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ESG Performance, OFDI and Firm's Financing Constraints — A Panel Data Analysis Based on The Fixed-Effects and
Regression Discontinuity in Time (RDiT)

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Master's Thesis

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I have written this Master's Thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced.

About AI: author uses AI to help translate the abstract to Estonian; also uses AI to refine the econometrics model, for example: he used AI to help to construct the System GMM model and draw the framework plot. For the paper, author did not use AI to write any contents.

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Abstract

This paper studies whether ESG performance affects firms' financing constraints and whether outward foreign direct investment (OFDI) plays a mediating role in this relationship. Financing constraints limit firms' ability to obtain external financing and conduct overseas investment, thereby affecting their sustainable development. Better ESG performance may alleviate financing constraints by improving information transparency, corporate governance, long-term risk management, and corporate social responsibility image. At the same time, better ESG performance may enhance firms' ability to conduct OFDI, while OFDI may further affect financing constraints by changing short-term internal cash flow pressure and long-term external financing capacity. In terms of variables and data, this paper uses panel data of listed firms in China's A-share market from 2013 to 2023. Financing constraints are measured by the SA-Index, and ESG performance is measured by the annual change in firms' ESG scores. In the empirical design, this paper first uses a two-way fixed effects model (TWFE) as the baseline regression. Then, a three-step mediation model is used to test the "ESG \rightarrow OFDI \rightarrow FC" mechanism, and the squared term of OFDI is added to examine the inverted U-shaped relationship between OFDI and financing constraints. To address endogeneity, this paper further uses system GMM, Regression Discontinuity in Time (RDiT), IV-RDiT, and Sharp Regression Discontinuity Design (SRDD). The results show that ESG performance improvement can alleviate corporate financing constraints, and OFDI transmits this effect as a mediating variable.

Key Words: *Financing Constraints; ESG; OFDI; Regression Discontinuity Design; GMM*

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1. Introduction

Financing constraints remain one of the main barriers that prevent firms from obtaining credit, undertaking productive investment and maintaining sustainable development. Firms need both internal working capital and external finance to support investment projects, absorb operating shocks and reduce financial pressure. For this reason, how to ease financing constraints, improve corporate financial structure and support investment and financing decisions has become an important research question in accounting and finance (De Maeseneire and Claeys, 2012). The question is especially related with listed firms because their investment decisions are closely watched by banks, shareholders and other market participants. This study focuses on one firm-level channel that has received growing attention in accounting and finance field recent years: environmental, social and governance (ESG) performance. The central research question is whether better ESG performance can reduce firms' financing constraints, and, if so, through which mechanism this effect takes place. In particular, this paper examines whether ESG improves firms' access to finance directly and whether this relationship operates partly through outward foreign direct investment (OFDI).

Existing studies on financing constraints usually focus on two broad channels: expanding access to external finance and reducing firms' internal costs (Hao and Wu, 2024). The first channel concerns whether firms can obtain credit from banks, capital markets and other financial intermediaries. The second channel concerns whether firms can improve their financial structure, strengthen cash-flow management, reduce unnecessary supply-chain costs and lower excessive debt pressure. These studies have contributed to the understanding of corporate financing constraints, but they often begin from the institutional environment or the direct financing conditions faced by firms (Poncet, Steingress and Vandebussche, 2010). Less attention has been paid to ESG as a firm-level signal that may influence creditors' and investors' assessment of firm quality, risk and long-term value. This omission matters because financing constraints are often linked to information frictions, not only to the amount of physical collateral held by firms.

ESG needs to be included in the framework of financing constraints because it can work as a broad signal of firm quality, information transparency, governance capacity and risk management. The firm with higher ESG score is more likely to disclose non-financial information, show better governance discipline and build a more positive social responsibility image. These features can reduce information asymmetry between the firm and outside investors. They can also help banks and institutional investors form a clearer judgement of the firm's long-term operating capacity, default risk and investment value. In this sense, ESG is

not only a measure of sustainable development performance. It can also operate as an information, governance and reputation signal in capital markets, and therefore affect external financing costs and financing availability (El Ghoual et al., 2011; Dhaliwal et al., 2011; Agoraki et al., 2023; Hao et al., 2024; Wang et al., 2024). This point is important for the present study, because the effect of ESG on financing constraints is expected to operate through the information environment rather than through a purely mechanical increase in profits.

The next issue is about OFDI. This paper argues that OFDI is an important mechanism in this relationship. OFDI is not simply another type of investment. Compared with domestic investment, it usually involves cross-border capital allocation, exchange-rate risk, foreign market uncertainty, institutional differences and the management of overseas subsidiaries. These features make OFDI more visible to external investors and more closely linked to firms' financing needs and risk assessment. Therefore, when studying how ESG may ease financing constraints, it is necessary to consider whether firms with stronger ESG performance are more able to undertake OFDI and whether OFDI then changes their access to finance. This focus also helps distinguish the present paper from studies that treat investment only as a domestic capital expenditure decision.

In the short run, OFDI requires large and continuous investment in the early stage of overseas expansion. Firms need to pay for market entry, overseas assets, due diligence, compliance, subsidiary operation and cross-border monitoring. These expenditures may reduce internal cash flow and increase the need for external finance. In fact, in the early stage of OFDI, the consumption of the cash flow reserves of multinational companies is extremely huge, which is often difficult for the small and medium enterprises of non-listed enterprises. The main reason is that compared with large state-owned enterprise groups or mature large private business groups, it is very difficult for small, medium and micro enterprises to obtain stable and long-term targeted credit support or targeted financial support from government agencies. This means that micro and medium enterprises often struggle to afford OFDI expenses such as big overseas M&A projects. In the subsequent analysis of this article, a portion of smaller listed companies will also be included in the analysis. In addition, even large state-owned enterprise groups often need to further consider their own cash flow and asset reserve status when carrying out OFDI expansion, and at the same time try to carry out various capital operation methods such as internal financing and external fund-raising to support their OFDI behaviors. At the same time, overseas investment exposes firms to exchange-rate volatility, political risk and possible failure in foreign markets. These risks may increase monitoring costs for parent firms and lenders, especially when the overseas

subsidiary is located in a market with different legal and financial institutions. In the long run, however, successful OFDI can improve a firm's international image, expand its revenue base and generate reverse knowledge spillovers. Through cross-border mergers and acquisitions or overseas operations, firms may absorb advanced technology, management experience and market knowledge from host countries. These gains can flow back to the parent company and improve its future growth prospects (De Maeseneire and Claeys, 2012; Buch et al., 2014). A stronger international profile and better technological and managerial capability can then improve external investors' evaluation of the firm and help the firm obtain new financing channels (Buch et al., 2014; Sasidharan and Padmaja, 2018). Therefore, OFDI may increase financing pressure at the beginning, but it may also reduce financing constraints when overseas expansion improves expected future performance.

Based on this logic, this paper argues that OFDI mediates the effect of ESG on corporate financing constraints. The relationship among ESG, OFDI and financing constraints is not treated as three parallel correlations. Instead, this paper develops a progressive mechanism of "ESG \rightarrow OFDI \rightarrow financing constraints (FC)". In the first stage, ESG may affect firms' OFDI decisions because ESG reflects social responsibility, information transparency, governance quality and the ability to manage risks. Firms with better ESG performance may have stronger credibility when applying for credit, receiving policy support or communicating with external investors. These conditions can make it easier for them to enter foreign markets and undertake overseas expansion. In the second stage, OFDI may change financing constraints by affecting financing demand, international reputation, risk exposure and external financing capacity. Therefore, the paper does not only test whether ESG is associated with lower financing constraints. It also examines whether ESG affects financing constraints through the mediating role of OFDI (Wang, Han and Zeng, 2024). This design allows the paper to connect corporate sustainability, internationalisation and financing frictions within one consistent framework.

China provides a suitable setting for this study. As a large emerging economy, China has many listed firms with increasingly mature governance structures, but many of these firms still face serious financing frictions and limited access to external credit. This combination makes China useful for examining whether ESG can reduce information asymmetry and ease financing constraints. China also provides a long observation window for ESG-related research, as ESG ideas and disclosure practices have gradually developed in Chinese capital markets since the early 2010s. In recent years, Chinese regulators and stock exchanges have strengthened guidance on environmental information disclosure, corporate social responsibility and ESG reporting, including the policy documents and disclosure requirements

issued around 2018. In 2018, the China Securities Regulatory Commission issued the revised "Corporate Governance Guidelines for Listed Companies", providing a more formal institutional framework for the corporate governance, social responsibility and ESG-related disclosure practices of listed companies.

