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The Impact of ESG Policies on the Secondary Market: Evidence from China

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Abstract

In the wave of rapid development of ESG around the world, China enters into its rapid growth stage of ESG development since 2018. A series of essential national policies have been released in a more systematic way to guide the green transformation and development of the state. The release of policies brings the stock markets new information which is assumed to impact the investors' sentiment and the movements of the stocks. However, few literatures is available on this topic. This study aims to investigate how the release of ESG national policies can affect the stock returns of the A-share market in China. The study employs event study as the methodology and can be divided in two stages. In the first stage, five core ESG strategies are selected to test how their announcement can impact the CSI300 and CSI500, two representatives from A-share market. In the second stage, the two first environment policies are selected further to test how their release can impact the involved industries like coal, oil and petrochemical, steel, finance and so forth.

The empirical results demonstrate that the release of national ESG policies generates impacts on the stock returns of both CSI300 and CSI500. The intensity of the policy impacts does not vary a lot between CSI300 and CSI500 but the direction does. Moreover, the release of national double-carbon policies generates impacts on the stock returns of involved industries. The impacts of the release of double-carbon policies on high energy consumption and high emission industries are mostly negative while those on the industries supporting the low-carbon practices are mostly positive.

Key Words: ESG policy, event study, Fama-French three-factor model, abnormal stock return, CSI300, CSI500, A-share market

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1. Introduction

1.1 Research Background and Significance

1.1.1 Background and Motivation

The development of environment, society, governance (ESG) can be traced back to 1990s. However, it is the Principles for Responsible Investment (PRI) launched in 2006 firstly stating that ESG practices can generate impacts on the financial performance of enterprises, marking the official entry of ESG into the vision of investors. An increasing number of investors begin to take environmental, social and governance factors into consideration when making investment decisions. By the end of June 2022, up to 5022 global investment institutions from 60 countries have signed the PRI proposed by the UN (PRI, 2022). ESG information is disclosed by more companies in a systematic way. The growing interest of investors on ESG issues as well as the explosive growth of ESG information in the capital market bring a lot of opportunities and challenges to the field of academic research.

ESG development in China is relatively lagging compared to that in Europe and the U.S. However, since 2018, China has entered its rapid growth stage of ESG development. In the national context of China, ESG development is motivated by top-down policy systems. ESG policies are regarded as a significant tool by the government, regulators and authorities to lead the green transformation and upgrading of all Chinese industries. The change in policy orientation should change the expectations of investors and therefore impact Chinese capital markets. However, due to arrival of the high growth period, there are a lot of gaps in academic research in the ESG field in China. Thus, this study aims to focus on the ESG development in China and investigate the relationship between the release of ESG policies and stock returns in order to provide valuable insights for government, companies and global financial investors and to promote the further development of the ESG field in China.

1.1.2 Research Significance

There is almost no relevant research investigating the impact of ESG policies on the stock market. This can be explained from two aspects. For one thing, the development of ESG in China is still in the initial stage. The academic research on ESG is still in the mapping and development stage. There is almost no relevant research investigating the impact of ESG policies on the stock market. For another, in contrast ESG researches in China, the ESG researches in European countries are more about the impacts of ESG news. This is due to the national context of China that the ESG development is motivated and led by top-down policy system. In this way, combining policy events and capital markets is an innovative perspective in research field which can not only enrich the gap of ESG research in China and but also provide valuable reference information for researches who are interested in the relations between policies and stock markets.

Most importantly, the research can bring implications to multiple stakeholders. First of all, for ESG policymakers and market regulators, the results of this study enable them to understand how ESG policies they have issued impact the stock markets. In this way, they will be able to evaluate and optimize their ESG policy framework to lead the market and promote the development more efficiently. Secondly, for enterprises especially the listed enterprises, getting to know the impact of ESG policies can help them evaluate and manage the risks related to ESG management in a better way. If ESG policy announcement can affect their operations and profitability, they are expected to integrate ESG into their strategies and release more ESG information to the market to draw the attention of investors. Finally, for institutional and individual investors, by raising their awareness of the effects and risks of policies, they can enhance their ability to make rational investment decisions, improve their sensitivity to policy events, reasonably judge the impact of different policies, predict the direction of the stock market, improve the accuracy of their investments and increase their investment returns.

1.2 Research Question and Methodology

1.2.1 Research Question

Given the absolute guiding role of the policy system in Chinese ESG development and the Chinese investors' increasing attention to ESG issues, this study plans to investigate the following questions:

How does the release of ESG policies affect the stock returns in Chinese A-share market?

1.2.2 Research Methodology

This study applies the literature research method, comparative analysis method and event study method to investigate the impacts of key national ESG policies on the stock returns of the A-share market in China from the theoretical and practical levels. In the literature research method, we will use books, journals, magazines, and the Internet to review relevant research results, to understand the development of relevant researches, and lay the theoretical foundation for this study. In terms of comparative analysis, this paper will involve a comparative analysis of the current situation of ESG development in China and the world, which will describe the background of the topic into details and sort out the research context for this paper. In terms of event study method, this study will determine the estimation window and event window, select suitable model to estimate the expected normal returns, and calculate the average abnormal returns as well as the cumulative average abnormal return and finally conduct t-test and significance analysis to verify whether the policy event has a significant impact on the relevant stock returns.

1.3 Research Structure

Part I: Introduction. This part mainly presents the research background and the research significance of the paper, describes the research ideas and research methods of the whole paper, briefly outlines the research line and research content, and summarizes the innovation and research difficulties of the study.

Part II: Literature review. This part investigates and summarizes the previous

literature into three categories: ESG performance and financial results, policies and stock markets, and ESG news and stock markets to gain inspiration and reference from different thinking perspectives.

Part III: Theoretical framework. This section analyzes the theories related to the impact of policy information on stock prices. This part analyzes the theoretical basis of policy factors affecting stock prices from three perspectives, and based on the theory proceeds to dissect the transmission mechanism of stock price fluctuations due to policy events.

Part IV: ESG development in the world and in China. This section first introduces the overall ESG development history of the world. Then this study summarizes the three stages of China's ESG development, the exploration stage, the budding stage and the growth stage, and arranges related policies under each stage to see the evolution of key ESG national policies.

Part V: Empirical analysis. The empirical analysis is based on the event study method to is based on the event study and is conducted into steps including the hypothesis development, the methodology determination, the data selection and the analysis, the findings and results and the robustness check.

Part VI: Research conclusions and limitations. Based on the results of the empirical analysis, final conclusions are made and limitations are analyzed in order to highlight the findings and provide more inspirations for future research.

2. Literature Review

2.1 Previous Literature: ESG and Financial Performance

Summarizing the research about the link between ESG behaviors, initiatives and events and financial performance helps to determine if ESG can play a moderating role in financial indices. Much research can be found in this field, which can be summarized into two categories, research based on Chinese markets and research based on foreign markets. Friede et al. (2015) investigate 2200 individual studies

on the impact of ESG on financial performance and find that the vast majority of the studies concluded with a positive relationship, and less than 10% of the studies find a negative relationship.

The latest research implemented by Chen, Zeng and Zhu (2023) implies that ESG can, not only directly, but also indirectly reduce the cost of equity capital and then increase firm value by reducing the market risk of enterprises and increasing their equity diversification. Li et al. (2022) employs an event study approach to investigate and identify the impact of ESG performance on cumulative abnormal returns during the covid-19 outbreak based on Chinese-listed company data. Results suggest that ESG performance significantly increases firms' cumulative abnormal returns and has asymmetric effects during the pandemic.

Zhao et al. (2018) explore the relationship between ESG and financial performance based on the empirical study of China's Listed Power Generation Companies. The results show that good ESG performance can indeed improve financial performance, which has significant meaning for investors, company management, decision-makers, and industry regulators (Zhao et al., 2018). Weber (2014) investigates the relationship between ESG and firm market value. The findings reveal that the improvement of ESG performance of listed companies can improve the market value of the company, and the operational capacity is an important mediating way for ESG performance to affect the company's value.

Koundouri, Pittis and Plataniotis (2022) explore the connection between good ESG performance and financial results based on European companies and discover a significant dominance in the profitability of companies that have good ESG performance compared to the rest, in all industries in the case of both ROA and ROE. Similarly, Aybars, Ataünal and Gürbüz (2019) investigate the impact of ESG performance on Return on Assets (ROA) based on S&P 500 firm data. The study confirmed unidirectional positive and significant relation between ESG performance and ROA, suggesting that improvements in ESG behaviours have a positive impact on the operating performance of the firm (Aybars, Ataünal and Gürbüz, 2019). in the profitability of companies that have good ESG performance

compared to the rest, in all sectors. This was observed to be the case for both ROA and ROE and agrees also with results from the literature.

The relation proved between good ESG performance and financial results inspire the research. Either nominative, guidance or supportive ESG policies aim to lead companies to achieve higher ESG performance, which therefore may have the potential to impact the financial results of the companies.

2.2 Previous Literature: Policies and Stock Markets

Summarizing the research about policies and stock markets helps to prove the notion of monetary policy transmission via the stock market. Any policies related to the business operation of the firms can have impacts on the stock prices or returns. For example, dividend policies are related to stock changes since it not only impacts future cash flows but can also bring positive signals to stakeholders of the company like shareholders and investors. Hooi, Albaity and Ibrahimy (2015) indicate that dividend yield and dividend payout were found to be negatively related to share price volatility and were statistically significant. In contrast, Ilaboya and Aggreh (2013) find that among the dividend policies dividend yield stimulates a positive and significant influence on the stock price volatility of firms while dividend payout exerts a negative and insignificant influence on stock price volatility.

Wang, Tsai and Li (2017) investigate the policy Impact on the Chinese Stock Market during the period between 1994 and 2015. The results suggest that in addition to stabilization policies, reform policies are effective in reducing stock market volatility. By contrast, volatility increases severely when bailout policies and macro-control policies may cause the stock market to fluctuate when used inappropriately (Wang, Tsai and Li, 2017). Li and Peng (2017) research the impact of US economic policy uncertainty on the co-movements of Chinese stock markets with the US stock market. It is found that the absolute changes in the US economic policy uncertainty index hurt the co-movements (Li and Pen, 2017).

Monetary policies can also be related to the changes in stock prices since they

directly alter the money supply and demand and then impact a series of indices like the discount rates of stock valuation. Ioannidis, C., & Bissoon et al. (2016) investigate the impact of monetary policies on stock markets based on a sample of five open countries with growing stock markets over the period 2004 to 2014. The results confirm that both in the short run and long run monetary variables explain changes in stock markets (Bissoon et al., 2016). Furthermore, Jansen and Zervou (2017) point out that the transmission strength of monetary policy varies over time. Monetary policy surprises have weak effects on stock returns during most of the 1990s but strong and statistically significant effects during the 2000s (Jansen and Zervou, 2017). Li, İşcan and Xu (2010) find that the impacts of monetary policies also vary among areas. The findings imply that in Canada, the immediate response of stock prices to a monetary policy shock is small and the dynamic response is brief, whereas in the United States, the immediate response of stock prices to a similar shock is relatively large and the dynamic response is relatively prolonged.

Researches into policies and stock markets imply that many types of policies like bailout policies, reform policies, monetary policies, and dividend policies can influence stock prices, returns and volatility. The mechanism is that all the policies impact the business operation of the firms and the views of the investors, which lays a foundation for the research of the impacting mechanism of ESG policies.

2.3 Previous Literature: ESG News and Stock Markets

Few previous studies focus on the impacts of policies on the stock market, indicating a huge gap in this research field. Most of the relevant studies investigate the impacts of ESG news rather than ESG policies, which may be because the concept of policy is more prevalent in China than in European countries since it is the main tool for the government to guide the green development of the whole industries to achieve ESG goals. For countries in Europe where ESG development is mature, ESG news just covers as much information as possible also including the policies and principles issued by the

relevant authorities. Thus, researching and summarizing the past literature on ESG news impacts also has a strong reference value.

Länsilahti completed a relevant study based on European stock markets in 2012, especially researching the impacts of ESG negative news on stock markets. With a dataset of 123 negative ESG news and stock information of the companies listed in Europe during the period between 1998 and 2017, Länsilahti (2012) concludes that ESG misbehavior news leads to a statistically significant negative market reaction in stock returns in the short-term and a positive in the long term. The long-term positive overreaction may be due to the investing strategy to buy the undervalued stock right after the initial plunge with a discount and hold it in the investment portfolio for at least a year to make profits.

The amount of research on the topic of the stock market reaction to the ESG news is higher in Nordic countries that own richer ESG development history. Firstly, Ketola (2022) implements a study in Nordic markets to test whether ESG news published by the media affects the value of a company based on 16,765 ESG news and 40 Nordic publicly listed companies over the period from 2013 to 2020. The results illustrate that there is an asymmetry between the effects of positive and negative ESG news as positive news is not found to affect the value of a firm negative ESG news is followed by a statistically significant negative market reaction (Ketola, 2022).

Larsen and Larsen (2022) initiate research exploring how the stock market will respond to the ESG news involving positive and negative sentiment indicators focusing only on Norwegian markets. To explore that, news articles in the energy sector noted on the Oslo Stock Exchange during the period between 2010 and 2021 are collected based on a structure search and then an event study is implemented. Results show that ESG news announcements that were indicated as having a positive sentiment drive a positive stock price reaction while the news indicated by a negative sentiment motivated a negative stock price reaction (Larsen and Larsen, 2022). And the stock reaction observed for positive news is stronger than the reactions associated with negative news (Larsen and Larsen,

2022).

Yoon and Serafeim (2020) obtain similar findings to Larsen and Larsen that a positive market reaction to positive ESG news and a negative reaction to negative news via investigating the reactions of the stocks of companies participating in ESG ratings. Moreover, Yoon and Serafeim (2020) reveal that the market reaction to positive news is smaller for firms with high ESG ratings and interpret this finding as positive news already being reflected in stock prices. Sabbaghi (2020) also employed the MSCI indices as proxies for ESG test assets to investigate the volatility risk for the highest ESG-rated firms whose rankings are above 'BB'. Results coincide with Yoon's and Serafeims's that both positive and negative ESG news have impacts but the impacts of news on the volatility of ESG firms is larger for bad news, compared to good news.

