM-DiD approach. We match firms in the treatment and control groups based on propensity scores derived from several covariates, including *SIZE*, *LEV*, *ROA*, *COST*, *GROWTH*, *QUICK*, *INVEST*, *LISTAGE*, *INST*, *AUDITFEE*, *TMTPAY*, and *INDUSTRY*. We then investigate the effect of the LCCP policy on investor sentiment. Columns 1 & 2 report fixed effects models, while Columns 3 & 4 include control variables. Definitions for all variables are provided in Appendix A. Standard errors, clustered at the city level, are shown in parentheses. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

4.7 Mechanism analysis

To explore the mechanisms driving the observed relationship between the LCCP Policy and investor sentiment, we investigate the role of financial analyst coverage as a potential intermediary. We first analyse whether the LCCP Policy increases financial analyst coverage for firms located in pilot cities. The rationale for examining the effect of the LCCP policy on financial analyst coverage is based on the notion that the policy introduces a new environmental regulation, which increases uncertainty for firms. Financial analysts serve as intermediaries who can help mitigate the uncertainty introduced by the LCCP policy. Given increased uncertainty due to the LCCP policy, there is likely to be greater demand for analyst coverage of firms in pilot cities. Table 7 presents the regression results of the three analyst coverage measures on the variable of interest, *POLICY*, while controlling for fixed effects and the full set of controls. The coefficients for *POLICY* are positive and statistically significant at the 5% level for *ANALYST*, *REPORT*, and *STARANALYST*, respectively.

Table 7 The effect of the LCCP policy on analyst coverage

Variable	(1) $ANALYST_{t+1}$	(2) $REPORT_{t+1}$	(3) $STARANALYST_{t+1}$
POLICY	0.096** (2.321)	0.118** (2.300)	0.051** (2.071)
Constant	-4.071*** (-5.737)	-5.362*** (-6.024)	-3.117*** (-6.745)
Controls	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	11,731	11,731	11,731
R-squared	0.700	0.694	0.560

Note: This table presents the regression results demonstrating the effect of the LCCP policy on analyst coverage, using three proxies: *ANALYST*, *REPORT*, and *STARANALYST*. The sample includes firm-year observations from 2007 to 2021. Definitions for all variables are provided in Appendix A. Standard errors, clustered at the city level, are shown in parentheses.
***, **, and * denote significance at the 1%, 5% and 10% levels, respectively.

This suggests that the LCCP policy results in an increase in the number of analysts following, the number of analyst reports, and the number of star analysts covering firms in pilot cities. This finding implies that the policy enhances the visibility and attractiveness of these firms to financial analysts.

Next, we estimate the direct effect of the LCCP policy on investor sentiment while controlling for analyst coverage. As shown in Table 8, the *POLICY* variable remains positive and statistically significant at the 1% level across all models (Columns 1-6). This suggests that while the LCCP policy exerts a direct positive influence on investor sentiment, a portion of this effect is indeed mediated through analyst coverage.

Collectively, these findings provide strong support for *H2*. The positive and statistically significant coefficients for *ANALYST*, *REPORT*, and *STARNALYST* in Tables 7 and 8 indicate the mediating role of analyst coverage in the relationship between the LCCP policy and investor sentiment. Specifically, as shown in Table 9, firms experiencing an increase in analyst coverage as a result of the LCCP policy demonstrate a more pronounced positive impact on investor sentiment. The indirect effects through *ANALYST* and *REPORT* are statistically significant at the 1% level, while the effect through *STARANALYST* remains significant at the 10% level for *SENTIMENT2*. These results are consistent with the hypothesis that increased analyst coverage amplifies the positive effects of the LCCP policy on investor sentiment.