These changes make ESG more visible to investors and also make ESG scores more relevant for firm-level financing analysis. At the same time, China is one of the major sources of global OFDI. Since the policy shift towards the "going global" strategy and the Belt and Road Initiative, many Chinese firms have had strong incentives to expand overseas through greenfield investment, cross-border mergers and acquisitions and overseas subsidiaries. Therefore, China offers a rich institutional and market environment for analysing ESG, OFDI and financing constraints. It also provides a large sample of listed firms and panel data that can support firm-level empirical analysis. These features make the Chinese setting different from a purely developed-market setting, where firms may already face lower financing frictions and more mature ESG disclosure systems. However, in the environment of emerging market economies such as China, the establishment and development of ESG governance concepts keep pace with the overall trend of many listed companies and small and medium enterprises. Such a development environment is more conducive for this paper to analyze and evaluate the correlation between the development of ESG, corporate financing constraints and corporate governance from an external and long-term vertical perspective. It can also provide similar research and development experience to more countries or regions facing economic transition (CEE region or other emerging developing countries with rapid economic growth).

The existing literature has examined several parts of this relationship. Some studies show that better ESG or corporate social responsibility performance can reduce information asymmetry, lower the cost of external finance and ease financing constraints (El Ghoual et al., 2011; Dhaliwal et al., 2011). Other studies show that financing constraints affect firms' decisions to undertake OFDI and the scale of their overseas investment (Buch et al., 2014). However, relatively few studies place ESG, OFDI and financing constraints within one unified mediation framework. The current literature pays more attention to two separate relationships: whether ESG affects financing constraints, and whether financing constraints affect OFDI. This leaves an important gap. It remains unclear whether ESG can influence financing constraints partly by changing firms' OFDI behaviour and whether this transmission mechanism is economically meaningful. This gap is worth studying because firms' sustainability performance may affect not only their direct financing conditions, but also their strategic ability to expand abroad and reshape investors' expectations.

To address this sort of research gap, this paper builds a mediation framework linking ESG, OFDI and financing constraints at the firm level. It focuses on two main questions. First, does an improvement in ESG performance alleviate corporate financing constraints? Second, does ESG affect financing constraints indirectly through the mediating role of OFDI? In addition, previous studies have shown that OFDI itself may affect firms' financing constraints. In the early stage of overseas expansion, OFDI may increase financing pressure because it requires a large amount of capital and consumes internal cash flow. However, after overseas investment becomes successful, OFDI may improve firm reputation, market access and technological capability. Therefore, this paper also examines the possible nonlinear relationship between OFDI and financing constraints by adding the squared term of OFDI in the mechanism analysis. This supplementary test is useful because the effect of OFDI may not be constant across different investment stages or investment scales. It also allows the paper to distinguish between the short-term financial burden of overseas expansion and the longer-term financing benefit created by successful internationalisation.

This paper uses panel data (2013-2023) on Chinese listed companies. The empirical analysis begins with a two-way fixed effects model as the benchmark specification to estimate the impact of ESG on financing constraints. It then constructs a three-step mediation model and uses OFDI as the mediating variable to test whether ESG affects financing constraints through OFDI. As a supplementary mechanism test, the squared term of OFDI is added to examine the nonlinear effect of OFDI on financing constraints. Because the nexus between ESG and financing constraints may suffer from reverse causality and omitted variable bias, this paper also uses several strategies to address endogeneity. First, it constructs a dynamic panel model and applies system GMM. Second, in 2018, the Chinese government emphasized guiding enterprises to standardize and systematize ESG scores, and at the same time, it particularly stressed guiding enterprises to attach importance to ESG scores and providing policy support. Considering the ESG-related policy changes in China around 2018, it uses Regression Discontinuity in Time (RDiT) to support the baseline regression results. Third, based on the positive and negative points in ESG scores (cutoff = 0), it uses Sharp Regression Discontinuity Design (SRDD) as a robustness test to examine whether the results remain stable under a quasi-natural experimental setting. These methods are used to check whether the estimated relationship is robust across different empirical designs rather than being driven only by one model specification. In this way, the empirical design combines conventional panel estimation with causal-inference-based robustness checks.

Based on the theoretical discussion and empirical design, this paper proposes four hypotheses:

H1: ESG improvement alleviates firms' financing constraints.

H2: OFDI mediates the effect of ESG on financing constraints.

H3: ESG-related policy shocks are associated with firms' ESG performance and lower financing constraints.

H4: The effect of ESG on financing constraints is heterogeneous across firm characteristics.

The structure of this study is as follows. Section 2 reviews the literature on ESG, OFDI and financing constraints. Section 3 defines the variables, describes the data and presents descriptive statistics. Section 4 reports the results of the benchmark fixed effects model, the mediation analysis, RDiT, system GMM, heterogeneity tests and the SRDD robustness test. Section 5 discusses the limitations of the study, possible directions for improvement. And the conclusion of the paper.

2. Literature Review

This literature review focuses on the central issue developed in the introduction: whether firms' ESG performance can alleviate financing constraints, and whether this effect operates partly through outward foreign direct investment (OFDI). Some studies have tried to examine the direct effect of ESG on financing constraints, the relationship between financing constraints and OFDI, and the influence of ESG on firms' international expansion. However, much of this literature treats these relationships separately and usually studies one pair of variables at a time. Less attention has been paid to the possibility that ESG, OFDI and financing constraints are linked through a unified transmission mechanism. To address this gap, this paper does not treat the three variables as merely parallel factors. Instead, it examines a deeper mechanism in which ESG performance may affect firms' financing constraints by improving their ability and willingness to engage in OFDI. In this framework, OFDI acts as the mediator channel through which ESG performance is transmitted into changes in financing constraints. The review therefore begins with the theory of financing constraints, before turning to ESG, OFDI, the mediating mechanism, the Chinese context, the research gap and the empirical methods. This structure also follows the logic of the empirical design. The theoretical review first clarifies why financing constraints matter for firm development, then explains why ESG can be interpreted as an information, governance and reputation signal to influence the financing constraints, and finally discusses why OFDI is a plausible but more complex transmission channel through the mechanism between ESG performance and financing constraints. This order is important because the mediating effect can only be justified if both links are theoretically credible: ESG must be able to influence

firms' financing conditions, and ESG must also be able to affect firms' international investment behaviour.

2.1 Theory of Financing Constraints

In accounting and finance, financing constraints are a core concept in corporate finance and corporate governance research because they determine whether firms can maintain stable and sustainable long-term development. Adequate cash flow is closely related to the effectiveness of corporate governance and investment decisions. The ability to maintain sufficient cash flow depends on a firm's access to internal funds and external finance, while financing constraints directly restrict this ability (Fazzari, Hubbard and Petersen, 1988). When a firm has valuable investment opportunities and good market valuation, but cannot obtain sufficient internal or external funds at a reasonable cost, the firm can be regarded as financially constrained. Brown, Fazzari and Petersen (2009) further show that financing constraints do not only affect firms' cash flow positions. At the same time, financing constraints also severely restrict enterprises' technological innovation, technological and efficiency progress, the green transition of traditional inefficient enterprises, as well as overseas mergers and acquisitions and overseas expansion behaviors.

According to the classical investment theory, financially constrained companies tend to rely more on internal funds, so their own investment status is more closely related to cash flow fluctuations (Fazzari, Hubbard and Petersen, 1988). Based on the requirements of accounting information standards, traditional listed enterprises, after the initial public offering (IPO), must regularly release complete annual and quarterly financial statements. Listed enterprises need to regularly complete accounting information disclosure to the capital market in accordance with the requirements of securities policy regulatory agencies, which involves the internal cash flow fluctuations in the enterprise. This means that if there is a negative fluctuation of cash flow inside the listed company, this kind of information will come out with the disclosure of financial information such as cash flow statement. As a result, investors will rapidly reduce their valuation of the company, which in turn will reduce their continued investment in the business. This will exacerbate the financing constraints of listed companies. Stein (2003) further explained on this basis that the incomplete capital market and agency problems would distort the investment decisions of enterprises and external investors, and then lead to financing constraints. Whited and Wu (2006) also explained from the perspective of dynamic investment model, arguing that financing constraints would affect enterprises' investment capacity and capital allocation efficiency in the capital market.