Similarly, Øzkurt and Pedersen (2021) also focus on the Norwegian stock market investigating the effects of non-financial and firm-specific ESG news. They select 25 companies in the OBX-Index at the Oslo Stock Exchange and 107 positive and 225 negative news preparing for an event study. The results, which coincide with those of Ketola's, indicate that negative ESG news has a significant negative effect on abnormal returns, but no significant results are found in the case of positive ESG news, which implies that investors do not reward positive ESG behaviors but penalize negative ESG behaviors (Øzkurt and Pedersen, 2021). Capelle-Blancard and Petit (2017) also have similar findings that firms facing negative events experience a drop in their market value of 0.1% but companies gain nothing on average from positive announcements based on the dataset containing 33,000 positive or negative ESG news and one hundred listed companies over the period 2002 and 2010.

Researches exploring the impacts of ESG news are rare in Asian countries. Only one research in this field can be found in China. Xu, Chen and Wang (2022) implement an event study to research the impacts of ESG news on the Chinese market. It is worth mentioning that instead of dividing news into positive and negative, they split it into the environment, society, and governance-related news.

And it is found that environmental ESG news generates significant impacts. However, the study of S and G news has not yielded significant effects because objective information on social responsibility and corporate governance appears sparse, which provides valuable recommendations for the empirical study based on the Chinese market. Besides that, Inamdar (2019) conducts research exploring the impacts of ESG news based on Indian news and companies. The findings show that ESG events have affected the share performance return significantly for a one-week duration but not affected much for two-week duration (Inamdar, 2019).

3. Theoretical Framework

3.1 The Efficient Markets Hypothesis Perspective

First of all, the efficient market hypothesis (EMH) proposed by Fama lays a theoretical foundation for our research. It states that everyone in the market is a rational economic agent and that stock prices reflect all available information about the asset and the supply and demand balance of these participants (Titan, 2015). The efficient market hypothesis can be categorized into three market forms: weak, semi-strong, and strong efficient markets (Fama, 1970). In the weak efficient market, stock prices are assumed to reflect all historical trading information like the close price and trading volume. In a semi-strong efficient market, stock prices are assumed to reflect all the publicly disclosed information like financial reports. In a strong efficient market, stock prices are assumed to reflect both the public and non-public information. That means even investors obtain inside information, they will not make excess returns in that market. Obviously, the announcement of policies will bring markets a lot of information. Based on EMH, if the market is efficient, the new information included in the policy will be immediately reflected in the stock market. Investors will infer the future operations and profitability of the target companies based on the content of the policy. And the sentiment and attitude of the investors affect the trend in the

stock market in turn.

3.2 The Behavioral Finance Theory Perspective

In contrast to EMH theory, the behavioral finance theory study aims to effectively explain some abnormal market reactions based on psychological research results about human beings. Behavioral finance research states that stock prices deviate from their intrinsic value in the long term. That is, market prices do not reflect all information, and thus markets may not always be efficient and market portfolios may not be efficient portfolios (Shiller, 2003). That means when a new policy is announced, the market may not respond immediately or the market responds but in an inadequate manner. According to the behavioral finance theory, the deviation of stock price from the intrinsic value after the policy release can be explained from three aspects. Firstly, the investors may overreact or underreact after receiving the new information from the policy, which can lead to short-term abnormal volatility of the stock market. The optimistic or pessimistic attitudes of the investors have great uncertainty, making the stock changes unpredictable to some extent. Secondly, the follower behaviors of investors can also lead to abnormal fluctuations. According to behavioral finance theory, there is information asymmetry among investors. Institutional investors tend to obtain more inside information than individual investor. Therefore, individual investor may have crowd mentality to follow the decisions of others. Last but not the least, the ability of processing information differs a lot among investors. Some investors may overfocused on some policies and ignore other aspects when making investment decisions. Overall, behavioral finance theory implies that the policy information affects the judgment of stock value and the choice of investment strategy by changing the psychological expectations of non-fully rational investors, whose irrational decision-making behavior affects the supply and demand of stocks in the short term, which in turn leads to changes in stock prices and returns.

3.3 The Synergistic Market Hypothesis Perspective

Similar to behavioral finance theory, the synergistic market hypothesis no longer follows the assumptions of the efficient market hypothesis of rational economic agents, random movement of prices and rates of return, and normal distribution. Instead, it also aims to explain why stock prices can violate dramatically and deviate significantly from their intrinsic value in reality. Synergies happen when the strong external influence on stock prices and the sentiment of the investor are in the same direction, which in turn leads to a far stronger impact in the same direction (Vaga, 1990). In details, when a new policy is released, the market receives the information and reacts. If the policy is favorable to the valuation of the stock, the stock price will naturally adjust to a higher level. Meanwhile, investor sentiment can amplify the effect of the information, causing the stock price to adjust to a higher level. In a synergistic market, the collective sentiment of investors can cause the market to react more strongly, resulting in a "synergistic bull" or "synergistic bear" market. The degree of influence of policy information on stock prices is determined by the degree of correlation between external information and investor sentiment, which determines the stock volatility.

4. Development of ESG and ESG Policies in China

4.1 ESG Development in the World

Table 1 Overview of ESG topics

Classification	Topics
Environment (E)	Carbon emissions, climate change, biodiversity, energy use, resource management, raw material and supply chain management, waste recycling utilization, etc.
Social (S)	Employee health and safety, human capital management, human rights protection, stakeholder claims, community relations, etc.

Governance (G)	Shareholding structure, board structure, bribery and corruption, anti-hostile takeover, executive compensation, transparency in decision-making, risk prevention and control, etc.

The emergence of ESG, the abbreviation of environment (E), society (S), and governance (G), can be traced back 1997 when the Global Reporting Initiative (GRI) was established by the US non-profit Environmental Economic Organization (CERES) and the United Nations Environment Programme (UNEP). GRI proposes that the sustainability report should be divided into E, S and G three sectors. By the early 2000s, the Global Compact issued by the United Nations (UN) promotes that the corporate should take the responsibility for environmental protection, human rights, labor rights, anti-corruption and other aspects that related to E, S and G. In 2006, GRI provides detailed guidelines on the disclosure of E, S and G information for enterprises, symbolizing that the ESG concept is integrated into the corporate social responsibility report formally. In the next follow years, the economic crisis in 2008 generated more attention to the operation of companies especially their ESG practices. And the Sustainable Development Goals (SDGs) proposed by the UN in 2005 further accelerate the development and popularity of ESG concepts. More and more stakeholders like creditors and shareholders begin to take ESG concepts into consideration when they evaluate the performance of the target companies and make investment decisions. Meanwhile, more fund is flowed into the financial products related to ESG. Besides that, the outbreak of covid-19 enabled an increasing number of investors to realize the significance of sustainability and pay more attention to ESG development. In recent years, the global ESG development is more focused on ESG ratings and regulations to ensure a more transparent and sustainable business environment as more companies join the development system of ESG.

Currently, the ESG participant group has grown to a large scale. By the end of June 2022, up to 5022 global investment institutions from 60 countries have signed the Principles for Responsible Investment (PRI) proposed by the UN (PRI, 2022). And the global ESG rating system is growing increasingly mature. Various ratings systems including MSCI, ISS, Moody's, S&P, Bloomberg and so forth

have emerged. According to the Bloomberg Intelligence, the ESG investment is developing around the globe as the investment related to ESG has been doubled since 2016 and is estimated to exceed 50 trillion by 2050 (Bloomberg, 2022). The rapid penetration of ESG concept into the capital markets makes more and more researchers to start to explore the relation between ESG and financial markets.

4.2 ESG Development in China

Compared with European and American countries, China's ESG development is relatively lagging behind. The history of ESG development in China can be mainly divided into three periods: the exploration stage, the budding stage, and the growth stage.

4.2.1 The Exploration Stage (2000-2010)

At this stage, the concept of ESG and sustainability were relatively new for the investors in Chinese markets. Only few large state-owned enterprises started to pay attention to the issues on environmental, social and governance issues and published the corporate responsibility reports proactively. The significance of ESG concept on the operation of the business was not realized by most enterprises. In details, regarding the environment, with the rapid development of the economy, greater environmental pressure was exposed to companies to think about how to take measures to reduce the pollution. The Shenzhen Stock Exchange took the lead to issue the Guidelines on Social Responsibility of Listed Companies on the Shenzhen Stock Exchange, mentioning the environmental protection responsibility of listed companies. China started to publish a series of policies and regulations on environmental protection but there was still a lack of systematic construction. In terms of the governance topic, the reform of corporate governance was proposed by Chinese government. Some listed companies took the lead to pay efforts to optimize their internal management and increase their operational transparency. As for the social sector, the companies were still in the stage of lacking awareness of improving employee training and constructing the welfare

and health system for employees.

Few ESG policies were released during this period. Chinese government paid more attention to economic development and structural reforms at that time. The released policies related to ESG concentrated more on the information disclosure issues as the global wave of ESG reporting set off at that time.

- 09/2003 “Announcement on the Disclosure of Corporate Environmental Information”
- 06/2006 “Guidelines on Social Responsibility of Listed Companies”
- 04/2007 “Environmental Information Disclosure Methods (for trial implementation)”

4.2.2 The Budding Stage (2010-2018)

At this stage, the ESG concept gradually penetrated into the national development policies. The development of ESG concept witnessed significant progress in three major aspects. First of all, an increasing number of ESG policies were issued in contrast to the situation of last period. The ESG policies in China mostly concentrated on the topics of environment and society. Based on its own national conditions, China introduced a top-down development driven primarily by national policies to the capital markets. This customized method motivated a growing number of enterprises to take positive actions in the areas of environmental protection, social contribution and employee rights. Secondly, China also established its own ESG rating systems like CSI and Wind to further oversee the orderly development of the ESG market. After years of figuring out, China further increased its requirements for enterprises to release non-financial information in their annual reports. Led by central enterprises and listed companies, the ESG information disclosure and ESG performance evaluation in China are gradually moving forwards to the international standards. In 2018, A-share listed companies were officially included in the MSCI Emerging Markets Index and MSCI Global Index. Last but not the least, it is worth mentioning that ESG investment also grew steadily with the popularity of ESG concepts among

Chinese investors. In 2015, China started constructing the green financial system. A number of significant policies on sustainable investment and financing such as green bonds, green credit, green insurance, and carbon emissions trading have been formulated and introduced by the end of this stage.

- 02/2008 “Guiding Opinions on Strengthening Supervision and Management of Environmental Protection Issues of Listed Companies”
- 05/2008 “Notice on Strengthening the Social Responsibility of Listed Companies”
- 05/2008 “Guidelines of Disclosing Environmental Information for Listed Companies”
- 04/2013 “Assessment Methods for Information Disclosure Work of Listed Companies”
- 09/2015 “Guiding Opinions on Accelerating the Construction of Ecological Civilization”, “Overall Program of Ecological Civilization System Reform”
- 08/2016 “Guiding Opinions on Building a Green Financial System”
- 06/2018 “Guidance on Better Fulfillment of Social Responsibility for State-owned Enterprises”
- 09/2018 “Code of Governance for Public Companies”

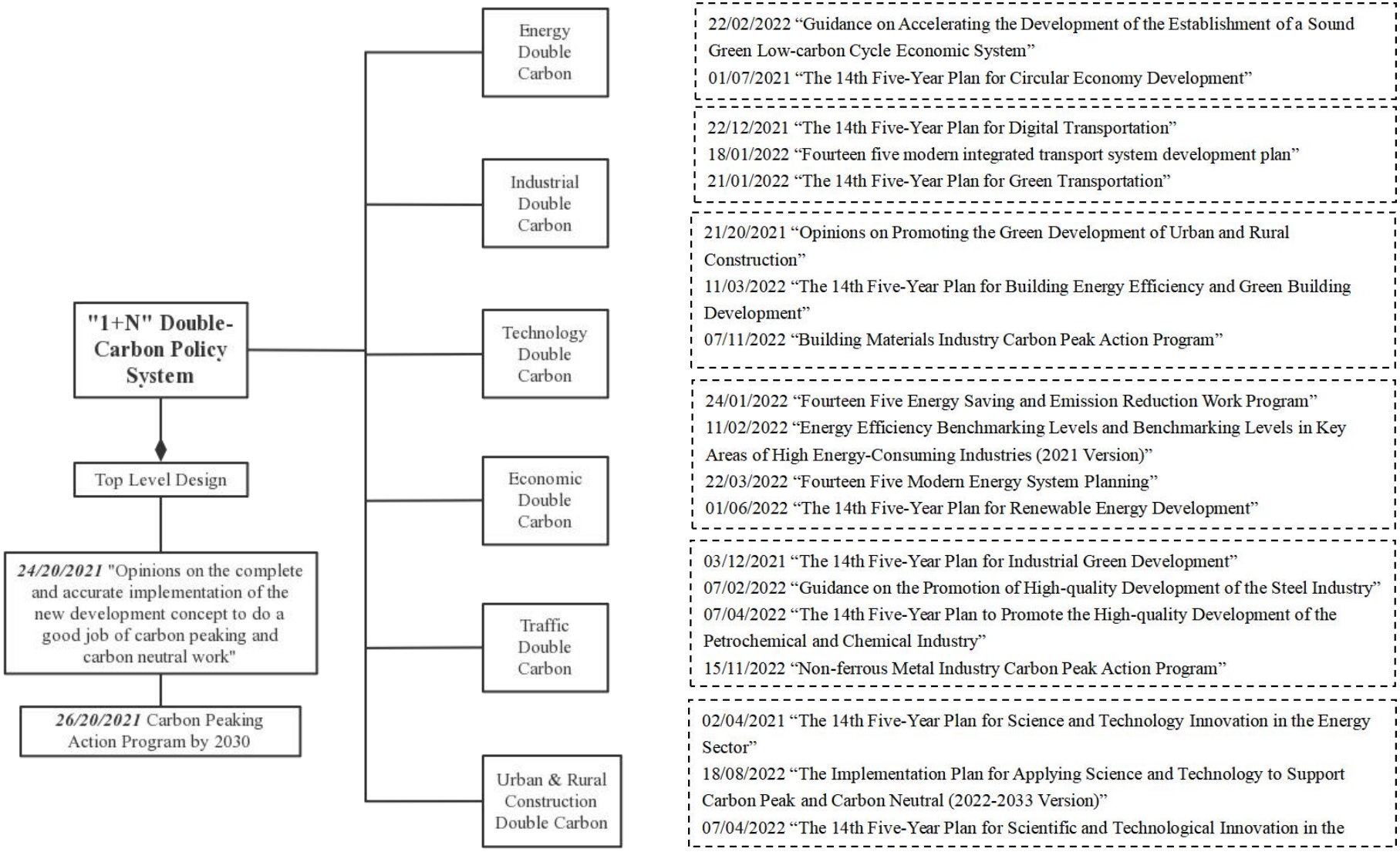
4.2.3 The Growth Stage (2018-now)

At this stage, ESG development entered an accelerated phase in China. ESG is regarded as an essential tool to further promote the high-quality economic transformation in China. There is an explosive growth in ESG policies and guidelines. Most importantly, the publishment is in a more systematic way. Not only the central and large listed companies but also other medium- and small-scaled companies are involved into the process of strengthening the ESG management. As what has been discussed above, the focus of Chinese ESG development is more on the environmental topic. Since China announced its goal of achieving “carbon peak” by 2030 and “carbon neutral” by 2060, more ESG policies have been issued to promote the achievement of the goals. Chinese government introduced “1+N” policy system, among which “1” refers to a

top-level design document, and "N" refers to a series of carbon peaking action plans and policies targeted in key areas and industries. As it is shown in the figure1, “1” refers to the release of the “Opinion” and “Action Plan” released on 24th, 26th October, 2021 respectively while “N” refers to the following policies in different areas among which energy, economy, technology, transportation, urban and rural construction are selected as the representatives. The “1+N” approach that the central government published key policies first and relevant departments and units and also each region follow to develop their own plans accordingly is effective in the Chinese national context. Currently, the double-carbon is one of the most heated topics in ESG field in China. It can generate effects to a great number of industries like carbon, energy, chemicals, oil, metals, electricity, finance, and so forth, which also set a foundation for our following empirical research.