Table 8 The mediation effect of LCCP policy on investor sentiment

Variable	(1) $SENTIMENT1_{t+1}$	(2) $SENTIMENT1_{t+1}$	(3) $SENTIMENT1_{t+1}$	(4) $SENTIMENT2_{t+1}$	(5) $SENTIMENT2_{t+1}$	(6) $SENTIMENT2_{t+1}$
POLICY	0.140***	0.140***	0.142***	0.126***	0.126***	0.128***
	(3.650)	(3.627)	(3.662)	(3.493)	(3.470)	(3.502)
ANALYST	0.059***			0.052***		
	(3.572)			(3.564)		
REPORT		0.050***			0.045***	
		(3.604)			(3.616)	
STARANALYST			0.028			0.041**
			(1.402)			(2.253)
Constant	2.344***	2.395***	2.000***	2.758***	2.814***	2.561***
	(3.027)	(3.112)	(2.599)	(3.883)	(3.980)	(3.648)
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	11,731	11,731	11,731	11,731	11,731	11,731
R-squared	0.504	0.504	0.502	0.501	0.501	0.500

Note: This table presents the regression results demonstrating the effect of the LCCP policy on investor sentiment, incorporating three proxies to measure analyst coverage: *ANALYST*, *REPORT*, and *STARANALYST*, into the regression. The sample includes firm-year observations from 2007 to 2021. Definitions for all variables are provided in Appendix A. Standard errors, clustered at the city level, are shown in parentheses.
***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

Table 9 Joint significance test of regression coefficient products

Panel A. Impact of LCCP policy on SENTIMENT1 mediated by ANALYST, REPORT, and STARANALYST

Pair	δ_1^*	δ_2	$\delta_1^* \times \delta_2$	Bootstrap standard error	z	p > |z|	95% C.I.
ANALYST	0.096	0.059	0.006	0.002	2.93	0.003	0.002 - 0.009
REPORT	0.118	0.050	0.006	0.002	2.94	0.003	0.002 - 0.010
STARANALYST	0.051	0.028	0.001	0.001	1.51	0.131	0.000 – 0.003

Panel B. Impact of LCCP policy on SENTIMENT2 mediated by ANALYST, REPORT, and STARANALYST

Pair	δ_1^*	δ_2	$\delta_1^* \times \delta_2$	Bootstrap standard error	z	p > |z|	95% C.I.
ANALYST	0.096	0.052	0.005	0.002	2.96	0.003	0.002 - 0.008
REPORT	0.118	0.045	0.005	0.002	2.91	0.004	0.002 - 0.009
STARANALYST	0.051	0.041	0.002	0.001	1.85	0.064	0.000 – 0.004

Note. This table reports the joint significance test results for the indirect effect of the Low Carbon City Pilot (LCCP) policy on investor sentiment through analyst coverage. Specifically, Equation 4 tests the effect of the LCCP policy on analyst coverage, i.e., δ_1^*. Equation 5 examines the direct influence of the LCCP policy on investor sentiment while controlling for analyst coverage, i.e., δ_2. The product of the coefficients, i.e., $\delta_1^* \times \delta_2$, quantifies the estimated indirect effect. A joint significance test is conducted to assess whether this indirect effect is statistically significant.

5. Conclusion

This study examines the influence of China's LCCP policy on investor sentiment, with a particular emphasis on the mediating role of financial analyst coverage. We find a significant positive impact of the LCCP policy on investor sentiment. Specifically, firms located in pilot cities demonstrate a notable increase in investor sentiment relative to their counterparts in non-pilot cities. These results suggest that the LCCP policy enhances the relative attractiveness and investor sentiment for firms that are actively engaged in low-carbon initiatives.

Furthermore, our findings indicate that the LCCP policy substantially increases financial analyst coverage for firms in pilot cities. This increase in analyst coverage subsequently has a positive impact on investor sentiment. This dual effect highlights the important role of financial analysts in reducing information asymmetry and addressing the uncertainty introduced by new environmental regulatory frameworks. Analysts provide critical insights and evaluations that enable investors to better comprehend the implications of the LCCP policy, thereby increasing investor sentiment and shaping more favourable perceptions of affected firms.

Our study highlights the advantages of environmental policies such as the LCCP. By enhancing investor sentiment, these policies not only advance environmental sustainability but also promote the financial performance and market valuations of the firms involved. These findings suggest that policymakers should account for these broader economic implications when formulating and enacting environmental regulations, acknowledging their potential to attract investment and foster long-term economic growth.