However, how to correctly measure the financing constraints and difficulties of an

enterprise? What criteria and indices are appropriate to use? This is more controversial. Early theories of corporate governance and accounting finance believed that the standard of "investment-cash flow sensitivity" could be used to measure this level of financial constraints, because they generally believed that enterprises mainly rely on internal cash flow for survival and development. On the contrary, Kaplan and Zingales (1997) raised a very obvious doubt on this index. The main reason for this skepticism is that they believe that it is too one-sided to use cash flow sensitivity to describe financing constraints, ignoring a series of endogenous factors such as corporate assets, liabilities, establishment year and industrial differences. Based on this consideration, subsequent accounting and finance research has proposed a variety of newly constructed indexes according to different types and industries of enterprises, the most widely used such as KZ index, WW index and SA index (Kaplan and Zingales, 1997; Whited and Wu, 2006; Hadlock and Pierce, 2010). Hadlock and Pierce (2010) directly pointed out in their research that SA index had the best effect in explaining corporate financing constraints and internal and external financing capabilities. They believe that the measurement variables of SA index mainly depend on the enterprise's own asset scale and establishment years, which can explain why different enterprises have different levels of financing constraints to the greatest extent. They believe that the fundamental reason for the different levels of financing constraints among enterprises lies in the size of assets and the age of enterprises. Asset size and age are the two most important endogenous factors of firms. Due to above literature research contents, this paper finally chooses to adopt the SA index and take its absolute value when designing the empirical analysis. The SA index treated with absolute value is used to construct the financial constraints variable FC (explained variable). The main reason is that SA index is very suitable for characterizing listed firms, which is indirect and clear. Moreover, the description of SA index mainly focuses on the asset size and enterprise age, which means that the depicted FC can be less affected by short-term financing decisions. The measurement factors focus on just two variables.

2.2 ESG Performance and Financing Constraints

Why can ESG alleviate firms' financing constraints? This paragraph aims to analyze this issue through a literature research perspective. ESG usually includes the comprehensive performance level of firms in terms of environmental responsibility, corporate governance and social responsibility burden. The original theoretical motivation of ESG is to actively guide and call on all kinds of enterprises to fulfill and meet their social responsibilities and realize the unity of economic interests and social welfare. However, with the research in the field of accounting and finance, ESG has gradually become a factor to measure the level of

enterprise investment value. In other words, ESG scores are often tied to a company's own valuation performance. Eccles, Ioannou and Serafeim (2014) found that this means that ESG has gradually become an information signal that can be incorporated by investors into their investment strategies: Enterprises with higher ESG scores are often regarded as having better management experience, more standardized governance structure, more stable stakeholder relationships and more open and transparent information level. Based on the comprehensive evidence of more than 2,100 research studies, Friede, Busch and Bassen (2015) showed that this phenomenon meant that the enterprise had strong risk management ability and a very good social image, which was an important signal worthy of active investment.

In order to support the above conclusions, firstly, from the information asymmetry theory, ESG can help financing constraints by improving the external information environment of enterprises. Due to the problem of information asymmetry, external investors and creditors often do not see too much business information from inside the enterprise. Healy and Palepu (2001) emphasized that information disclosure is an important channel for enterprises to communicate with the capital market. However, even for companies that have been listed and need to timely disclose information, there will also be many problems in their internal business information, such as the whitewashing of financial statements and the untimely disclosure of information. Botosan (1997) and Lambert, Leuz and Verrecchia (2007) pointed out that higher quality information disclosure can reduce the cost of capital. Therefore, for external institutions and creditors, in addition to referring to the financial statements and disclosure information provided by the enterprise, they will also take into considerations such as the enterprise's governance level, social image, risk management level and technological transformation level. Biddle, Hilary and Verdi (2009) also found that better report quality helped to improve investment efficiency and investment level. The reporting quality of these quality indicators exactly constitutes the level of ESG scoring performance, and therefore, outside investors are very happy to use ESG scoring as the basis for investment decisions.

Second, relevant research conclusions on ESG also support the above logic. El Ghouli et al. (2011) pointed out that enterprises that undertook more social responsibilities and handled public interests well tended to have equity financing costs. At the same time, Dhaliwal et al. (2011) also put forward a similar conclusion: when enterprises start to take the initiative to conduct voluntary non-financial disclosure, their equity financing cost is likely to continue to decline. This shows that firms with good ESG have lower equity financing costs. Moreover, Agoraki et al. (2023) found in panel data analysis and empirical research based on European listed companies that lower ESG reputation risk was associated with weaker financing constraints and better corporate performance. At the same time, in the application scenario of

China's capital market and secondary market, the fixed effect analysis of Hao and Wu (2024) and Wang et al. (2024) based on the panel data of listed companies also found that the improvement of ESG performance can significantly alleviate the financing constraints of enterprises themselves.

To sum up, the principle that ESG can affect financial constraints is that enterprises with high ESG scores significantly improve external investors' judgment on corporate social image, governance credibility and risk control ability. It is this new judgment basis that guides external investors to actively invest in enterprises with high ESG scores, improving financing constraints.

2.3 ESG Performance and Firms' OFDI

After explaining the influence relationship between ESG performance and corporate financing constraints in this article, this paragraph focuses on: the relationship between ESG performance and the OFDI decisions and behaviors of enterprises themselves. The theoretical analysis of foreign direct investment is closely related to Dunning's OLI framework (Dunning, 1988). OFDI refers to outward foreign direct investment and may include overseas mergers and acquisitions, overseas investment projects and the expansion of overseas sales markets. It can also be understood as a form of cross-border capital allocation by firms. According to the OLI framework, firms that invest abroad normally need ownership advantages, internalisation capacity and the ability to choose suitable host-country locations. Therefore, firms that can carry out OFDI in a mature way usually need advanced management experience, clear strategic planning and strong risk prevention capacity. They also need sufficient disposable cash flow and external financing capacity. These conditions form the basic foundation for firms to undertake OFDI.

ESG may affect firms' OFDI behaviour through three main mechanisms. First, as discussed above, improved ESG performance might strengthen a firm's social reputation and international image. Cross-border investment and overseas operations often expose firms to labour conflicts, regulatory pressure, environmental supervision and social responsibility requirements. Compared with firms with weak ESG performance, firms with stronger ESG scores may find it easier to obtain support from host-country governments, external investors and strategic partners when they implement OFDI projects (Wang, Han and Zeng, 2024; Yuan et al., 2026). Second, ESG can improve firms' financing capacity. At the early stage of OFDI, firms must commit substantial cash flow and asset reserves to overseas mergers and acquisitions, foreign production bases, overseas employees and the absorption of advanced

technology. If better ESG performance helps reduce financing constraints, it also improves the firm's ability to bear these short-term OFDI costs (Wang, Han and Zeng, 2024). Third, ESG scores can reflect risk management ability and governance quality. Overseas operations are often difficult to monitor, and principal-agent problems and information asymmetry may become stronger across borders. Firms with high ESG scores usually have better management structures, stronger risk control and more developed internal management systems. These characteristics make them more capable of undertaking OFDI (Wang, Han and Zeng, 2024; Yuan et al., 2026). These three mechanisms are also related to the logic of internationalisation. OFDI usually requires firms to interact with foreign regulators, suppliers, employees and financial institutions. Strong ESG performance may reduce the liability of foreignness faced by firms entering overseas markets because it signals that the firm is more willing and able to comply with host-country standards. Therefore, ESG may not only support financing capacity at home, but also improve the institutional acceptance of firms abroad.

Several studies have examined ESG and OFDI in the Chinese context. Using panel data and fixed-effects models, Wang et al. (2024) analyse how the ESG performance of Chinese listed companies affects their OFDI behaviour. They find that firms with higher ESG scores are more willing to invest abroad and expand the scale of OFDI. Wang, Han and Zeng (2024) also find a positive relationship between ESG performance and firms' OFDI using Chinese firm-level panel data. These studies provide an important literature basis for the mediating mechanism examined in this paper. They suggest that ESG can promote OFDI by improving firms' external image, financing capacity, risk management and corporate governance quality.