In addition to the growing development in environment sector, China also increased its attention to society and governance. In the practice of poverty eradication, China actively drew on experience form international practices, closely integrated them with Chinese reality, and creatively proposed and implemented a series of strategies and policies focusing on human rights. As for the governance part, the number of policies also witnesses an obvious increase. However, as what has been discussed above, the focus of the current ESG work is still on environment, our empirical studies will more focused on carbon policies in the “1+N” system.

Figure 1: The “1+N” double-carbon policy system in China



5. Empirical Analysis

5.1 Hypothesis Development

Hypothesis 1a: The release of national ESG policies will generate impacts on the stock returns of CSI300 constituent stocks.

Hypothesis 1b: The release of national ESG policies will generate impacts on the stock returns of CSI500 constituent stocks.

Based on the previous discussion, it is known that the ESG development in China is a top-down development process led and supervised by a series of national policies. Thus, it is inferred that the publishment of national ESG policies especially those landmark policies can play a role as the windsock for the investors in stock markets. And CSI300 and CSI500 are two stock portfolios composed by large, medium-and small enterprises respectively, both of which are of good liquidity and representativeness from Shanghai and Shenzhen security market. Thus, this study would like to firstly test if there is any relation between the release of national core ESG policies and the stock returns in A-share marker (represented by CSI300 and CSI500 markets).

Hypothesis 2a: The release of national ESG policies will impact CSI300 and CSI500 constituent stocks with different directions.

Hypothesis 2b: The release of national ESG policies will impact CSI300 and CSI500 constituent stocks with different degrees.

With size and liquidity as two fundamental criteria for sample selection, CSI300 are composed by large-cap stocks whose performance are in top 300 and whose growth are basically in a mature stage. In contrast, CSI500 is made up by the top 500 stocks where the CSI 300 constituent stocks and the top 300 stocks regarding the total market capitalization are excluded already. CSI300 is often referred as a combination of large-cap enterprises with high quality and liquidity while CSI500 is often referred to as a combination of the medium- and small-cap firms in the A-share market. Regarding that difference, this study then would like to test if the

size and liquidity performance of the firms will lead to the policy impacts with different directions or intensities.

Hypothesis 3: The release of national environment policies will impact the involved industries.

Hypothesis 4a: The release of national environment policies will impact the involved industries with different directions.

Hypothesis 4b: The release of national environment policies will impact the involved industries with different degrees.

In China's national context, environment is the most popular area of interest among the areas of environment, society, and governance. In contrast with society and governance, environment area has witnessed a rapidly increasing number of policies. After the carbon peak and carbon neutral goals was set, "1+N" double-carbon policy system has been built up and several essential national policies have been published. Unlike most policies, those policies are regarded as the top design of the ESG framework and assign objectives and tasks to a series of industries like coal, oil& petrochemical, steel, finance, clean energy, electricity equipment and so on. Thus, in the second analysis stage, this study aims to investigate if those top design environment policies will generate impacts to those involved industries and if the impacts will also differ in directions and intensities.

5.2 Event Study Methodology

Event study is the methodology used in this thesis to test if there are significant abnormal returns around the date when the event happens. The event study method focuses on whether there is a correlation between a specific event and the stock price of listed companies, i.e., whether the occurrence of a certain event will lead to an abnormal rate of return on the stock price of the relevant company. The principle is that the impact of an event on a company will be reflected in asset prices within a short period. By studying the changes in stock returns of listed companies before and after the occurrence of a particular event, we can determine whether there is a correlation between the event and the company's stock price. If

there is a correlation, the stock returns before and after the event will produce a difference (abnormal return). If the abnormal return is positive, it indicates that the event has a positive impact on the stock price of the listed company. If it is negative, it indicates that the event hurts the listed company. Therefore, the core of the event research method is to work out the expected return of the event window and then calculate the abnormal return to analyze the degree and direction of stock price fluctuation caused by the event, providing the relevant parties with suggestions for guidance.

The general research steps of the event study method are as follows.

1) Define the estimation window and event window
2) Determine the estimation model and estimate the expected normal returns
3) Calculate the abnormal returns (AR), average abnormal returns (AAR), cumulative abnormal returns (CAR), cumulative average abnormal returns (CAAR)
4) Conduct t-test to see the significance of AARs and CAARs.

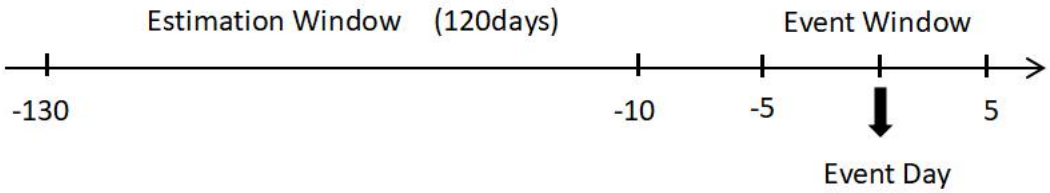
5.2.1 Estimation and Event Windows

The event date refers to the policy issuance date or the time when the market is informed of the event. The estimation window refers to the longer period before the event date where the asset pricing model is applied estimate the parameters, preparing for the calculation of the expected normal returns in the event window. And the event window refers to the period before and after the event date when the abnormal returns are worked out. The estimation window and the event window cannot overlap, and the length of the window is determined by the nature of the event and other conditions.

After selecting the policy event, this study takes the trading day closest to the announcement date of the documents as the event date. If the announcement date of the policy event is a trading day, there is no need to consider the issue of deferral date, and the announcement date is set as the base date, marked as T=0. The five trading days before and after the event date are set as the event window, marked as T=-5,-4,-3,-2,-1,0,1,2,3,4,5 respectively, for a total of 11 trading days.

The estimation window is set to 130 trading days to 10 trading days before the event date, for a total of 120 trading days. The specific event window and estimation window dates are as follows.

Figure 2: Window selection of the event study



5.2.2 Estimation of Normal Return

This study applies Fama-French three-factor model to estimate the normal returns of the event window. The Fama and French model has three factors: the size of firms, book-to-market values, and excess return on the market. As an extension of capital asset pricing model (CAPM), Fama-French three-factor model refines the model by adding value risk and size risk to the original market risk. Fama-French model decomposes part of the excess return that is unexplained by CAPM model into SMB and HML factors, helping to better capture the effects in the market.

$$R_{it} = ln(\frac{P_{it}}{P_{it-1}})$$

$$R_{it} - R_{ft} = \alpha_i + \beta_j(R_{mt} - R_{ft}) + m_i SMB_t + n_i HML_t + \varepsilon_{it}$$

$$\text{SMB} = \frac{(\text{SL} + \text{SM} + \text{SH})}{3} - \frac{(\text{BL} + \text{BM} + \text{BH})}{3}$$

$$\text{HML} = \frac{\text{SH} + \text{BH}}{2} - \frac{\text{SL} + \text{BL}}{2}$$

Where R_{it} is the daily return on stock i at time t, R_{ft} is the daily risk -free rate at time t, and R_{mt} is the daily return on market portfolio at time t. SMB_t, small minus big, is the excessreturns of small-cap companies over large-cap companies at time t. HML is the excess returns of value stocks (high book-to-price ratio) over growth stocks (low book-to-price ratio).

The market value is divided into two groups: large (L) and small (S) groups according to the median market value. And the book-to-market ratio is classified into three groups: High (H), Medium (M), and Low (L). Those six subgroups can be freely combined into six portfolios: SL,SM,SH,BL,BM,BH. In the calculation process, SL,SM,SH,BL,BM,BH are the weighted average stock return of the six portfolios.

With all the explanatory variables, we run the Fame Three-factor Model within the estimation window (120 days). For each company, it has 120 groups of independent and dependent variables. Therefore, we can estimate the parameters β_j, m_i and n_i for each sample company separately based on the panel data within the estimation window.

5.2.3 Abnormal Returns

Then, for each day during the event window, we can estimate an expected normal return for each company with the parameters estimated before. That means we obtain N abnormal returns (AR_{it} s) at time t where N is the number of the companies of the sample. The average abnormal return AAR_t per day is the sum of AR_{it}s divided by the number of companies.

$$AR_{it} = R_{it} - E(R_{it}|Y_t) = R_{it} - (\alpha_i + R_{ft} + \beta_j(R_{mt} - R_{ft}) + m_i SMB_t + n_t HML_t + \varepsilon_{it})$$

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$$

Where R_{it} is the actual stock return of company i at time t while $E(R_{it}|Y_t)$ is the expected stock return of company i at time t, Y_t is the conditioning information of the normal performance model. AR_{it} is the abnormal stock return of company i at time t and AAR_t is the average abnormal return of day t within the event window.

$$\mathrm{CAR}(t1, t2) = \sum_{t=t1}^{t2} AR_{it}$$

$$\mathrm{CAAR} = \frac{1}{N}\sum_{i=1}^{N} \mathrm{CAR}(t1, t2)$$

In order to measure the effect across time, the abnormal returns for company can be aggregated across the event windows, exporting the cumulative abnormal return (CAR) foreach company. Similarly, the average of the CAR per day within the event window is cumulative average abnormal return (CAAR).

5.2.4 Significance Test of Abnormal Returns

As what has been discussed above, for each day during the event window, we obtain N abnormal returns (ARs) where N is the number of the companies in the sample. In order to test if the average of those ARs differ from zero with some statistical validity, we apply test statistics here. The t-statistics is then compared with the critical values of student t-distribution, helping to figuring out the AAR on which time during the event window is truly abnormal. In a similar way, we also have the sample CARs per day within the event window. The formula can be applied to CARs as well to test if the CAAR at time t is significantly different from 0. The application of t-test is highly dependent on the assumptions: i) the abnormal returns are normally distributed; ii) the abnormal returns are uncorrelated. If the AAR and CAAR are significantly different from 0, that proves the event truly generate impacts on the stock returns at a specific day or during a specific period.

$$t_{AAR} = \frac{\overline{AR_{it}}}{\sigma(AR_{it})/\sqrt{n}}$$

$$t_{CAAR} = \frac{\overline{CAR_{it}}}{\sigma(CAR_{it})/\sqrt{n}}$$

5.3 Data Collection

5.3.1 Event Selection

This study can be divided into two stages. In the first stage, how environment, society, and governance policies can affect A-share market (CSI 300 & CSI 500) is explored. In the second stage, how the first two environment policies, which are regarded as the most essential carbon policies in China during its process of achieving carbon peak and carbon neutral, are selected further. The reason why

the environment policies are selected is that environment area is the area that Chinese government pays highest attention to in the current growth period. How the effects of the release of those two environment policies on the stock return in the capital market can differ among involved industries is the major research topic of the second stage. According to the ESG rating system and the current state of China, environmental policies refer to the policies that are related to environment protection and green development. In contrast, social policies refer to the policies that are related industrial poverty alleviation, rural revitalization, public charity and so forth while governance policies are those related to shareholding structure, information disclosure and so on.

The criteria of selecting the ESG policies can be viewed into two aspects. Firstly, the policy is issued by the central government instead of regional governments since we assume central government policies can generate director and greater impacts on the A-share stock market. Secondly, the policy is released in recent years like not earlier than 2015 since the period 2018 to 2023 is the growth period of Chinese ESG development. During this period, not only the policy number is larger but also the policy quality is higher as the government started to build up systematic policy systems. Thirdly, the policy content should be closely related to the business operation of A-share market enterprises since only in this way may the investors' opinions on the targeted stocks change. Finally, event cluster dates should be avoided in the process of selecting events. The period when the events that may generate potential impacts on the sample are aggregated is not an ideal selection since it will be hard to figure out if the abnormal returns are caused by the tested event and then the statistical power can be reduced. Based on the above criteria and the national context of China, five key policies are selected in total as shown below.

Table 2: Summary of Selected ESG Policies

Classification	Name of the policy	Issue Date	Policy no.
Environment	Carbon Peaking Action Plan by 2030	26/10/2021	1
	The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction	24/01/2022	2
Society	Opinions on Playing the Role of Capital Market to Serve the National Strategy of Poverty Eradication	09/09/2016	3
Governance	Code of Governance for Public Companies	30/09/2018	4
	Information Disclosure Management Measures for Listed Companies	18/03/2021	5

Notes: This tables summarize the five key national ESG policies we select for the empirical analysis.

1) "Carbon Peaking Action Plan by 2030" released on 26th October 2021

This policy is regarded as the top design policy, which is the "1" in the "1+N" double carbon (carbon peak and carbon neutral) policy system. It aims to promote the carbon peak actions among all related industries like coal, oil, chemicals, metals, building materials, and new energy throughout the whole process of economic and social development and all aspects. The action plan is further divided into several subplans including energy area carbon peak, industrial area carbon peak, technology area carbon peak, transportation area carbon peak, economy area carbon peak and so on.