Appendix A. Variable definitions

Variable	Definition
SENTIMENT1	In line with Rhodes-Kropf, Robinson, and Viswanathan (2005) and Huang et al. (2021), we first conduct cross-sectional regressions within each industry by year as follows: $M/B_{i,t,j} = \alpha + \beta_1 SIZE_{i,t,j} + \beta_2 LEV_{i,t,j} + \beta_3 ROA_{i,t,j} + \varepsilon_{i,t,j}$ Then, we calculate *SENTIMENT1* for each firm using the formula: $SENTIMENT1 = (\varepsilon_{i,t,j} - \bar{\varepsilon_{t,j}}) / \sigma_{\varepsilon_{t,j}}$
SENTIMENT2	In line with Rhodes-Kropf, Robinson, and Viswanathan (2005) and Huang et al. (2021), we first conduct cross-sectional regressions within each industry by year as follows: $TobinQ_{i,t,j} = \alpha + \beta_1 SIZE_{i,t,j} + \beta_2 LEV_{i,t,j} + \beta_3 ROA_{i,t,j} + \varepsilon_{i,t,j}$ Then, we calculate *SENTIMENT2* for each firm using the formula: $SENTIMENT2 = (\varepsilon_{i,t,j} - \bar{\varepsilon_{t,j}}) / \sigma_{\varepsilon_{t,j}}$
ANALYST	Ln (Number of analysts (teams) tracking the firm+1)$_t$
REPORT	Ln (Number of analyst reports targeting the firm +1)$_t$
STARANALYST	Ln (Number of star analysts (teams) tracking the firm +1)$_t$
SIZE	Ln (Total Assets)$_t$
LEV	Total liabilities$_t$ / Total Assets$_t$
ROA	Net Income$_t$ / Total Assets$_t$
COST	Operating Costs$_t$ / Operating Income$_t$
GROWTH	(Sales$_t$ – Sales$_{t-1}$) / Sales$_{t-1}$
SOE	A Dummy variable equal to 1 if the firm is a state-owned enterprise and 0 otherwise.
QUICK	(Current Assets$_t$ - Inventory$_t$) / Current Liabilities$_t$
INVEST	(Net investment in long-term assets and subsidiaries$_t$)/ Total Assets$_t$
LISTAGE	Ln (Year$_t$ – Year$_{IPO}$)
INST	Number of shares held by institutional investors$_t$ / Total Number of Shares$_t$
AUDITFEE	Ln (Audit Fees)$_t$
TMTPAY	Ln (Executive Compensation)$_t$
BIG4	A dummy variable equal to 1 if the firm is audited by a Big 4 firm and 0 otherwise.

Appendix B. Balance test results after propensity score matching

Variable	Mean			t-test		V(T)/V(C)
	Treated	Control	%bias	t	p>|t|	
SIZE	21.938	21.958	-1.7	-0.31	0.753	1.19*
LEV	0.458	0.468	-4.8	-0.85	0.396	0.99
ROA	0.046	0.045	1.1	0.21	0.837	0.88
COST	0.734	0.733	0.5	0.08	0.933	0.96
GROWTH	0.353	0.364	-1.2	-0.20	0.845	0.81*
QUICK	1.896	1.839	2.3	0.41	0.679	0.93
INVEST	0.078	0.083	-4.5	-0.79	0.428	0.92
LISTAGE	2.116	2.126	-1.5	-0.26	0.797	1.13
INST	53.824	54.518	-2.8	-0.51	0.613	0.98
AUDITFEE	13.383	13.387	-0.6	-0.11	0.915	1.12
TMTPAY	14.203	14.193	1.3	0.25	0.801	0.89

Note: This table presents balance test results after propensity score matching for firms covered by the Low Carbon City Pilot (LCCP) policy. The "Treated" group consists of firms subject to the LCCP policy, while the "Control" group includes firms not covered by the policy.

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