2.4 The Mediating Role of OFDI

This paper argues that ESG might improve firms' financing constraints partly by promoting OFDI. In this mechanism, OFDI acts as a mediating variable. OFDI itself can affect financing constraints, but this effect may differ between the short run and the long run. For example, in short run, OFDI is capital-intensive. When firms first enter overseas markets, they need large amounts of capital and cash flow for overseas expansion, mergers and acquisitions, subsidiary establishment and supply-chain development. These costs may put pressure on the parent company's financing capacity and may worsen its financing constraints in the short term. This is not limited to emerging economies such as China. Similar evidence has been found in other contexts (De Maeseneire and Claeys, 2012; Buch et al., 2014). For example, De Maeseneire and Claeys (2012), using Belgian panel data, find that micro and medium enterprises face clear equity and debt financing constraints when undertaking FDI. This means that compared with large state-owned enterprise groups and mature private large

commercial groups, the complex and difficult financing constraints are the first thing that small and micro level and medium enterprises need to consider when making OFDI decisions. micro and medium enterprises usually give up the decision of OFDI expansion because they cannot afford the financing constraints caused by the huge cash flow input in the early stage of OFDI. Therefore, for small and medium enterprises considering the expansion of OFDI, the most important issue that needs to be addressed is the financing constraints. Buch et al. (2014), using data on German firms, show that financing constraints create short-term financial pressure and weaken firms' willingness to expand abroad. Sasidharan and Padmaja (2018) also find that financing constraints affect firms' subsequent OFDI decisions in the Indian context. In the long run, however, successful OFDI may help reduce financing constraints. Overseas investment can help firms enter foreign markets, strengthen international reputation and absorb advanced management and technology from host countries. These effects may increase overseas revenue and net profit, improve international image and strengthen financing capacity. Firms may therefore receive greater attention and support from external investors (Zhou, Li and Tse, 2019; Lu, 2023). For instance, Lu (2023) finds that greenfield investment by Chinese listed firms can improve international visibility and financing ability abroad. This effect may operate through information channels such as analyst attention and recommendations from international investment banks. Therefore, the nexus between OFDI and financing constraints may be nonlinear: OFDI can intensify financing constraints in short run, might alleviate them in the long run. This theoretical logic explains why the empirical model later includes a squared OFDI term. This distinction between the short term and long term effects is important for the mediation analysis. If OFDI only increased financing pressure, it would be difficult to interpret it as a positive mediating channel. However, if OFDI first creates financing pressure but later improves firms' international reputation, technology access and revenue base, its overall effect may be nonlinear. The empirical model must therefore allow for the possibility that the effect of OFDI changes with the scale and maturity of overseas investment.

OFDI therefore plays a mediator role in the broader mechanism through which ESG affects financing constraints. Due to literature reviewed above, author also analyses ESG, OFDI and financing constraints within a unified mediation framework rather than treating them as three separate parallel variables. The proposed mechanism is as follows. First, ESG lower financing constraints by improving information asymmetry, governance quality and social reputation. Second, improved ESG performance also increases a firm's ability to undertake OFDI. Third, successful OFDI can bring stronger external financing attention, higher revenue and better profitability, which may further ease financing constraints. In this

framework, ESG is the starting point, OFDI is the transmission channel and financing constraints are the final outcome.

The above mechanism may also vary across firm characteristics and institutional contexts. The level of financing constraints, cash flow position, ownership structure, audit quality, information disclosure and OFDI scale may all shape the ESG-OFDI-financing constraint relationship. For example, non-state-owned enterprises usually rely more on external capital markets, so ESG improvement may have great effect on their financing constraints. Firms with negative cash flow may be more exposed to the short-term cost pressure of OFDI. These differences provide the basis for the heterogeneity analysis in the empirical design. In fact, studying the heterogeneity effect analysis of the theoretical mechanism is very helpful for policy researchers and policymakers to flexibly sort out their thinking when formulating industrial promotion policies and modify specific industrial policies according to various situations. For different types of enterprises, they often have different assets, accounting and financing constraints. Therefore, the heterogeneity of different enterprises will make it difficult for unified policies to play a good role: this means that policy makers must formulate different industrial policies according to different firms in order to better solve the heterogeneity of different enterprise subjects. At the same time, understanding these heterogeneity is also helpful for policy institutions to analyze which enterprise entities get the most benefits from the industrial policy. Which enterprises only get less or even no policy effect? This will help policy makers more scientifically and reasonably consider the comprehensiveness and reliability of economic policies. It is more helpful to optimize the effect of economic policy. Therefore, in the heterogeneity analysis of empirical design, this paper mainly adopts a variety of comparative regression methods such as quantile regression and grouped variable regression based on TWFE benchmark regression. These heterogeneity research methods have generally gained extensive application experience and practical experience in the field of applied micro and empirical analysis, and their results can also be widely recognized. This method enables research to observe different effects under different categorical variables more intuitively. This method can better reveal these differentiated mechanisms and merely present them through comparison.

2.5 The Context of China as an Emerging Economy

This paper chooses China as the main setting for testing the proposed mediation mechanism. China is a huge emerging economy with a substantial number of listed companies and extensive experience in both ESG development and OFDI expansion. The Chinese context is suitable for this study for several reasons.

First, financing constraints are an important obstacle to the Chinese firms. Based on Chinese firm-level data, Poncet, Steingress and Vandebussche (2010) find an obvious political pecking order in China's credit allocation, with private firms facing stronger financing constraints than state-owned and foreign-funded firms. When in China, financing constraints are closely related to ownership type, information asymmetry between banks and firms, limited external financing channels and the long-term imbalance in credit allocation. Firms with different sizes, industries and ownership backgrounds often have very different access to bank credit, direct financing, indirect financing and policy support. Therefore, the connection between China's internal and external financing environment is also becoming stronger. Thus, whether Chinese enterprises can successfully expand OFDI often must take ESG score performance into the scope of reference and decision-making (Wang, F., Han and Zeng, 2024). Overall, it is realistic for Chinese enterprises to put the three variables of ESG, OFDI and FC together under the same mechanism framework. In addition, this kind of analysis can better explain the internal relationship between the sustainable development of Chinese multinational enterprises, international M&A strategy and financing ability.

Second, China's industrial policy support and institutional background also provide solid research support for this paper, which is very suitable for analysis from the perspective of economic policy evaluation. Since 2013, the government in China has continued to promote opening-up and the green transformation and sustainable development of traditional enterprises. At the same time, China Securities Regulatory Commission (CSRC) also actively promotes the reform of information disclosure and governance of listed companies, and introduces the concept of ESG scoring governance and evaluation. China is also paying more attention to the performance of ESG scores. For example, in 2018, the Chinese government promoted a series of ESG institutions to guide enterprises to optimize their ESG performance, and gave more tax saving and subsidy support to enterprises with high ESG scores. This means that enterprises with great ESG performance are more likely to obtain financial and support from Chinese government in their subsequent development. These enterprises with high ESG scores can slow down financing costs and save part of capital expenditure through tax incentives and subsidies, so as to better alleviate their financing constraints. At the same time, China's outbound investment system has also experienced more new changes.

The OFDI scale of Chinese enterprises has been greatly improved with policy support. The scale of OFDI in China mainly went through three stages between 2014 and 2023. From 2014 to 2016, the traffic scale of OFDI in China maintained a period of rapid growth, with an annual growth rate of over 20%, and the total scale reached 196.15 billion US dollars. The period from 2017 to 2018 was a stable growth period. From 2019 to 2023, it was a period of

growth against the trend. Despite the global downturn caused by the pandemic, the scale of China's OFDI still grew against the trend. It reached the top in the world in 2020, and the OFDI flow rebounded to 177.29 billion US dollars in 2023. Behind these figures of OFDI scale achievements made by China lies a series of OFDI industry support and open trade policies of the Chinese government. For example, in 2014, the Measures for the Administration of Approval and Filing of Overseas Investment Projects simplified the approval process of enterprises' overseas investment. In 2018, the Measures for the Administration of Enterprises' Overseas Investment strengthened support for enterprises' overseas investment and the expansion of OFDI. Together, these institutional changes constitute an ideal institutional environment. In this environment, the ESG performance, OFDI and financing conditions of enterprises deserve more and more attention from financial institutions and policy departments. Therefore, China's institutional and reform environment provides a meaningful application scenario for testing the ESG-OFDI-FC mechanism in this paper. Moreover, as an emerging economy in continuous transformation, China also has very good development experience. Analyzing this economic theory in the Chinese scenario can provide more development experience for the vast number of emerging economies and regions in transition (such as the CEE region).