2) "The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction" released on 24th January 2022

This policy is one of the most essential sub action plans within the "1+N" policy system. Similar to the first policy, this policy also focuses on multiple industries. It proposes goals and plans to achieve energy saving, carbon reduction, pollution reduction, synergistic efficiency, sustained improvement in the ecological environment. Not only the high energy-consuming and high-emission industries are involved but also other fields like finance are mentioned. For instance, the green credit is encouraged to be developed further to support energy conservation and emission reduction in key sectors.

3) ***"Opinions on Playing the Role of Capital Market to Serve the National Strategy of Poverty Eradication" released on 9th September 2016***

The reason why only one policy is collected for society is that we found China is still immature in this area. China pays highest attention to environmental part and then governance. As for the society area, it can be found that China concentrates on precise poverty alleviation and rural revitalization. However, few issued policies are related to the business operation of listed companies except this selected policy. This policy aims to support and encourage listed companies, securities companies, fund and future operators to enhance their social responsibility of poverty alleviation.

4) ***"Code of Governance for Public Companies" released on 30th September 2018.***

This policy is under the topic of governance. It is one of the most representative policies that are issued in recent years customized for corporate governance. It defines the latest governance principles for the listed companies including the operation of shareholder meeting, the composition of board of directors and supervisor committee, the incentive and restraint mechanism for employees, the code of conducts for related parties and so on.

5) ***"Information Disclosure Management Measures for Listed Companies" released on 18th March 2021***

This policy helps to finalize and clarify the latest requirements on information disclosure of listed companies. In addition to improving the basic requirements of information disclosure, it also refines the interim reporting requirements, supplements and improve the circumstances of material events, improve the point of disclosure of material matters by listed companies, and clarify that the disclosure obligation is triggered when the directors, supervisors or senior management become aware of the occurrence of the material event.

5.3.2 Company Selection

In the first stage of the study, CSI300 and CSI500 constituent stocks are collected as the samples. Empirical studies are conducted to see if CSI300 and CSI500

stock markets will be impacted by publishment of the selected 5 ESG policies and if the impacts on stock returns differ between CSI300 and CSI500 enterprises. The CSI 300 Index is composed by 300 most representative securities with large scale and high mobility. This portfolio is usually applied to represent the overall performance of large public securities listed in the Shanghai and Shenzhen markets. In the meantime, its constituent stocks are balanced distributed across industries so that there will be lower volatility risk of holding a single sector. In contrast, CSI500 index is the top 500 stocks in terms of total market capitalization within the sample of all A-share companies where the CSI 300 constituent stocks and the top 300 stocks regarding the total market capitalization are excluded already. Thus, CSI500 is often referred to represent the performance of the medium- and small-sized firms in A-share market.

In the second stage of the study, the stocks under nine different industries are collected respectively as the subsamples. Empirical studies are conducted to see if the release of significant environment policies will generate impacts to the sample industries and if the impacts will differ among those industries. The industries include Coal, Oil& Petrochemical, Steel, Building Materials, Non-ferrous Metal, Electricity Equipment, Clean Energy, Environment Protection and Finance. The data is collected from iFund Database and the Industry Classification Criteria is consistent with the latest version of the Wind criteria. The detailed composition of each industry can be viewed in the table 3. The reason why we select the above 9 industries is that they are the key industries that are involved in both of the two double-carbon policies and are expected to be impacted by the release of the policies.

Table 3: Summary of involved industries in the second empirical stage

Industry	Composition	Sample Number
Coal	Listed coking and coal mining companies	38
Steel	Listed plain steel, special steel, and steel smelting material companies	45
Non-ferrous metal	Listed industrial metals, precious metals, small metals, energy	137

	metals and other metals companies	
Oil & Petrochemical	Listed oil and gas exploration, oil service engineering, oil refining and trading companies	44
Clean Energy	Listed hydroelectric power, wind power, photovoltaic power, and nuclear power companies	35
Building Materials	Listed cement, glass fiberglass, decoration and building materials companies	76
Environment Protection	Listed atmosphere management, water management, solid waste management, comprehensive environmental management, and other companies	130
Electricity Equipment	Listed battery, motor, grid equipment companies	338
Finance	Listed banks and non-bank financial institutions	125

Notes: This tables summarize the 9 subsamples in the second stage of the empirical study. Before running models, ST companies and companies with missing values during the defined window will be excluded first.

5.3.3 Financial Data Selection

To apply the Fama–French three-factor model within the estimation model, firstly the stock data like stock price, book-to-market ratio, and market value are collected to calculate the daily excess stock return, SMB and HML factors in the Fama–French three-factor model. Besides that, the daily price of market index and daily risk-free rate are also required to calculate the daily market excess return in Fama–French three-factor model. In this study, we use CSI800 index to represent the market price since CSI800 contains the constituent stocks of both CSI300 and CSI500, reflecting the stock performance of the major small, medium and large cap companies in the A-share market. In terms of the risk-free rate, we select the 7-day weighted average interest rate of the Depository-Institutions Repo Rate (DR007). DR007 is restricted to depository financial institutions and the pledges are interest rate bonds. Currently, DR007 is pledged with risk-free interest rate bonds such as treasury bills, which effectively eliminates the credit risk premium and also represents a real transaction price. Regarding the situation that DR is collateralized by sovereign debt such as treasury bills, central bank notes and policy finance bonds isolating the credit risk of counterparties, we select daily DR007 to represent the daily risk-free rate. All of the above-mentioned financial

data including the daily close price of the stock, the daily book-to-market ratio, the daily market value, the daily close price of the market index, the daily risk-free rate will be collected and processed for CSI300, and CSI500 enterprises and also the companies under the tested 9 industries. All of the financial data is collected from 2015 to 2023 from iFund Database. To sum up, in this study, there are five main panels shown as follows.

Table 4: Summary of empirical panels

Panel	Financial Data	Period	Company data	Event data
Panel A	Daily stock price, price to book ratio, and market value. Daily risk-free rate and market index price	2015 -2023	CSI300 companies	5 ESG policies
Panel B	Daily stock price, price to book ratio, and market value. Daily risk-free rate and market index price	2015 -2023	CSI500 companies	5 ESG policies
Panel C -Panel K	Daily stock price, price to book ratio, and market value. Daily risk-free rate and market index price	2018 -2023	Companies under Nine industries	2 Environment Double-Carbon Policies

Notes: This tables summarize the panel data A-K which will be used in the following two empirical stages.

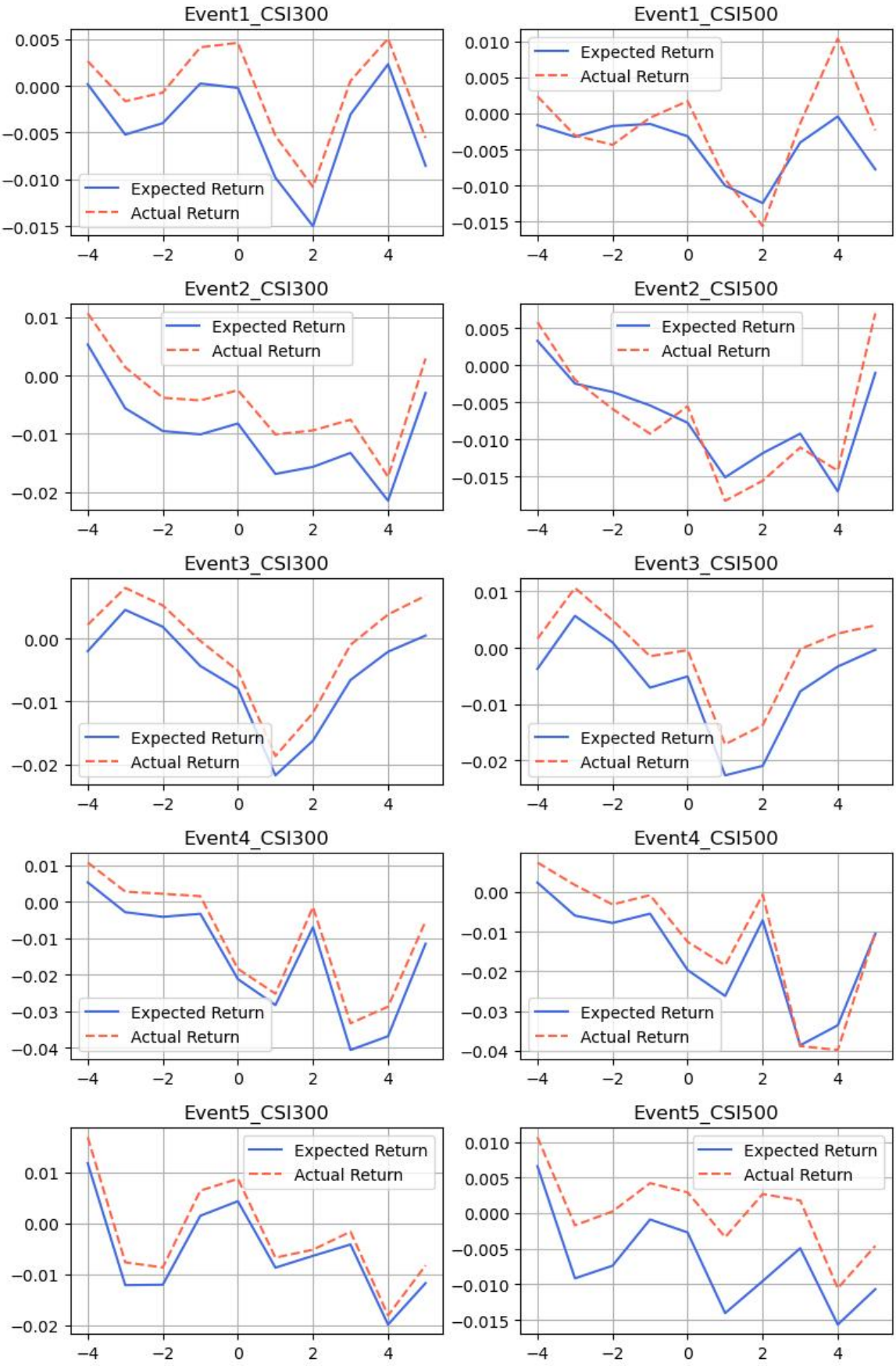
5.4 Findings and Results

5.4.1 First-stage Empirical Results

Table 5: Summary of AARs and CAARs for the first empirical stage based on (-5,5) event window

	Day	AAR_1	$CAAR_1$	AAR_2	$CAAR_2$	AAR_3	$CAAR_3$	AAR_4	$CAAR_4$	AAR_5	$CAAR_5$
CSI 300	-5	0.0033**	0.0033**	0.0010	0.0010	0.0038**	0.0038**	0.0061***	0.0061***	0.0032**	0.0032**
	-4	0.0017	0.0049**	0.0097***	0.0107***	0.0046**	0.0084**	0.0048***	0.0109***	0.0070***	0.0102***
	-3	0.0055***	0.0104***	0.0044***	0.0151***	0.0025*	0.0108***	0.0065***	0.0173***	0.0019	0.0121***
	-2	0.0011	0.0115***	0.0071***	0.0221***	0.0044***	0.0152***	0.0062***	0.0235***	0.0049***	0.0170***
	-1	0.0067***	0.0182***	0.0046***	0.0267***	0.0037***	0.0189***	0.0034***	0.0269***	0.0050***	0.0220***
	0	0.0030**	0.0211***	0.0068***	0.0336***	0.0020	0.0209***	0.0022	0.0291***	0.0038***	0.0258***
	1	0.0060***	0.0272***	0.0067***	0.0403***	0.0041**	0.0250***	0.0040***	0.0332***	0.0001	0.0259***
	2	0.0023	0.0295***	0.0058***	0.0461***	0.0047***	0.0297***	0.0070***	0.0402***	0.0023	0.0282***
	3	0.0048***	0.0344***	0.0056***	0.0516***	0.0065***	0.0362***	0.0076*	0.0478***	0.0028*	0.0309***
	4	0.0006	0.0350***	0.0026**	0.0543***	0.0054***	0.0416***	0.0086**	0.0564***	0.0008	0.0318***
	5	0.0053***	0.0403***	0.0092***	0.0635***	0.0073***	0.0489***	0.0038*	0.0601***	0.0061***	0.0379***
CSI 500	-5	0.0073***	0.0073***	0.0082***	0.0082***	0.0033***	0.0033***	-0.0021**	-0.0021**	0.0030**	0.0030**
	-4	0.0007	0.0080***	-0.0032	0.0051**	0.0074***	0.0107***	0.0122***	0.0101***	0.0051***	0.0082***
	-3	-0.0003	0.0077***	0.0042***	0.0093***	0.0026**	0.0133***	0.0032***	0.0133***	0.0097***	0.0179***
	-2	-0.0049***	0.0028	-0.0088***	0.0005	0.0052	0.0185**	0.0061***	0.0194***	0.0055***	0.0234***
	-1	0.0066***	0.0094***	0.0012	0.0016	0.0059***	0.0244***	0.0032***	0.0227***	0.0047***	0.0281***
	0	0.0031**	0.0126***	0.0033**	0.0049	0.0034	0.0278***	0.0110***	0.0337***	0.0066***	0.0347***
	1	-0.0014	0.0112**	-0.0096***	-0.0047	0.0076**	0.0354***	0.0044***	0.0381***	0.0147***	0.0495***
	2	-0.0050**	0.0062	0.0022	-0.0025	0.0068***	0.0423***	0.0085***	0.0466***	0.0097***	0.0592***
	3	0.0103***	0.0165***	-0.0059***	-0.0084*	0.0082***	0.0504***	-0.0089***	0.0377***	0.0037**	0.0629***
	4	0.0113***	0.0278***	0.0115***	0.0031	0.0035***	0.0540***	-0.0035*	0.0342***	0.0065***	0.0693***
	5	-0.0004	0.0274***	0.0046***	0.0077	0.0051***	0.0591***	0.0040***	0.0382***	0.0057***	0.0751***

Figure 2: The trend of actual return and expected return for CSI300 and CSI500



Notes: This plot shows the trends of expected return and actual return during the event window (-5,5) for both CSI300, CSI500. The difference in impacts can be visualized from the interval and position of the lines.