2.6 Research Gap and Empirical Hypothesis

Existing literature has provided an important research foundation for this paper, especially analyzing the mediating effect mechanism relationship among ESG, OFDI and financing constraints from the role of theoretical analysis. In the previous part of the literature review, this article has systematically sorted out and analyzed the previous literature. The research of the previous literature mainly has two deficiencies:

First, most studies still examine one-way relationships separately, such as the effect of ESG on financing constraints, the effect of financing constraints on OFDI, or the effect of ESG on OFDI. Few studies examine these three variables within a unified mediation framework.

Second, the identification strategy used to focus on the nexus of ESG with financing constraints has not been sufficiently considered. Many existing studies rely mainly on basic panel regressions, while endogeneity concerns may remain. In addition, the nexus of ESG with financing constraints may be influenced by external policy shocks. This makes it necessary to use quasi-natural experimental designs to distinguish treatment and control groups and strengthen causal inference. The causal identification strategy in this paper therefore helps support the main conclusions. The ESG-OFDI-FC framework constructed in

this paper mainly answers two research questions: (1) Can ESG performance alleviate firms' financing constraints? (2) Will ESG performance affect financing constraints through the mediating role of OFDI? Due to above literature review, the study proposes four hypotheses: The second limitation is especially important because ESG performance may be jointly determined with financing constraints. Firms with better financing conditions may have more resources to improve ESG performance, while better ESG performance may in turn reduce financing constraints. This two-way relationship creates reverse causality. In addition, unobserved firm characteristics, such as management quality, local policy support or industry-level green transformation, may affect both ESG and financing constraints. A research design that combines fixed effects, mediation analysis and quasi-natural experimental methods can therefore provide more persuasive evidence.

H1: ESG improvement alleviates firms' financing constraints.

H2: OFDI mediates the effect of ESG on financing constraints.

H3: ESG-related policy shocks are associated with firms' ESG performance and lower financing constraints.

H4: The effect of ESG on financing constraints is heterogeneous across firm characteristics.

2.7 Methodology and Causal Inference

2.7.1 Fixed Effects and Mediation Effect Model

The fixed effects model is an econometric approach commonly used in panel data studies. This method is mainly used to control for firm and year fixed effects. When both are included, the FE is known as a two-way fixed effects (TWFE) model. By controlling for these factors, TWFE can alleviate omitted variable bias to some extent. In this framework, the model can be used to analyse the relationship between ESG performance and corporate financing constraints and to estimate the size of the effect (Wooldridge, 2002).

The mediation effect model is used to explain the transmission mechanism through which an independent variable affects a dependent variable. It tests whether a mediating variable transmits part of the effect from the independent variable to the dependent variable. The classical mediation approach is usually implemented through a three-step procedure and is often expressed as the mechanism path of $X \rightarrow M \rightarrow Y$ (Baron and Kenny, 1986; Imai, Keele and Tingley, 2010). In addition, the interaction term of ESG variable and OFDI variable is created in TWFE regression and added to the benchmark regression to test its estimated coefficient and significance, which can also support the moderating effect of ESG variable and OFDI variable on corporate financial constraints. However, as the moderating

effect and the three-step mediating effect as a whole, there are repeated method test concepts; Moreover, compared with the moderating effect of the interactions, the three-step mediating effect can better explain the transmission mechanism of $ESG \rightarrow OFDI \rightarrow FC$. To sum up, we mainly adopt the mediating effect test mechanism to conduct regression analysis and statistical test in the mechanism research part of this paper.

This paper uses TWFE as the benchmark regression to analyse the relationship between ESG and financing constraints. At the same time, the three-step mediation model is suitable for testing whether OFDI acts as a mediating channel in the effect of ESG on financing constraints.

2.7.2 Regression Discontinuity in Time (RDiT)

Since it was first proposed by Thistlethwaite and Campbell (1960), Regression Discontinuity Design (RDD) has become an important causal inference tool in empirical research. The core idea of RDD is to use a discontinuity in a running variable at a cutoff point. Observations just above and just below the cutoff are compared to identify the causal effect. Compared with DID strategy, which relies on the parallel trends tests, and Instrumental Variables (IV), which require instrument relevance and exclusion restrictions, RDD is closer to a natural experiment. Its identifying assumptions are also more directly testable in many empirical settings (Athey and Imbens, 2017; Cattaneo and Titiunik, 2022).

To address endogeneity and build a clearer causal identification strategy, this study uses Regression Discontinuity in Time (RDiT) as a quasi-natural experimental design. RDiT is an extension of RDD that uses time as the running variable and treats the timing of a policy or event as the cutoff. It is especially useful when all observed units are exposed to a policy at the same time. In this case, traditional DID may be difficult to apply because there is no obvious untreated group in the same period. The key assumption of RDiT is that unobservable factors affecting the outcome, and other factors that may interfere with the policy effect, change smoothly over time around the cutoff (Hausman and Rapson, 2018). Under this assumption, researchers can use the discontinuity in treatment status at the policy timing to estimate the treatment effect. Hausman and Rapson (2018) also discuss the use of IV-RDiT as an auxiliary test when a policy takes effect at a clear time threshold but an ideal cross-sectional control group is not available. Earlier studies also apply similar time-based policy shock designs. Davis (2008), for example, studies the effect of driving restrictions on air quality in Mexico City, while Chen and Whalley (2012) examine the effect of urban rail transit on air quality. By exploiting an exogenous policy cutoff, we mitigate selection bias, heterogeneity bias, and other potential confounding effects between treated and control firms.

The identification framework satisfies the Conditional Independence Assumption (CIA), the Stable Unit Treatment Value Assumption (SUTVA), and the potential outcomes model, thereby enabling consistent causal inference on the nexus between ESG performance and financing constraints.

2018 can serve as a meaningful policy time breakpoint for studying the relationship between China's ESG performance and financing constraints. In 2018, the China Securities Regulatory Commission issued the revised "Corporate Governance Guidelines for Listed Companies", providing a more formal institutional framework for the corporate governance, social responsibility and ESG-related disclosure practices of listed companies. Based on the background of the Chinese government's ESG supporting industrial policies in 2018, this paper adopts the three kernel densities of Regression Discontinuity in Time (RDiT) and the polynomial regression identification strategy to sensitively identify the impact of the optimization of ESG score performance on firms' financing constraints, and estimates the treatment effect. This study chooses 2018 as the cutoff, and use the time variable as the running variable to construct the RDiT regression model as the second regression model after the fixed effect model to support H3: Mitigation effect of ESG on financing constraints under external economic policy shocks. This paper also adopts three kernel densities of RDiT and polynomial regression methods for causal inference. Moreover, the empirical design constructs multiple subsamples and variables of regression discontinuity design based on the Chinese firm's micro-panel data of approximately 4,000 listed companies (2013-2023). This fully and effectively alleviates the endogeneity issue. This design helps address endogeneity concerns and provides an additional causal inference test for the benchmark results. The use of different kernel functions and polynomial specifications is intended to check whether the estimated discontinuity is robust to reasonable changes in the local estimation method. If the results remain similar across these specifications, the evidence for a policy-related change in financing constraints becomes more credible. This approach also makes the RDiT analysis more consistent with the broader RDD literature, which emphasises bandwidth choice, local estimation and sensitivity checks. Since the RDiT causal identification strategy is not a perfect one, and may also be interfered by a variety of endogenous factors in 2018, this paper adds the RDiT multi-bandwidth sensitivity test and the more cutting-edge IV-RDiT causal identification strategy for robustness test after the RDiT local polynomial regression analysis. RDiT multi-bandwidth sensitivity test is carried out by changing the bandwidth range of local polynomial regression and using the expanded or reduced version of the optimal MSE bandwidth to conduct sensitivity test, which is conducive to auxiliary verification of the robustness of RDiT regression. At the same time, the IV-RDIT causal identification strategy

is the combination analysis of IV instrumental variable method and RDiT, with a total of two stages of analysis. On the one hand, this strategy can use ESG performance as the instrumental variable of RDiT to detect whether economic policies affect ESG performance as an exogenous shock; On the other hand, it can also be used as a robustness test model to deal with the endogeneity of RDiT to support the reliability and scientific nature of RDiT identification strategy. In conclusion, RDiT will serve as supplementary evidence for TWFE benchmark regression to explain H1 and H3, rather than simply and strategically as a baseline to directly verify the causal relationship.

2.7.3 Sharp Regression Discontinuity Design (SRDD)

In the empirical design of this paper, RDiT is estimated using panel data on Chinese listed firms from 2013 to 2023, where time is set as running variable. However, the number of available time points around the cutoff is limited. It is therefore necessary to use another form of RDD as a robustness test for the fixed-effects and RDiT results. In the cutoff selection of RDD, in addition to the unique exogenous policy impact points, some innate distinguishing characteristics can also be taken into account. For example, natural youth, middle age and old age distinguish the age threshold value; The threshold value of the distinction between excellent and good grades; The natural boundary of geographical environment or the boundary of temperature and climate; And 0, which naturally has the line between positive numbers and negative numbers. These variables can be included in the analysis as the natural cutoff of RDD. Since the ESG score is the main explanatory variable in this paper and can naturally distinguish between positive and negative values, this paper also uses zero as the cutoff in a Sharp Regression Discontinuity Design (SRDD). Firms with ESG scores greater than or equal to zero are defined as the treatment group, while firms with ESG scores below zero are defined as the control group. This SRDD approach is used as an additional causal inference test. When applying SRDD, the analysis also considers the McCrary density test, local polynomial regression and RD plots to examine the validity and robustness of the identification strategy. This robustness design is not intended to replace the main panel and RDiT analyses. Rather, it provides an additional way to examine whether firms on different sides of the ESG cutoff show different financing constraint outcomes. If the SRDD results support baseline and RDiT evidence, the overall empirical conclusion will be more reliable. If the results differ, the comparison can also help identify whether the main findings depend strongly on a particular identification strategy. In conclusion, SRDD will also serve as a supplementary evidence to explain benchmark regression and is a type of robustness test. Meanwhile, SRDD can also supplement and explain H1 and H3.

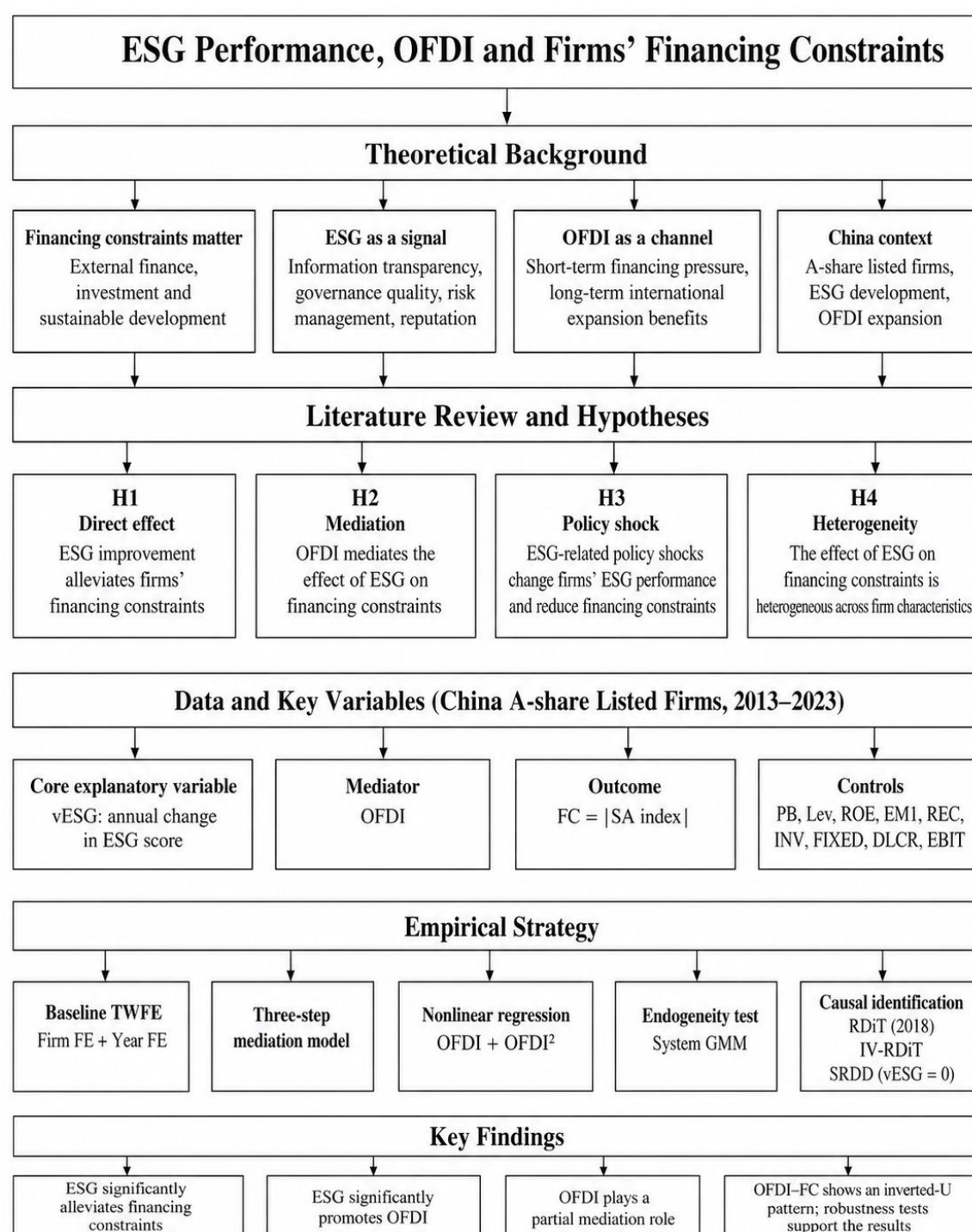


Figure 1. Technical Framework Map of The Paper and Methodology

Source: author

3. Variable Definitions and Descriptive Statistics

The variable definitions and abbreviations in the research are mainly shown in Table 1, which clearly shows the explained variables, explanatory variables and control variables required by the fixed effect model (TWFE), mediating effect model, system GMM, RDIT and SRDD models. The remaining variables that are not included are explained separately and

described separately in the section of the regression equation.

Table 1. *Variable Definitions for Econometric Model*

| VARIABLES | Description | Source |
|-------------|---|--|
| FC | Dependent variable/Outcome variable. Financing Constraints, which reflects the hardship of each listed firm in the China A-Share market, is measured by SA-Index: $FC = -0.737*Size + 0.043*Size^2 - 0.040*Age$. Data covers 2013–2023. The larger the value of the FC variable is, the stronger the level of financing friction of the enterprise will be, and thus the more difficult it will be for the enterprise to obtain external funds. | WIND, CSMAR |
| vESG Change | Core variable: Reflects the changing ESG scores of Chinese A-Share market listed firms each year, covering from 2013 to 2023, calculated and collected by Huazheng ESG Ranking Database and Bloomberg ESG Ranking Database. The numerical unit of this variable is point, which is uniformly calculated from the above-mentioned database. | Huazheng /Bloomberg ESG Ranking Database |
| OFDI | Mediator variable. Outward Foreign Direct Investment amount by each listed firm in the China A-Share market calculated in current US million dollars (log-transformed, 2013 – 2023). Used as the interaction term or mediator variable. | CSMAR, WRDS |
| PB | Control variable. Price-to-book ratio. PB is used to measure the ratio between the market value of a company's stock and its book value. The PB value is used to reflect the capital market's judgment on the growth potential, valuation level and investment potential value of a listed company. In this paper, PB is used as one of the control variables to control the level of market valuation differences among enterprises. | WIND, CSMAR, WRDS |
| Lev | Control variable. Financial leverage. The calculation method of Lev: total liabilities divided by total assets. In this article, Lev is used to measure the debt burden and asset-liability structure level of enterprises. A higher financial leverage means a debt-paying pressure ratio. This will affect the external financing capacity of enterprises. | WIND, CSMAR, WRDS |
| ROE | Control variable. Return on equity. ROE is used to measure a company's ability to generate profits based on shareholders' equity investment. A high ROE indicates that the enterprise has a high level of profitability. This means that the company may enhance its internal financing capacity and thereby reduce its reliance on external investors for financing. | WIND, CSMAR, WRDS |
| EM1 | Control variable. Earnings management. $EM1 = Total\ Accruals - Non-discretionary\ Accruals $. This variable is used to measure the level of earnings management of enterprises. For a company, a higher level of earnings management may increase external investors' concerns about the company's risk management level. | WIND, CSMAR, WRDS |
| REC | Control variable. Proportion of accounts receivable. REC refers to the proportion of accounts receivable in the Company's assets or operating activities. Higher accounts receivable mean a longer capital recovery cycle, which will intensify short-term financing pressure. | WIND, CSMAR, WRDS |
| INV | Control variable. Inventory ratio. This variable reflects the ratio of a company's inventory to its assets. An excessively high INV may indicate a decline in the liquidity of an enterprise. Excessively high INV will directly affect the financing needs and pressure of the enterprise itself. | WIND, CSMAR, WRDS |
| FIXED | Control variable. Ratio of fixed assets. $FIXED = Fixed\ Assets / Total\ Assets$. Measure the proportion of fixed assets in corporate assets. A higher proportion of fixed assets may enhance debt financing capacity. | WIND, CSMAR, WRDS |
| DLCR | Control variable. Debt capital structure indicator. This variable is used to reflect the debt repayment pressure of an enterprise or the characteristics of its debt capital structure. | WIND, CSMAR, WRDS |
| EBIT | Control variable. Ebit. This variable is used to measure a company's profitability before deducting interest and income tax. | WIND, CSMAR, WRDS |