Table 6: The summary of CAARs for the first empirical stage based on different event windows

	Window	$CAAR_1$	$CAAR_2$	$CAAR_3$	$CAAR_4$	$CAAR_5$
CSI 300	(-5,0)	0.0211***	0.0336***	0.0209***	0.0291***	0.0258***
	(-3,0)	0.0164***	0.0226***	0.0125***	0.0183***	0.0155***
	(-1,0)	0.0098***	0.0115***	0.0058**	0.0057**	0.0087***
	(0,1)	0.0091***	0.0137***	0.0062**	0.0063**	0.0040*
	(0,3)	0.0164***	0.0248***	0.0175***	0.0209***	0.0090***
	(0,5)	0.0225***	0.0364***	0.0303***	0.0332***	0.0160***
	(-5,5)	0.0403***	0.0635***	0.0489***	0.0601***	0.0379***
	(-3,3)	0.0297***	0.0406***	0.0278***	0.0370***	0.0206***
	(-1,1)	0.0159***	0.0183***	0.0098***	0.0097***	0.0089***
CSI 500	(-5,0)	0.0126***	0.0049	0.0278***	0.0337***	0.0347***
	(-3,0)	0.0046	0.0003	0.0171***	0.0234***	0.0266***
	(-1,0)	0.0102***	0.0049**	0.0094*	0.0138***	0.0114***
	(0,1)	0.0021	-0.0056**	0.0110	0.0149***	0.0213***
	(0,3)	0.0078**	-0.0080***	0.0260***	0.0137***	0.0346***
	(0,5)	0.0194***	0.0086***	0.0346***	0.0141***	0.0466***
	(-5,5)	0.0274***	0.0077	0.0591***	0.0382***	0.0751***
	(-3,3)	0.0086*	-0.0126***	0.0397***	0.0267***	0.0547***
	(-1,1)	0.0089***	-0.0043	0.0170**	0.0182***	0.0260***

*Notes: This table shows the CAARs based on different event windows. They are calculated from the first stage empirical analysis where the impacts of the five main policies on CSI300 and CSI500 are tested. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

Event 1: " Carbon Peaking Action Plan by 2030" on 26th October, 2021

Following the requirements of carbon peak and carbon neutral, this action plan defines the main objectives of carbon peak into details, and makes overall arrangements for the future carbon peak work. This plan aims to penetrate the carbon peak concept into all involved industries and all aspects of economic and social development. The results in Tables 5 and 6 demonstrate that the AARs of CSI 300 and CSI 500 constituent stocks are significantly non-zero at the 95% confidence level for 7 days during the 11-day event window. However, it is found that the absolute values of the AARs are mostly less than 1%. On the event day after the action was released, the AAR of both CSI300 and CSI500 was about 0.30%. However, the AAR of CSI300 is 0.60%, 0.48% and 0.53% on t+1, t+3 and t+5, respectively, and the AAR of CSI500 is -0.5%, 1.03% and 1.13% on t+2, t+3 and t+4, respectively. Moreover, the CAAR of CSI300 and CSI500 within the

window (0, +5), (-5, +5) are 2.25% and 1.94%, 4.03% and 2.74% respectively.

To sum up, the release of this action plan does not generate a very large positive impact on CSI 300 constituents and CSI 500 constituents in the short term. And the positive impact is continuous among CSI300 constituents but is intermittent among CSI500 constituent stocks. Moreover, the policy has a quicker and stronger impact on CSI 300 in contrast with CSI 500. The result indicates that although the release of the policy is able to break through the bottlenecks limiting China's sustainable economic development like the constraints on energy resources and ecological environment as well as the accelerating expansion of the ecological deficit, the market still maintains a cautious and defensive mindset due to the uneven state of recovery. The large-cap companies reacted more positively to the policy than the small- and medium-cap companies.

Event 2: "The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction" on 24th January, 2022

In order to promote the development of a well-established green low-carbon economic system, and boost the green transformation of the overall economic and social development, this work plan puts forward to improve the energy conservation and emission reduction mechanisms on significant projects, laying a solid foundation for achieving the carbon peak and carbon neutral goals proposed by "14th Five-Year Plan". The results in Tables 5 and 6demonstrate that the AARs of CSI 300 and CSI 500 constituents are significantly non-zero at the 95% confidence level for 10 and 8 days respectively during the 11-day event window. However, most of the absolute values of the AARs are less than 1%. Among them, the AARs of CSI300 and CSI500 were 0.68% and 0.33%, respectively, on the event day after the policy was announced. However, the AAR of CSI300 is positive for each day after the event date, and the AAR of CSI500 is -0.96% and -0.59% on days t+1 and t+3, respectively. The CAAR of CSI300 and CSI500 within the window (-3, +3) is 4.06% and -1.26% respectively, both at a 99% confidence level.

In summary, it can be concluded that CSI 300 constituents and CSI 500

constituents show opposite stock price performance after the release of the work program. In details, the program has a positive impact on CSI300 and a negative impact on CSI500, and the policy has a more pronounced impact on CSI300 compared to CSI500. The results imply that the market may perceive large-capitalization companies as having greater advantages in strategic planning, production and operation and regulation compared to small- and medium-capitalization companies, making them benefit more from the policy release in the short term. In contrast, small-cap companies may be doubted to incur more costs in these ESG efforts, and thus face higher risk of damaging their performance.

Event 3: "Opinions on Playing the Role of Capital Market to Serve the National Strategy of Poverty Eradication" on 9th September, 2016

The opinion puts forward to gather the strength of the CSRC system and capital markets to serve the practice of national poverty eradication strategies, to support enterprises in poor areas to use multi-level capital markets to raise funds, and to encourage listed companies, securities companies, fund and futures operators to take their social responsibility of poverty alleviation. The results in Tables 5 and 6 show that the AARs of both CSI 300 constituents and CSI 500 constituents are significantly non-zero at the 95% confidence level for 9 days during the 11-day event window, and all values are positive at less than 1%. The CAAR of CSI300 and CSI500 within the window period (-5, +5) is 4.89% and 5.91% respectively. To conclude, we can find that the CSI 300 constituents and CSI 500 constituents show the same trend of stock price movement after the release of the policy. Both CSI300 and CSI500 constituents show a continuous positive effect, which indicates that the support provided by the capital market for the poor areas and real economy will generate a boosting effect on the stock prices of listed companies. And it is interesting to find that small- and medium-capitalization companies may benefit more in that process compared to large-capitalization companies.

Event 4: "Code of Governance for Public Companies" on 30th September, 2018

This is the latest code of governance for listed companies with the last one being introduced in 2002. This new code in 2018 mainly revises the guidelines in four aspects. First, the guidelines require that the listed companies should always follow the green principle and pay efforts to enhance their leading role in environmental protection and social responsibility. Secondly, the guidelines help to finalize the framework for environmental, social responsibility and corporate governance (ESG) information disclosure. Thirdly, the Code focuses more on protecting the small and medium-sized investors and further strengthens the constraints on controlling shareholders, actual controllers and their related parties. Finally, the standard proposes new requirements on the control stability, independent directors, evaluation and incentive mechanisms, and information disclosure of listed companies.

The results in Tables 5 and 6 show that the AARs of CSI 300 constituents and CSI 500 constituents are significantly non-zero at the confidence level of 95% for 8 and 10 days, respectively during the 11-day event window. Among them, the AAR of CSI300 is 0.40% and 0.70% on days t+1 and t+2 respectively, and the AAR of CSI500 is 1.10%, 0.44% and 0.85% on days t, t+1 and t+2 respectively, with a share price retracement of -0.89% on day t+3. The CAARs of CSI300 and CSI500 during the window (-5, +5) are 6.01% and 3.82% respectively. In summary, we can find that the release of the new version of the guidelines caused the CSI 300 constituents and CSI 500 constituents to show similar share price movement trends that are overall positive trends. This implies that the market may perceive the revision and improvement of the governance code as conducive to increasing company value, and that large- capitalization companies with larger business scale are more likely to benefit more through improving governance than small- and medium- capitalization companies.

Event 5: "Information Disclosure Management Measures for Listed Companies" on 18th March, 2021

Information is the key point in capital markets since information publicly disclosed in accordance with the law is a significant reference for investors when

making financial decisions. The information disclosure is the legal obligation of listed companies. This guideline aims to strengthen the management on the measures of information disclosure for listed companies, protecting the interests of investors as well as the healthy development of the stock market. The results in Tables 5 and 6 show that the AARs of CSI 300 constituents and CSI 500 constituents are significantly non-zero at the confidence level of 95% for 6 and 11 days, respectively during the 11-day event window. Among them, the AARs of CSI 300 on days t-2, t-1 and t are around 0.5% while the AARs of CSI 500 on days t, t+1 and t+2 are 0.66%, 1.47% and 0.97% respectively. The CAARs of CSI300 and CSI500 within the window period (-5, +5) are 3.79% and 7.51%, respectively.

In summary, it can be noticed that although the release of the policy generates a positive impact on both CSI 300 constituents and CSI 500 constituents, the positive impact on CSI 500 is more obvious and sustained in contrast to CSI 300. This is probably because the information disclosure system of small- and medium- capitalization companies is not so perfect as large- capitalization enterprises. In this way, standardizing their information disclosure behavior through rules and regulations can indirectly urge the companies to improve the quality and efficiency of their operation. In this way, their intrinsic value is added and investors have a positive attitude towards it.

5.4.2 Second-stage Empirical Results

Table 7: The summary of AARs for different industries based on (-5,5) event window

	Day	Coal	Oil Petrochemical	Steel	Building Materials	Non-ferrous Metal	Electricity Equipment	Clean Energy	Environment Protection	Finance
	-5	0.0424***	0.0113**	0.0056**	0.0037	0.0042	0.0066***	0.0042	-0.0003	0.0033**
	-4	-0.0783***	-0.0194***	0.0068*	-0.0021	-0.0014	0.0163***	0.0245***	0.0128***	0.0011
	-3	0.0105	0.0089**	0.0082***	0.0024	0.0052**	-0.0055***	-0.0091	-0.0089***	0.0131***
	-2	-0.0560***	-0.0341***	-0.0301***	0.0132***	-0.0273***	-0.0253***	-0.0421***	-0.0162***	-0.0013
	-1	0.0184***	0.0258***	0.0254***	-0.0072**	0.0143***	0.0333***	0.0234***	0.0144***	0.0010
Event1	0	-0.0059	-0.0020	0.0077**	-0.0038	0.0015	0.0047**	0.0115**	0.0051**	-0.0004
	1	-0.0318***	-0.0171***	-0.0011	-0.0107***	-0.0069**	0.0132***	0.0432***	0.0071*	-0.0092***
	2	-0.0792***	-0.0503***	-0.0404***	0.0053	-0.0351***	-0.0116***	-0.0205***	-0.0174***	-0.0018
	3	-0.0087	0.0050	0.0008	0.0023	0.0163***	0.0118***	-0.0104	0.0069***	0.0072***
	4	0.0196***	0.0067	0.0037	0.0115***	0.0310***	0.0210***	0.0220***	0.0092***	0.0125***
	5	-0.0417***	-0.0181***	-0.0210***	-0.0079***	-0.0155***	-0.0075***	-0.0210***	-0.0085***	-0.0081***
	-5	0.0176***	0.0011	-0.0056*	-0.0047	0.0049**	0.0059***	-0.0052**	0.0080***	-0.0008
	-4	0.0126**	-0.0020	0.0001	0.0021	-0.0073***	-0.0071***	0.0051	-0.0060***	0.0129***
	-3	0.0179***	0.0075***	0.0159***	0.0348***	-0.0015	-0.0053***	-0.0010	0.0114***	0.0101***
	-2	-0.0329***	-0.0275***	-0.0331***	-0.0251***	-0.0191***	-0.0325***	-0.0096**	-0.0226***	0.0114***
	-1	0.0644***	-0.0055*	0.0026	0.0016	0.0093***	0.0082***	0.0025	-0.0044**	0.0013
Event2	0	-0.0144***	0.0089***	0.0182***	-0.0046	-0.0031	0.0109***	-0.0009	-0.0053	-0.0009
	1	-0.0464***	-0.0125***	-0.0238***	-0.0140***	-0.0164***	-0.0131***	-0.0187***	-0.0197***	-0.0124***
	2	0.0062	0.0095***	0.0203***	0.0027	0.0057***	0.0117***	0.0088***	0.0078***	0.0081***
	3	0.0090**	0.0031	-0.0060**	-0.0017	-0.0134***	-0.0086***	-0.0042	-0.0039	0.0021
	4	-0.0151**	0.0173***	0.0118**	0.0198***	0.0125***	0.0215***	0.0145***	0.0201***	0.0045***
	5	0.0329***	0.0420***	0.0464***	0.0201***	0.0201***	0.0030	0.0133**	0.0162***	0.0162***

Notes: The table shows the AAR value and its significance on each day during the event window (-5,5) under different industries.