SOE

Dummy. 0 - 1 Dummy. 0:SOE firms, 1:Non SOE firms.

WIND

 Source: calculated by author; Huazheng/Bloomberg ESG Ranking Database; WIND, CSMAR, WRDS

Table 2 presents the descriptive statistics of all the variables selected in this paper. The main data used in the empirical analysis and econometric model analysis sections of this article are evidence from China. For the data descriptions and variables' descriptions, we use the around 3,900 listed firms' panel data from China A-share market from 2013 to 2023, around 30,532 observations. Independent variable is vESG (Reflects the ESG scores of listed firms each year). We set the dependent variable FC (Financing Constraints, is measured by *SA-Index*: $FC = -0.737*Size + 0.043*Size^2 - 0.040*Age$).

As for data cleaning, considering that China's capital market fluctuates greatly from 2013 to 2023, many enterprises choose to be listed and traded in China's capital market after 2016, and some enterprises withdraw from the market for bankruptcy and liquidation several years after initial listing and IPO. In addition, a large number of enterprises choose to delist voluntarily under the condition of poor management and low stock price. At the same time, there are also a large number of enterprises that lack complete financial information and data disclosure and do not accept professional ESG score calculation by ESG institutions, so there are many missing data overall. The main reason lies in the fact that the promotion of the ESG scoring governance system takes a relatively long time. In the first few years when the ESG concept was just in operation in China, most enterprises lacked ESG scores. At the same time, due to concerns over the confidentiality of financial and company information, many enterprises were reluctant to disclose their ESG scores and other excessive financial data at that time, which led to the loss of a considerable amount of data information. In view of this situation, this paper takes the initiative to delete the data of enterprises that choose to be delisted voluntarily, are forced to be delisted due to poor management, refuse to fully disclose financial information or lack ESG score information, and retain the basic financial data and panel data of required variables of about 3,000 listed enterprises.

In addition, about data cleaning and processing methods, this paper first adopts the median imputation method and industry mean imputation method for a large number of missing values. Secondly, this paper winsorizes and cleans extreme data, and gradually removes excessive outliers. The threshold values for the tapering range in this article are selected as 1% and 99%. Values higher or lower than these two parts will be treated as extreme values for tapering. If there are still more extreme cases that cannot be interpolated, this paper selects the vacant part that cannot be interpolated. All the panel data needed to form

the regression are collected. The statistics are shown in Table 2.

Table 2. Data and its Descriptive Statistics

| Variable | Period | Obs. | Mean. | Sd. | Min. | Max. |
|-----------------|---------------|-------------|--------------|------------|-------------|-------------|
| FC | 2013 - 2023 | 30,532 | 4.852 | 1.580 | 2.339 | 10.293 |
| vESG | 2013 - 2023 | 35,347 | 0.002 | 0.050 | -0.152 | 0.155 |
| OFDI | 2013 - 2023 | 37,086 | 2.251 | 15.882 | 0.000 | 140.000 |
| PB | 2013 - 2023 | 30,532 | 3.645 | 3.154 | 0.516 | 19.596 |
| Lev | 2013 - 2023 | 30,532 | 0.412 | 0.202 | 0.055 | 0.892 |
| ROE | 2013 - 2023 | 30,532 | 0.058 | 0.128 | -0.604 | 0.366 |
| EM1 | 2013 - 2023 | 30,532 | 2.037 | 1.189 | 1.055 | 8.598 |
| REC | 2013 - 2023 | 30,532 | 0.125 | 0.103 | 0.000 | 0.466 |
| INV | 2013 - 2023 | 30,532 | 0.135 | 0.123 | 0.000 | 0.674 |
| FIXED | 2013 - 2023 | 30,532 | 0.204 | 0.154 | 0.002 | 0.682 |
| DLCR | 2013 - 2023 | 30,532 | 0.136 | 0.158 | 0.000 | 0.684 |
| EBIT | 2013 - 2023 | 29,018 | 0.095 | 0.189 | -0.895 | 0.615 |

Source: calculated by author; Huazheng/Bloomberg ESG Ranking Database; WIND, CSMAR, WRDS

4. Empirical Analysis and Results

This paper mainly uses the four hypotheses (H1-H4) proposed in the previous literature review of the TWFE model and the RDIT causal inference model to establish the econometric model, conduct analysis, and report and present the empirical analysis results. The main design ideas of the empirical model part in this paper are as follows:

First, TWFE is used as the baseline regression model to support the relationship between ESG and the level of corporate financing constraints, and to validate Hypothesis H1.

The two-way fixed effects (TWFE) baseline regression model function is set as below:

$$FC_{it} = \alpha + \beta_1 vESG_{it} + \gamma' Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

For function (1), FC_{it} is the financing constraints calculated by SA-Index, indicates the financing constraints of the listed firms; $vESG_{it}$ is the changing ESG scores of the listed firm i in year t ; α includes baseline regression's intercept term; $Controls_{it}$ is a series of financial variables concerning the financial indicators of listed companies represent all the control variables in this paper and the benchmark regression; including the PB, Lev, ROE, EM1, REC, INV, FIXED, DLCR, EBIT these variables. μ_i includes firms' fixed effect: controlling the heterogeneity of each listed firm that does not change with time trend; λ_t includes time fixed-effect which controls the time factors of the TWFE functions; The model adds the clustered standard errors. ε_{it} is the function's interaction term. Standard errors are clustered to the listed firms' level.

Secondly, following the analytical approach of the literature review, OFDI was taken as the mediating variable, and a three-step mediating effect model was constructed based on the TWFE benchmark regression for mechanism testing. support that ESG can influence a company's financing constraints by altering OFDI, and validate Hypothesis H2.

The Mediation Effects and non-linear relationship model regression model function are set as below:

$$FC_{it} = \alpha + \beta_1 vESG_{it} + \gamma' Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (2)$$

$$OFDI_{it} = \alpha + \beta_2 vESG_{it} + \gamma'' Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

$$FC_{it} = \alpha + \beta_3 vESG_{it} + \theta_1 OFDI_{it} + \gamma''' Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

$$FC_{it} = \alpha + \beta_4 vESG_{it} + \theta_2 OFDI_{it} + \theta_3 (OFDI_{it})^2 + \gamma''' Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5)$$

For function (2) - (4), they include the three-step mediation model regression function

which are added as the mechanism test analysis parts; α includes baseline regression's intercept term. Where $OFDI_{it}$ is set as the mediator variable, calculated by the listed firms' OFDI investment amount in year t ; $Controls_{it}$ is still a series of financial variables concerning the financial indicators of listed companies represent a series of control variables in this paper and the benchmark regression; including the PB, Lev, ROE, EM1, REC, INV, FIXED, DLCR, EBIT these variables. In addition, for function (5), the TWFE function also add the square term of the OFDI to test the inverted U-Shape nexus between OFDI and the financing constraints.

Third, properly handle the endogeneity issue in the TWFE benchmark regression model. One of the approaches to endogeneity is the systemic GMM. Report and present the endogeneity correction results of the system GMM, and reasonably discuss the reliability and robustness of the method. And analyze the heterogeneity analysis of the TWFE regression model to support H4.