****, **, *represents significance level at 99%, 95%, 90% respectively.*

Table 8: The summary of CAARs for different industries based on different event windows

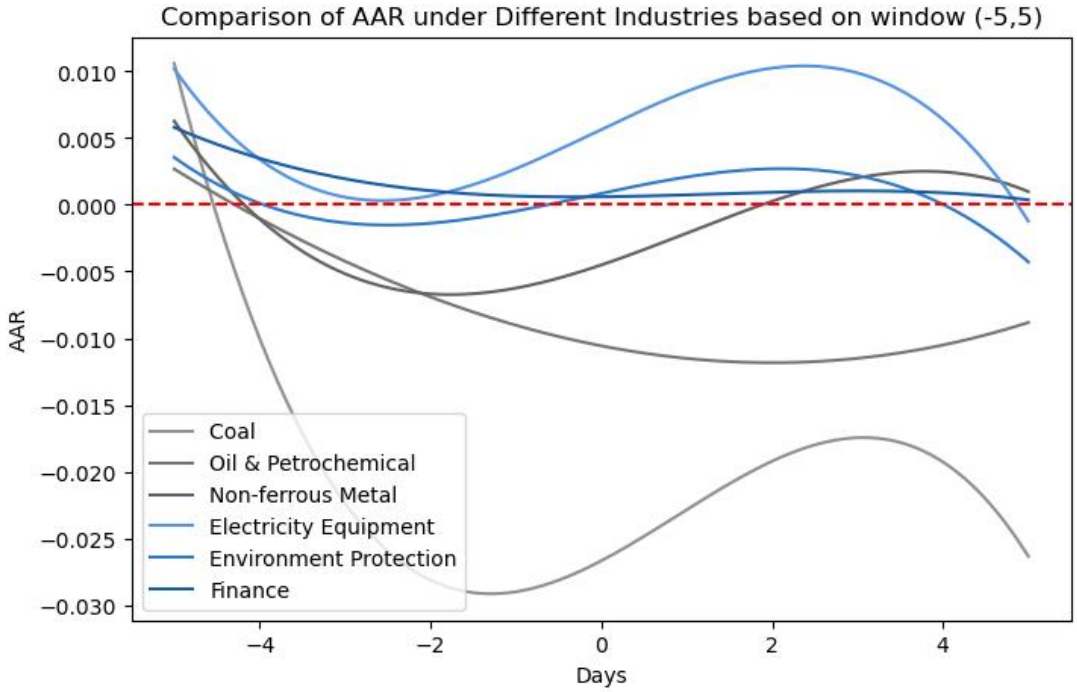
		Coal	Oil Petrochemical	Steel	Building Materials	Non-ferrous Metal	Electricity Equipment	Clean Energy	Environment Protection	Finance
Event1	(-5,0)	-0.0690***	-0.0095	0.0235***	0.0062	-0.0035	0.0300***	0.0125	0.0069	0.0169***
	(-3,0)	-0.0313**	-0.0011	0.0110**	0.0048	-0.0059	0.0067	-0.0172*	-0.0056	0.0126***
	(-1,0)	0.0142	0.0241***	0.0332***	-0.0106**	0.0172***	0.0384***	0.0360***	0.0200***	0.0006
	(0,1)	-0.0349***	-0.0189***	0.0058	-0.0141***	-0.0046	0.0175***	0.0551***	0.0124***	-0.0096***
	(0,3)	-0.1209***	-0.0631***	-0.0331***	-0.0064	-0.0227***	0.0176***	0.0245*	0.0026	-0.0039
	(0,5)	-0.1414***	-0.0750***	-0.0500***	-0.0025	-0.0061	0.0312***	0.0248*	0.0035	0.0005
	(-5,5)	-0.2108***	-0.0833***	-0.0345***	0.0067	-0.0138	0.0570***	0.0257*	0.0041	0.0176***
	(-3,3)	-0.1492***	-0.0627***	-0.0299***	0.0020	-0.0314***	0.0198***	-0.0054	-0.0090	0.0090**
	(-1,1)	-0.0153	0.0074	0.0321***	-0.0211***	0.0108***	0.0515***	0.0794***	0.0272***	-0.0087***
Event2	(-5,0)	0.0653***	-0.0175**	-0.0017	0.0042	-0.0169***	-0.0198***	-0.0092	-0.0188***	0.0341***
	(-3,0)	0.0345***	-0.0163***	0.0042	0.0070	-0.0138***	-0.0184***	-0.0091	-0.0206***	0.0218***
	(-1,0)	0.0500***	0.0038	0.0205***	-0.0034	0.0057	0.0197***	0.0019	-0.0093**	0.0000
	(0,1)	-0.0620***	-0.0019	-0.0056*	-0.0200***	-0.0204***	-0.0020	-0.0193***	-0.0236***	-0.0139***
	(0,3)	-0.0493***	0.0120**	0.0084**	-0.0199**	-0.0279***	0.0032	-0.0143*	-0.0191***	-0.0040
	(0,5)	-0.0324***	0.0714***	0.0667***	0.0206**	0.0050	0.0287***	0.0140*	0.0170***	0.0166***
	(-5,5)	0.0519***	0.0418***	0.0469***	0.0310***	-0.0083	-0.0054	0.0045	0.0016	0.0526***
	(-3,3)	0.0036	-0.0162**	-0.0057	-0.0062	-0.0377***	-0.0283***	-0.0234***	0.0016***	0.0196***
	(-1,1)	0.0034	-0.0087**	-0.0036	-0.0190**	-0.0104**	0.0067**	-0.0168*	-0.0360***	-0.0130***

*Notes: The table shows the CAAR value and its significance under different event windows and different industries. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

The Impacts of Environment Policy 1 on Different Industries

The policy "Carbon Peaking Action Plan by 2030" clearly defines the objectives of carbon peak in the current stage. It emphasizes that the proportion of non-fossil energy consumption will reach around 20%, and the energy consumption per unit of GDP will reduce by 13.5%, carbon dioxide emissions per unit of GDP will drop by 18% compared to 2020 by 2025. And the proportion of non-fossil energy consumption will take up about 25%, and carbon dioxide emissions per unit of GDP will decrease by at least 65% compared to 2005.

Figure 3



■ ***Coal and Oil Petrochemical***

First of all, the release of policy 1 generates similar impacts on coal industry and oil & petrochemical industry. The action plan requires to promote the substitution of coal consumption and transformation of the coal production, accelerating the pace of coal reduction. Moreover, the plan also puts forward that strict controls should be exerted to new coal projects and elimination methods should be applied to coal projects with backward production capacity. In terms of the oil& petrochemical, reasonable regulation is issued on oil and gas consumption, to maintain it in a reasonable range, and gradually adjust the scale of gasoline

consumption.

According to the results in Tables 5-6 and 5-7, we can find that the AAR of the coal sector is -3.18%, -7.92% and -4.17% on days t+1, t+2 and t+5, respectively, and the CAAR reaches -14.14% and -21.08% during the window periods (0, +5) and (-5, +5) respectively. Besides that, the AAR of the oil& petrochemical sector is -1.71%, -5.03% and -1.81% at t+1, t+2 and t+5 days respectively, and the CAAR within the window period (0, +5) and (-5, +5) reaches -7.50% and -8.33% respectively. Most importantly, all these values have a 99% confidence level. This indicates that the requirements mentioned in the action plan regarding coal and oil& petrochemical sectors have a strongly significant negative impacts on the stock prices of these two sectors. The market presents a very pessimistic sentiment state. The coal industry shows a greater degree of suppression, which may be due to the difference in the degree of coal reduction and oil regulation requirements proposed by the action plan. **In summary, the action plan generates a long-term significant negative impact on coal and oil& petroleum industries, and the coal industry suffers to a greater extent**.

■ ***Clean Energy***

Secondly, the release of policy 1 also generate significant impacts on clean energy industry. The action plan encourages a vigorous development of new energy. The new energy development refers to the comprehensive promotion of high-quality wind power and solar power at a large scale. The action plan requires the total installed capacity of wind power and solar power generation reached more than 1.2 billion kilowatts by 2030. Besides that, the plan also proposes that the development of hydropower and nuclear power should be in an active, safe and orderly manner according to local conditions. From the results in Tables 7 and 8, it can be found that the clean energy sector witnesses an AAR of 4.32% one trading day after the event, and another 2.20% rise after a two-day share price correction, with a CAAR of 2.57% within the window period (-5, +5). This indicates that the encouragement of the development of clean energy mentioned in the action plan favors the industry and investors are optimistic about the future of this sector. But

it is worth mentioning that the degree of positive impact on the clean energy sector is much smaller compared to the negative impact of the plan on the coal sector. **In conclusion, the release of the action plan generates a positive impact on clear energy industry which includes wind power, solar power, nuclear power, and hydropower but the degree is not that high**.

■ ***Electricity Equipment***

Thirdly, the stock return of the electricity equipment industry also witnesses an upward trend. The action plan puts forward that new electricity system with an increasing proportion of new energy should be built up, optimal allocation should be achieved for clean power resources on a large scale, and the adjustment capacity of the electricity system, should be vigorously enhanced. It is expected that the capacity of new energy storage machines can reach more than 30 million kilowatts by 2025 and the capacity of pumped storage power plants will reach about 120 million kilowatts by 2030. Moreover, the provincial power grids will basically achieve a peak load response capacity of at least 5% by 2030. According to the results in Tables 7 and 8, it can be noticed that the AAR of the electricity equipment sector is 0.47%, 1.32%, 1.18% and 2.10% on t, t+1, t+3 and t+4 respectively, and -1.16% and -0.75% on t+2 and t+5 respectively. The CAAR of the electricity equipment industry is about 5.70% within the window period (-5, +5). This suggests that the tasks assigned to electricity equipment industry by the action plan also has a mostly positive impact on the sector. And the positive impact on electricity equipment sector is more sustained compared to the impact on the clean energy industry. However, the impact on clean energy sector is faster and deeper. **In summary, the release of the action plan generates a mostly positive impact on electricity equipment industry which is more sustained than that on clean energy sector.**

■ ***Steel, Non-ferrous Metal and Building Materials***

Fourthly, the release of this action plan generates similar trends on steel, non-ferrous metal and building materials three sectors. Those three industries are

covered under the industrial sector carbon peak subplan. Firstly, the plan asks to deepen the structural reform on the supply side of the steel industry, strictly implementing capacity replacement, prohibiting new production capacity, and eliminating backward steel production capacity. According to the results in Tables 7 and 8, it can be found that the AAR of the steel sector is -4.04% and -2.10% on t+2 and t+5 respectively, and the CAAR is -3.45% within the window period (-5, +5), and all of those results are with a 99% confidence level. That implies that the release of the action plan brings a mostly negative impact to the steel industry. Furthermore, the plan also requires to deal with the excess capacity of electrolytic aluminum, strictly implement capacity replacement and control the new capacity of non-ferrous metals. According to the results in Tables 7 and 8,, it can be seen that the AAR of the non-ferrous metals sector is -0.69%, -3.51% and -1.55% at t+1, t+2 and t+5 respectively, and 1.63% and 3.10% at t+3 and t+4 respectively. And the CAAR is -3.14% within the window period (-3, +3). Thus, the release of the action plan shows a mostly negative impact to the non-ferrous metal industry as well. In terms of the building materials industry, this action plan proposes that the supervision of capacity replacement in the building materials industry should be enhanced and the withdrawal of inefficient capacity should be accelerated. In details, the cement clinker and flat glass production capacity are strictly prohibited. Based on the results in Tables 7 and 8, it can be found that the AAR of the construction materials sector is -1.07% on the trading day after the event and the CAAR is -2.11% during the window period (-1, +1). That implies the building materials industry also suffers from a negative impact but the impact does not last so long as that of the other two sectors. **In summary, the release of the action plan has had a negative impact on the stock returns of all three sectors which is especially significant in short term.** This is probably because the plan mentions the need to strictly prohibit new production capacity, which will undoubtedly hinder the profitability and development of the industry in the short term, and the pessimism in the market finally led to a decline in share prices.

- ***Environment Protection***

Fifthly, the environmental protection industry is mentioned under the carbon sink capacity consolidation and enhancement subplan. Adhere to the core concept of the double-carbon policy system, this subplan promotes the integrated protection and restoration of mountains, water, forests, fields, lakes, grasses and sands, improving the quality and stability of the ecosystem, and enhancing the incremental carbon sink of the ecosystem. According to the results in Tables 7 and 8,, we can find that the AAR of the environmental protection sector is 0.51%, 0.71%, 0.69% and 0.92% on t, t+1, t+3 and t+4 respectively, and -1.74% and -0.85% on t+2 and t+5, respectively, and the CAAR is 2.72% within the window period (-1, +1). This suggests that **the release of the action plan has had a mostly positive effect on the share prices of the environment protection industry which is not that deep but more sustained.**

■ ***Finance***

Finally, the release of the policy generates a volatility impact on finance industry. The action plan advocates a vigorous development of green finance instruments such as green loans, green equity, green bonds, green insurance and green funds and also the instruments supporting the carbon emission reduction. This action plan requires financial institutions to provide long-term and low-cost funds for green and low carbon projects, and encourages developmental policy financial institutions to provide long-term and stable financing support for carbon peaking actions in accordance with the principles of the market-oriented laws. From the results in Tables 7 and 8, it can be seen that the financial industry shows an AAR of -0.92% on the trading day after the release, followed by 0.72% and 1.25% on t+3 and t+4, and a CAAR of 1.76% within the window period (-5, +5). This implies that although the release of the action plan caused the share price of the financial sector to drop in the short term, it was followed by a share price correction and a positive cumulative abnormal return. This is probably due to the fact that green finance is still at an early stage in China and it takes some time for the market to receive the information accurately. The overall impact is still favorable for the financial industry but the degree is not that high. **In summary, it**

can be inferred that the market generally has a positive view of the green finance in long term but may be wavering and in a wait-and-see mood about the future development of green finance.

The Impacts of Environment Policy 2 on Different Industries

"The 14th Five-Year Comprehensive Work Plan for Energy Conservation and Emission Reduction" again emphasizes the goal that the national energy consumption per unit of GDP will drop by 13.5% compared to 2020 by 2025. This policy gives a binding indicator for energy consumption intensity, which is consistent with the expression in the Action Plan for Carbon Peaking by 2030 released on October 26, 2021, but no specific binding indicator is given for total energy consumption. The main task of this policy is that the energy efficiency and the emission control of key industries will reach the international advanced levels, and the green transformation of economic and social development will make significant progress.

- ***Coal and Oil Petrochemical***

This policy advocates a clean and efficient use of coal energy, a reasonable control of coal consumption growth and a substitution of coal with clean electricity and natural gas. Based on the results in Tables 7 and 8, we can find that the AAR of the coal industry dropped by 1.44% on the event day and then continued to extend its decreasing level to 4.64%, and both are significantly non-zero at the confidence level of 95%. The AAR of oil& petrochemical is 0.89% on the event day followed by -1.25% on t+1. This suggests that the release of the policy 2 generates the same impact on coal and oil& petrochemical sectors as policy 1. **Both of them are detrimental to the stock performance in the coal and oil& petrochemical sectors but the negative impacts on coal industry is far stronger and sustained**. However, since there are duplications between the polic1 and policy 2, the negative impact is significantly smaller this time than the first release. This may because the market already has a psychological expectation of

the development constraints on the coal industry at the national level, which is already partially reflected in its early stock reaction.

■ ***Clean Energy***

Except for the coal industry, the clear energy sector also receives significant impacts due to the work related to energy mentioned in policy 2. The AAR of the clean energy sector is 0.88%, 1.45% and 1.33% on t+2, t+4 and t+5 days respectively, and -1.87% on t+1 day, and all of them have 95% confidence level. **This indicates that the release of the work program has a favorable effect on the stock price of the clean energy industry in the short term, but the overall impact is not that significant**.

■ ***Steel, Non-ferrous Metal and Building Materials***

Moreover, steel, non-ferrous metals, and building materials are also key industries during the process of energy conservation and emission reduction. With the aim of transforming energy and treating pollutants deeply, this policy promotes an ultra-low emission transformation on steel, cement, coking industry and coal-fired boilers. The ultra-low emission transformation of 530 million tons of steel production capacity is required to be completed by 2025. Based on the results in Tables 7 and 8, it can be found that the AAR of the steel sector is 1.82%, 2.03%, 1.18% and 4.64% on t, t+2, t+4 and t+5, respectively, and -2.38% and -0.60% on t+1 and t+3 respectively. The AAR of the non-ferrous metals sector is 0.57%, 1.25% and 2.01% on t+2, t+4 and t+5 respectively, and -1.64% and -1.34% on t+1 and t+3 respectively. The AAR of the building materials sector is1.98% and 2.01% on days t+4 and t+5 respectively, and -1.40% on day t+1, and all of those results have a 95% confidence level. **The steel, non-ferrous metals, and construction materials sectors all suffer from negative impacts in the short term, which is the same as the situation under policy 1.** They may exhibit share price gains for a long period after the event, with steel and building materials being more significantly impacted than non-ferrous metals.

■ ***Environment Protection***

This policy mentions insisting on precise pollution control, scientific pollution control and pollution control according to law, and taking the total pollutant emission control system as an important tool to accelerate green and low-carbon development and improve environmental governance. According to the results in Tables 7 and 8, it can be found that the AAR of the environmental protection sector is 0.78%, 2.01% and 1.62% on t+2, t+4 and t+5 days, respectively. **This suggests that the energy conservation and emission reduction efforts will indeed have a boosting effect on the stock returns of the environment protection industry,** but since China has already introduced many double-carbon related policies at the national and local levels, the market has received this information many times and this time the market has not reacted particularly strongly, a situation which is occurring in many sectors.

■ ***Finance***

This policy advocates to build up a sound green financial system during the energy conservation and emission reduction process. In details, the policy encourages vigorously developing green credit and make efficient use of coal special refinancing to support energy conservation and emission reduction in key industry sectors. Meanwhile, enhancing the development of green bonds, and supporting eligible energy-saving and emission reduction enterprises in listing and refinancing are also mentioned in the policy. According to the results in Tables 7 and 8, it can be viewed that the AAR of the financial sector was 0.81%, 0.45% and 1.62% on t+2, t+4 and t+5 respectively. Although there was a -1.24% drop in stock return on the first trading day after the event, there was a reversal trend appearing quickly. And the CAAR of finance industry is about 1.66% on the window (-5,5) and 5.26% on the window (-5,5). **This indicates that the impact of this policy on the financial sector's share price is very similar to the impact of the carbon peak action plan, and investors remain positive attitudes about the future trends of green finance in the financial sector in a relatively long term**.

5.5 Robustness Check

In order to check the statistics power of the research, we check the robustness of the study results by testing if the results will keep consistent on different data samples and different model settings.

Different Sample: In this study, we apply (-5,5) as the main event window and obtain a series of empirical results. In robustness check, we change the event window to a short period (-3,3) and a longer period (-7,7) to see if the confidence level of AARs and CAARs as well as the absolute values of AARs and CAARs will maintain at a similar level. According to the appendix 1-2, it can be seen that the first-stage empirical results based on the event windows (-3,3) and (-7,7) are very similar to those calculated based on (-5,5). And according to the appendix 3-4, it can be seen that the second-stage empirical results based on the event windows (-3,3) and (-7,7) also do not deviate much from the results calculated based on (-5,5).

Different Model: In this study, we employ Fama-French three-factor model to estimate the expected normal returns during the vent window. In this robustness check, we apply Carhart four-factor model to estimate the returns instead.

$$R_{it} - R_{ft} = \alpha_i + \beta_j(R_{mt} - R_{ft}) + m_i SMB_t + n_i HML_t + k_i UMD_t + \varepsilon_{it}$$

Carhart four-factor model is a further extension on the basis of Fama-French three-factor model. It considers the momentum Factor (UMD), which means up minus down. It is calculated by subtracting the average return of the stocks with low returns in the past from the average returns of the stocks with high returns in the past. Carhart model states that stocks that outperformed in the past tend to outperform in the future. The model shows a further decomposition of the excess return and can be regarded as an upgrade from the three-factor model to some extent. According to the appendix 5 where we take the first-stage empirical study as an example, it can be found that the results obtained based on Carhart model show a consistent trend with the those got from Fama model. In this way, the reliability and generalizability of the study results can be confirmed to a large

extent.

5.6 Final Conclusions

i. ***The release of national ESG policies generates impacts on the stock returns of both CSI300 and CSI500.***

In the first stage of study, the hypothesis 1a, 1b and hypothesis 2a, 2b are tested. From an overall perspective, most of the ESG policies will impact CSI 300 constituents and CSI 500 constituents at a significant level but the degree of the impacts is limited. From the table 5 it can be seen that most of the AARs are significantly non-zero at 99% confidence level. And the impact is continuous since under most policies, the AARs is not only significantly non-zero at the event day but also significantly non-zero from t+1 to t+5. However, the absolute value of AARs is mostly below 1%, which means the impacts are significant but the degree is limited.

ii. ***The intensity of the policy impacts does not vary a lot between CSI300 and CSI500 but the direction does.***

From the figure 2, it can be observed that for some policies the absolute value of daily AAR is larger under CSI300 market while for other policies that is larger for CSI500, which can be proved by the interval between the two lines in each plot. Thus, the intensity of the policy impacts does not vary a lot between CSI300 and CSI500. However, it can also be observed that for CSI300 stocks, the actual return line is above the expected return line under all the events while for CSI500 stocks, the two lines sometimes can cross over each other. The suggests that the impact direction is always positive in CSI300 sample but can sometimes be negative in CSI500 sample.

iii. ***The release of national double-carbon policies generates impacts on the stock returns of involved industries. The impact on a specific industry is stronger than that on the whole stock market.***

From the table 5 and 7, it can be found that the both environment policy 1 and 2 generate significant impacts on the industries that are mentioned in the policies since mostly the AARs are significant non-zero with at least 95% confidence level.

It is just that for some industries the impact is in short-term while for others the impact is in long-term. And it is also worth mentioning that, summarizing the results from stage1 and stage2, we also found that the absolute value of most AARs in CSI300 or CSI500 sample is mostly much below 1% while that in subindustry samples is mostly far above 1%. That implies that the impact on a specific industry may be stronger than that on the whole stock market.

iv. ***The impacts of the release of double-carbon policies on high energy consumption and high emission industries are mostly negative while those on the industries supporting the low-carbon practices are mostly positive.***

From the summary table, it can be seen that for high energy consumption and high emission industries including coal, oil& petrochemical, steel, building materials, and non-ferrous metal, the AARs are always negative after the release of the policy. In contrast, for the industries supporting the new low-carbon practices like electricity equipment, clean energy, environment protection and green finance, the AARs after the event date are mostly positive. That suggest that investors' judgments of industry attributes can influence the directions of the stock changes after the policy is released. For the industry that the state encourages the vigorous development and everyone holds optimistic attitude, it always witnesses an upward trend in its stock returns after the carbon policies are announced.

v. ***The impact degree does not differ a lot among industries but coal industry is the one that is impacted the most.***

Also from the summary table, it can be noticed that impact degree does not differ a lot among different industries. That should depend on the content of the policy. If the policy defines the objectives and action plans into details for the industry, the industry can be impacted more. Moreover, if the content of a policy has been men**tion**ed in previous policies, the degree of its impact on stock prices will be diminished. For example, since many goals and tasks of the second environmental policy are already mentioned in the first environmental policy, its significance level of AARs is smaller than that of the first policy.

5.7 Limitations and Future Prospects

Event Cluster: One of the reasons that can lead to the biases is even cluster. Even cluster refers to the period when the announcement of many essential events is aggregated. The presence of event clusters can reduce the robustness of the event study under this period. However, this situation is hard to be avoided considering China's national context in ESG development. As it has been mentioned before, China just entered the growth stage (2018-now) during which the state starts to issue more ESG policies in a systematic way. Thus, we found most meaningful and valuable policies are concentrated in this period. The situation that after the release of top design policy, each department, each industry or each region will quickly response and issue their own policies occurs frequently in China. Thus, it is hard for researches investigating the topic of the ESG development in China using the event study method to totally eliminate the risks of event cluster. However, we have done our best to avoid this basis by repeatedly screening, comparing and organizing the events, which can also be seen from the dates of the our finally selected policies.

Model Selection: The other reason that can lead to the biases is the selection of the model to estimate the expected normal return. There are various models that can be selected like market adjusted model, mean adjusted model, capital asset pricing model, Fama-French three factor model, Fama-French five factor model, VAR model and so on. How to selecting a model that is neither too simplified nor over-fitted, suiting the investigated market, is a key topic for most event study researches. Fama-French three factor model is selected for this study for two reasons. For one thing, it presents higher explanatory ability than single-factor model like CAPM in our sample markets. It introduces two additional factors, size factor and value factor, to better explain the excess returns of the small-cap and large-value enterprises. For our research, CSI300 and CSI500 sample markets obviously are different in their size and market value. Thus, only applying single-factor model to capture the variability of the return with market risk is unreasonable for our study. For another, Fama-French three factor model also

helps to avoid the overfitting risks and multicollinearity risks. However, in the process of analyzing results, we still found that for some events, there are abnormalities in the values and trends of AARs. We finally found that they are caused by sudden changes in the stock market, such as the volatility of the European and American stock markets. In this way, we consider trying other multiple-factor models like Carhart four-factor model or Fama-French five-factor model in the future research or the vector autoregression model which we can add control variables to further reduce the impact of external unrelated events.

According to the process and findings of the empirical study in this thesis, and taking into account the characteristics of the ESG policy and capital market of China, it is recommended that future researchers who are interested in pursuing a similar research direction could make more efforts in the selection of expected return models of event study and in controlling for the effects of other events during the window and estimation period.

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Appendix

Appendix 1. Summary of AARs and CAARs in the first stage of empirical analysis based on event window (-3,3)

	Day	AAR_1	$CAAR_1$	AAR_2	$CAAR_2$	AAR_3	$CAAR_3$	AAR_4	$CAAR_4$	AAR_5	$CAAR_5$
	-3	0.0055***	0.0055***	0.0042***	0.0042***	0.0025*	0.0025*	0.0064***	0.0064***	0.0018	0.0018
	-2	0.0011	0.0066***	0.0069***	0.0111***	0.0044***	0.0068***	0.0062***	0.0126***	0.0049***	0.0067***
	-1	0.0067***	0.0134***	0.0046***	0.0157***	0.0037***	0.0105***	0.0034***	0.0160***	0.0050***	0.0117***
CSI300	0	0.0030**	0.0164***	0.0069***	0.0226***	0.0021	0.0125***	0.0023	0.0183***	0.0038***	0.0155***
	1	0.0061***	0.0224***	0.0068***	0.0293***	0.0041**	0.0166***	0.0040***	0.0223***	0.0001	0.0156***
	2	0.0024	0.0248***	0.0057***	0.0351***	0.0047***	0.0214***	0.0070***	0.0293***	0.0023	0.0179***
	3	0.0049***	0.0297***	0.0056***	0.0406***	0.0065***	0.0278***	0.0076*	0.0370***	0.0027*	0.0206***
	-3	-0.0003	-0.0003	0.0043***	0.0043***	0.0026**	0.0026**	0.0034***	0.0034***	0.0097***	0.0097***
	-2	-0.0049***	-0.0052**	-0.0085***	-0.0042**	0.0052	0.0078	0.0062***	0.0095***	0.0055***	0.0153***
	-1	0.0066***	0.0014	0.0013	-0.0030	0.0059***	0.0137*	0.0034***	0.0129***	0.0047***	0.0200***
CSI500	0	0.0032**	0.0046	0.0033**	0.0003	0.0034	0.0171***	0.0105***	0.0234***	0.0066***	0.0266***
	1	-0.0013	0.0033	-0.0095***	-0.0092**	0.0076**	0.0247***	0.0045***	0.0278***	0.0147***	0.0413***
	2	-0.0050**	-0.0017	0.0024*	-0.0069*	0.0068***	0.0315***	0.0085***	0.0364***	0.0097***	0.0510***
	3	0.0103***	0.0086*	-0.0058***	-0.0126***	0.0082***	0.0397***	-0.0097***	0.0267***	0.0037***	0.0547***

*Notes: This table shows the AARs obtained from the process of investigating the impacts of the five ESG policies on CSI300 and CSI500 stock markets. In order to check the robustness of the results, this table is based on a shorter event window (-3,3) as a comparison with the event window (-5,5) in the main text. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

Appendix 2. Summary of AARs and CAARs in the first stage of empirical analysis based on event window (-7,7)

	Day	AAR_1	$CAAR_1$	AAR_2	$CAAR_2$	AAR_3	$CAAR_3$	AAR_4	$CAAR_4$	AAR_5	$CAAR_5$
CSI300	-7	0.0067***	0.0067***	0.0058***	0.0058***	0.0014	0.0014	0.0060***	0.0060***	0.0067***	0.0067***
	-6	0.0099***	0.0165***	0.0028**	0.0086***	0.0032**	0.0046	0.0051***	0.0110***	0.0068***	0.0135***
	-5	0.0033**	0.0199***	0.0009	0.0095***	0.0038**	0.0083**	0.0061***	0.0171***	0.0031*	0.0166***
	-4	0.0017	0.0216***	0.0097***	0.0192***	0.0045**	0.0129**	0.0048***	0.0219***	0.0070***	0.0236***
	-3	0.0055***	0.0271***	0.0044***	0.0237***	0.0024*	0.0153***	0.0065***	0.0284***	0.0019	0.0255***
	-2	0.0011	0.0282***	0.0071***	0.0308***	0.0043***	0.0196***	0.0062***	0.0346***	0.0050***	0.0305***
	-1	0.0068***	0.0349***	0.0046***	0.0353***	0.0036***	0.0233***	0.0035***	0.0380***	0.0050***	0.0355***
	0	0.0031**	0.0380***	0.0068***	0.0421***	0.0020	0.0253***	0.0022	0.0402***	0.0038***	0.0394***
	1	0.0061***	0.0441***	0.0067***	0.0488***	0.0040**	0.0293***	0.0041***	0.0442***	0.0002	0.0395***
	2	0.0024	0.0465***	0.0058***	0.0546***	0.0047***	0.0340***	0.0070***	0.0513***	0.0022	0.0417***
	3	0.0049***	0.0514***	0.0056***	0.0602***	0.0065***	0.0405***	0.0076*	0.0588***	0.0029*	0.0446***
	4	0.0008	0.0521***	0.0026**	0.0629***	0.0054***	0.0458***	0.0086**	0.0674***	0.0010	0.0456***
	5	0.0054***	0.0575***	0.0093***	0.0721***	0.0073***	0.0531***	0.0038*	0.0712***	0.0062***	0.0518***
	6	0.0024	0.0599***	0.0052***	0.0773***	0.0029**	0.0560***	0.0020	0.0732***	0.0062***	0.0579***
	7	0.0014	0.0613***	0.0021*	0.0795***	0.0037**	0.0597***	0.0071***	0.0803***	0.0057***	0.0636***
CSI500	-7	-0.0013	-0.0013	0.0042***	0.0042***	0.0021**	0.0021**	0.0068***	0.0068***	0.0015	0.0015
	-6	0.0150***	0.0138***	0.0067***	0.0109***	0.0068***	0.0090***	0.0085***	0.0153***	-0.0022	-0.0007
	-5	0.0072***	0.0210***	0.0082***	0.0191***	0.0033***	0.0122***	-0.0019**	0.0134***	0.0031**	0.0024
	-4	0.0007	0.0217***	-0.0032**	0.0159***	0.0073***	0.0195***	0.0122***	0.0256***	0.0051***	0.0074**
	-3	-0.0004	0.0213***	0.0042***	0.0201***	0.0026**	0.0221***	0.0033***	0.0289***	0.0097***	0.0171***
	-2	-0.0052***	0.0162***	-0.0088***	0.0113***	0.0052	0.0273***	0.0062***	0.0351***	0.0054***	0.0226***
	-1	0.0066***	0.0228***	0.0012	0.0125***	0.0059***	0.0333***	0.0033***	0.0384***	0.0046***	0.0272***
	0	0.0031*	0.0258***	0.0033**	0.0158***	0.0035	0.0367***	0.0110***	0.0493***	0.0064***	0.0336***

	1	-0.0011	0.0247***	-0.0095***	0.0063	0.0076**	0.0444***	0.0045***	0.0538***	0.0146***	0.0482***
	2	-0.0050**	0.0197***	0.0021*	0.0085*	0.0068***	0.0512***	0.0085***	0.0623***	0.0097***	0.0579***
	3	0.0100***	0.0297***	-0.0059***	0.0026	0.0082***	0.0594***	-0.0090***	0.0534***	0.0036**	0.0615***
	4	0.0109***	0.0406***	0.0115***	0.0141***	0.0035***	0.0629***	-0.0034*	0.0500***	0.0063***	0.0679***
	5	-0.0006	0.0400***	0.0045***	0.0186***	0.0051***	0.0680***	0.0040***	0.0540***	0.0057***	0.0735***
	6	0.0122***	0.0522***	0.0136***	0.0322***	0.0071***	0.0751***	-0.0092***	0.0447***	0.0021**	0.0756***
	7	0.0030*	0.0553***	0.0093***	0.0415***	-0.0002	0.0748***	0.0071***	0.0518***	0.0024*	0.0780***

*Notes: This table shows the AARs obtained from the process of investigating the impacts of the five ESG policies on CSI300 and CSI500 stock markets. In order to check the robustness of the results, this table is based on a longer event window (-7,7) as a comparison with the event window (-5,5) in the main text. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

Appendix 3. Summary of AARs in the second stage of empirical analysis based on event window (-3,3)

	Day	Coal	Oil Petrochemical	Steel	Building Materials	Non-ferrous Metal	Electricity Equipment	Clean Energy	Environment Protection	Finance
Event1 20211026	-3	0.0110	0.0089**	0.0081***	0.0024	0.0053**	-0.0056***	-0.0091	-0.0089***	0.0131***
	-2	-0.0556***	-0.0339***	-0.0301***	0.0132***	-0.0272***	-0.0254***	-0.0426***	-0.0161***	-0.0012
	-1	0.0187***	0.0259***	0.0253***	-0.0071**	0.0144***	0.0332***	0.0234***	0.0144***	0.0011
	0	-0.0054	-0.0021	0.0076**	-0.0038	0.0016	0.0046**	0.0111*	0.0050*	-0.0003
	1	-0.0308***	-0.0169***	-0.0011	-0.0106***	-0.0068**	0.0131***	0.0430***	0.0070*	-0.0091***
	2	-0.0781***	-0.0499***	-0.0404***	0.0054	-0.0351***	-0.0117***	-0.0207***	-0.0174***	-0.0017
	3	-0.0090	0.0052	0.0008	0.0024	0.0164***	0.0117***	-0.0106	0.0070***	0.0073***
Event2 20220124	-3	0.0179***	0.0076***	0.0162***	0.0349***	-0.0016	-0.0052***	-0.0010	0.0111***	0.0102***
	-2	-0.0332***	-0.0272***	-0.0328***	-0.0250***	-0.0185***	-0.0322***	-0.0095**	-0.0221***	0.0113***
	-1	0.0645***	-0.0057*	0.0025	0.0015	0.0094***	0.0082***	0.0024	-0.0045**	0.0013
	0	-0.0146***	0.0091***	0.0183***	-0.0044	-0.0031	0.0109***	-0.0010	-0.0050	-0.0010
	1	-0.0461***	-0.0127***	-0.0243***	-0.0143***	-0.0163***	-0.0133***	-0.0189***	-0.0195***	-0.0124***
	2	0.0059	0.0098***	0.0206***	0.0029	0.0059***	0.0120***	0.0090***	0.0079***	0.0082***
	3	0.0092**	0.0030	-0.0062**	-0.0019	-0.0135***	-0.0086***	-0.0044	-0.0039**	0.0020

*Notes: This table shows the AARs obtained from the process of investigating the impacts of the two environment policies on involved industries. In order to check the robustness of the results, this table is based on a shorter event window (-3,3) as a comparison with the event window (-5,5) in the main text. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

Appendix 4. Summary of AARs in the second stage of empirical analysis based on event window (-7,7)

	Day	Coal	Oil Petrochemical	Steel	Building Materials	Non-ferrous Metal	Electricity Equipment	Clean Energy	Environment Protection	Finance
Event1 20211026	-7	0.0277***	0.0052	-0.0147***	-0.0030	-0.0028	-0.0125***	0.0027	-0.0092***	-0.0043***
	-6	0.0882***	0.0423***	0.0424***	0.0135***	0.0370***	0.0337***	0.0397***	0.0160***	0.0153***
	-5	0.0438***	0.0118**	0.0054**	0.0034	0.0043*	0.0065***	0.0041	-0.0007	0.0031**
	-4	-0.0767***	-0.0190***	0.0074*	-0.0019	-0.0013	0.0164***	0.0251***	0.0127***	0.0012
	-3	0.0104	0.0090**	0.0086***	0.0022	0.0054**	-0.0054***	-0.0089	-0.0089***	0.0127***
	-2	-0.0540***	-0.0339***	-0.0299***	0.0126***	-0.0273***	-0.0251***	-0.0418***	-0.0163***	-0.0016
	-1	0.0195***	0.0261***	0.0260***	-0.0068**	0.0143***	0.0331***	0.0235***	0.0142***	0.0008
	0	-0.0050	-0.0015	0.0082**	-0.0038	0.0016	0.0051**	0.0119*	0.0051*	-0.0004
	1	-0.0294***	-0.0166***	-0.0001	-0.0105***	-0.0066*	0.0126***	0.0436***	0.0070*	-0.0094***
	2	-0.0767***	-0.0498***	-0.0406***	0.0051	-0.0346***	-0.0114***	-0.0199**	-0.0173***	-0.0019
	3	-0.0089	0.0051	0.0004	0.0026	0.0162***	0.0116***	-0.0104	0.0068***	0.0079***
	4	0.0206***	0.0075	0.0037	0.0116***	0.0313***	0.0219***	0.0221***	0.0094***	0.0124***
	5	-0.0405***	-0.0172***	-0.0201***	-0.0078***	-0.0152***	-0.0078***	-0.0204***	-0.0085***	-0.0080***
	6	0.0242***	0.0053**	0.0159***	0.0164***	0.0099***	0.0041*	-0.0078	0.0119***	0.0059***
	7	-0.0341***	-0.0116***	0.0418***	0.0059**	0.0025	0.0290***	0.0271***	0.0070***	0.0006
Event2 20220124	-7	0.0270***	0.0199***	0.0114***	-0.0050	0.0085***	0.0013	-0.0063	0.0021	0.0155***
	-6	-0.0352***	-0.0204***	-0.0031	-0.0035	-0.0011	0.0089***	-0.0022	-0.0049***	-0.0125***
	-5	0.0171**	0.0007	-0.0054	-0.0046	0.0049**	0.0060***	-0.0050**	0.0081***	-0.0009
	-4	0.0127**	-0.0017	0.0001	0.0022	-0.0073***	-0.0071***	0.0051	-0.0061**	0.0130***
	-3	0.0181***	0.0076***	0.0163***	0.0347***	-0.0014	-0.0053***	-0.0013	0.0113***	0.0100***
	-2	-0.0324***	-0.0269***	-0.0331***	-0.0251***	-0.0189***	-0.0324***	-0.0097**	-0.0227***	0.0114***
	-1	0.0645***	-0.0059*	0.0026	0.0012	0.0092***	0.0082***	0.0020	-0.0046**	0.0013
	0	-0.0144***	0.0092***	0.0182***	-0.0046	-0.0035	0.0110***	-0.0013	-0.0055	-0.0008

1	-0.0470***	-0.0122***	-0.0241***	-0.0147***	-0.0165***	-0.0131***	-0.0195***	-0.0201***	-0.0123***
2	0.0065	0.0094***	0.0204***	0.0027	0.0057***	0.0117***	0.0089***	0.0077***	0.0079***
3	0.0086**	0.0035	-0.0060**	-0.0023	-0.0134***	-0.0087***	-0.0051*	-0.0043**	0.0023
4	-0.0150**	0.0166***	0.0117**	0.0193***	0.0125***	0.0215***	0.0142***	0.0199***	0.0044***
5	0.0331***	0.0420***	0.0465***	0.0204***	0.0202***	0.0030	0.0137*	0.0162***	0.0163***
6	0.0576***	0.0254***	0.0210***	0.0205***	0.0242***	0.0020	0.0190***	0.0266***	0.0349***
7	-0.0061	-0.0054	-0.0034*	-0.0014	0.0193***	0.0033***	0.0093***	0.0057***	-0.0023

*Notes: This table shows the AARs obtained from the process of investigating the impacts of the two environment policies on involved industries. In order to check the robustness of the results, this table is based on a longer event window (-7,7) as a comparison with the event window (-5,5) in the main text. ***, **, *represents significance level at 99%, 95%, 90% respectively.*

Appendix 5. Summary of AARs and CAARs in the first stage of empirical analysis based on Carhart four-factor model

	Day	AAR_1	$CAAR_1$	AAR_2	$CAAR_2$	AAR_3	$CAAR_3$	AAR_4	$CAAR_4$	AAR_5	$CAAR_5$
CSI 300	-5	0.0033**	0.0033**	0.0010	0.0010	0.0027	0.0027	0.0061***	0.0061***	0.003**	0.003***
	-4	0.0017	0.0050***	0.0098***	0.0108***	0.0052***	0.0079**	0.0048***	0.0109***	0.007***	0.010**
	-3	0.0053***	0.0104***	0.0044***	0.0151***	0.0024*	0.0103**	0.0065***	0.0174***	0.002	0.012**
	-2	0.0012	0.0116***	0.0069***	0.0221***	0.0045***	0.0148***	0.0062***	0.0235***	0.005***	0.017**
	-1	0.0067***	0.0183***	0.0045***	0.0266***	0.0028*	0.0175***	0.0035***	0.0270***	0.005***	0.022**
	0	0.0029**	0.0212***	0.0070***	0.0336***	0.0021	0.0196***	0.0021	0.0291***	0.003**	0.025**
	1	0.0060***	0.0271***	0.0067***	0.0402***	0.0027	0.0224***	0.0041**	0.0333***	0.000***	0.025**
	2	0.0023	0.0295***	0.0058***	0.0460***	0.0055***	0.0278***	0.0070***	0.0403***	0.003***	0.028**
	3	0.0050***	0.0344***	0.0055***	0.0515***	0.0075***	0.0354***	0.0076*	0.0479***	0.003***	0.031**
	4	0.0007	0.0351***	0.0025*	0.0540***	0.0046***	0.0400***	0.0086**	0.0565***	0.001***	0.031**
	5	0.0055***	0.0406***	0.0095***	0.0635***	0.0071***	0.0471***	0.0038*	0.0603***	0.006***	0.038**
CSI 500	-5	0.0067 ***	0.0067***	0.0083***	0.0083***	0.0033***	0.0033***	-0.0021**	-0.0021**	0.0033***	0.0033***
	-4	0.0011	0.0078***	-0.0031**	0.0051**	0.0073***	0.0106***	0.0122***	0.0101***	0.0052***	0.0084***
	-3	-0.0003	0.0075***	0.0042***	0.0093***	0.0027**	0.0132***	0.0032***	0.0134***	0.0098***	0.0182***
	-2	-0.0042**	0.0033	-0.0087***	0.0006	0.0054	0.0186**	0.0061***	0.0195***	0.0058***	0.0240***
	-1	0.0069***	0.0102***	0.0011	0.0018	0.0059***	0.0245***	0.0032**	0.0227***	0.0045***	0.0286***
	0	0.0038**	0.0140***	0.0032**	0.0050	0.0032	0.0277***	0.0111***	0.0338***	0.0064***	0.0350***
	1	-0.0003	0.0137***	-0.0096***	-0.0045	0.0076**	0.0353***	0.0045***	0.0383***	0.0148***	0.0497***
	2	-0.0035	0.0101*	0.0023*	-0.0023	0.0068***	0.0421***	0.0085***	0.0468***	0.0098***	0.0596***
	3	0.0109***	0.0211***	-0.0058***	-0.0080*	0.0081***	0.0502***	-0.0090***	0.0378***	0.0037**	0.0632***
	4	0.0098***	0.0309***	0.0116***	0.0036	0.0035***	0.0537***	-0.0035*	0.0344***	0.0066***	0.0698***

	5	-0.0000	0.0308***	0.0047***	0.0083*	0.0051***	0.0588***	0.0040***	0.0384***	0.0058***	0.0757***

*Notes: This table shows the AARs and CAARs worked out based on the Carhart four-factor model. ***, **, *represents significance level at 99%, 95%, 90% respectively*