The dynamic panel TWFE regression function model is set as:

$$FC_{it} = \alpha + \theta_4 FC_{i,t-1} + \beta_5 vESG_{it} + \delta_1 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (6)$$

Where the $FC_{i,t-1}$ is the first-lag of the FC (Financing Constraints) to test the dynamic processing effect for financing constraints. This paper currently chooses to use dynamic panel TWFE regression as the basis of system GMM estimations. Other items remain the same with TWFE function (1).

Fourthly, according to the background of exogenous policy shocks that the Chinese government comprehensively regulated and guided ESG development policies in 2018, this paper constructs the RDIT model as an identification strategy for causal inference. The aim of RDIT is to identify the relationship between ESG and corporate financing constraints, and it is used as a supplementary analysis of TWFE benchmark regression. At the same time, RDIT can also be used as a tool for policy evaluation and causal inference to test H3 and support the mitigation effect of the exogenous shock policy in 2018 on corporate financing constraints.

The RDIT causal identification strategy regression model is set as below:

$$FC_{it} = \alpha + \tau Post_{i,t} + \sum_{p=1}^t \beta_p t_t^p + \sum_{p=1}^t \delta_p (Post_t \times t_t^p) + \delta_1 Controls_{it} + \mu_i + \varepsilon_{it} \quad (7)$$

In function (7), FC_{it} is the firm i 's financing constraints level in year t ; $Post_{i,t}$ is the policy-trigger cutoff dummies, if the year is 2018 or later, then take 1, or take 0. It has been

used to identify the 2018's ESG policy's impact treatment effect. Where t_t^p is the running variable, it equals to the: year - 2018. $\sum_{p=1}^t \beta_p t_t^p$ represents the basic time trend before and after the cutoff, allowing financing constraints to change smoothly over time. $\sum_{p=1}^t \delta_p (Post_t \times t_t^p)$ represents the change in the time trend after a policy shock and is used to control the possible adjustment of the trend slope after the policy implementation. The main coefficient of this model is τ , because it measures whether there was a significant leap in financing constraints at the policy breakpoints in 2018. In addition, unlike the TWFE function, RDiT does not need to control the time trend because it uses time variable as the running variable. So it should not add the λ_t term to the function.

Fifth, due to some defects of the RDiT model, this paper also establishes the IV-RDiT model as an auxiliary identification strategy of the RDiT model.

$$\widehat{vESG}_{it} = \alpha + \pi_1 Post_{i,t} + \sum_{p=1}^t \pi_p t_t^p + \sum_{p=1}^t \phi_p (Post_t \times t_t^p) + \delta_2 Controls_{it} + \mu_i + \epsilon_{it} \quad (8)$$

$$FC_{it} = \alpha + \beta_6 \widehat{vESG}_{it} + \sum_{p=1}^P \beta_p t_t^p + \sum_{p=1}^P \delta_p (Post_t \times t_t^p) + \gamma_1 Controls_{it}^{RDiT} + \mu_i + \epsilon_{it} \quad (9)$$

The function (8) and (9) reflects the IV-RDiT. Where \widehat{vESG}_{it} is the instrument variable (IV), and this paper uses two-step IV-RDiT to help to identify the 2018 ESG policy's treatment effects and double check the robustness of the RDiT. Other items and variables remain the same with RDiT.

Sixth, robustness test and analysis. In this part, according to the advantages of vESG's natural distinction cutoff, the SRDD model is constructed as the identification strategy and method of robustness test, which is used to assist in supporting the test results of TWFE benchmark regression and RDiT causal inference model, further supporting hypothesis (H1).

$$FC_{it} = \beta_7 + \beta_8 D_{it} + \beta_9 (x_{it} - c) + \beta_{10} (x_{it} - c)^2 + \beta_{11} (x_{it} - c)^3 + \rho Controls_{it} + \mu_i + \lambda_t + \epsilon_{it} \quad (10)$$

The function (10) shows the robustness analysis check method - RDD. Where, x_{it} is the $vESG_{it}$. The running variable is vESG, which reflects the annual change in ESG scores of listed firms. The centered running variable is defined as $xc = x - c$, where the cutoff is $c = 0$. The treatment variable is D, which equals 1 if $x \geq c$ and 0 otherwise. The model also considers the quadratic term $(x - c)^2$ and the cubic term $(x - c)^3$ to test whether the estimated discontinuity is robust to different local polynomial specifications.

4.1 Baseline TWFE Results

Table 3. Baseline Results - Two Way Fixed Effects Results with Cluster SE

| VARIABLES | (1) | (2) |
|--------------|---------------------------|------------------------|
| | TWFE FC | TWFE FC |
| vESG | -0.125*** (-2.847) | -0.134*** (-3.452) |
| PB | | -0.068*** (-18.295) |
| Lev | | 1.005*** (10.249) |
| ROE | | 0.555*** (6.826) |
| EM1 | | 0.059*** (3.485) |
| REC | | -0.418*** (-2.730) |
| INV | | -0.309** (-2.502) |
| FIXED | | -0.817*** (-7.806) |
| DLCR | | 0.819*** (10.040) |
| EBIT | | 0.276*** (6.113) |
| Constant | 4.863*** (205,441.423) | 4.703*** (114.295) |
| Controls | NO | YES |
| Observations | 30,149 | 30,149 |
| R-squared | 0.935 | 0.950 |
| Firm FE | Yes | Yes |
| Year FE | Yes | Yes |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Table 3 reports TWFE results with FC as the explained variable and vESG as the core explanatory variable. Robust standard errors are clustered with firm level. The table presents two specifications in order to show whether the estimated relationship is sensitive to firm-level financial controls. Column (1) shows the model without control variables, while Column (2) adds PB, Lev, ROE, EM1, REC, INV, FIXED, DLCR and EBIT. The firm-level clustered standard errors further allow for within-firm serial correlation and heteroskedasticity. Therefore, the TWFE specification provides a useful benchmark for examining the nexus between ESG performance and firms' financing constraints.

We first analyze the regression results: from the perspective of the core explanatory variable (vESG), vESG is significantly negative in the results of the two groups of benchmark regression models. In Column (1) : From the perspective of Model (1) without adding control variables, the estimated coefficient of vESG is -0.125 and remains negative and significant (-0.125***). In Column (2), from the perspective of Model (2), which adds control variables of various financial indicators of enterprises, the estimated coefficient of vESG is -0.134, which still remains negative (-0.134***). According to the explanation in the previous literature review, variable definition and data description, the greater the FC value constructed by the SA-Index, the stronger financing constraints of the enterprise is. Therefore, the negative coefficient of vESG in the benchmark regression model can support that the improvement of enterprises' ESG performance can significantly reduce the current level of financing constraints of enterprises. This verifies Hypothesis 1 (H1) in this paper from the first step. Moreover, vESG still remains negative and significant (-0.134***) after all the common financial indicator control variables of listed enterprises such as PB, Lev, ROE, EM1, REC, INV, FIXED, DLCR and EBIT are added, indicating that under the control of two-way fixed effects, the association of ESG performance on corporate financing constraints is mainly determined and influenced by the core explanatory variable vESG. The econometric model in this paper has good robustness and reliability.

Second, the improvement of ESG performance may alleviate the level of financial constraints by enhancing the image of external financing, social responsibility, financial disclosure and information transparency of enterprises. In terms of economic significance, in the TWFE benchmark regression model of this paper, when vESG (ESG performance of enterprises) increases by one unit, the financial constraint FC of enterprises will decrease by about 0.134 units. If we try to explain ESG from the perspective of standard deviations, it means that the optimization and improvement of corporate ESG performance can make the

financing constraints of listed firms continue to decline, and achieve the alleviation of corporate financing constraints. This verifies the literature review of this paper in the literature review. As a result, firms with better ESG performance generally have easier way to priority attention and support from commercial banks, investment banks, large syndicates, international and domestic investors, and other external investors. This mechanism can help enterprises to lower the information asymmetry problem themselves. This result supports H1, the core hypothesis of the assumption of the research in the literature review and theoretical research section: the improvement of corporate ESG performance can significantly alleviate financing constraints.

We focus on the significance of regression results and parameter estimates for the control variables. Column (2) shows that the result of PB is -0.068, which remains negative and significant (-0.068***), indicating that listed companies with a higher PB P/E ratio usually face smaller financing constraints. The coefficient of Lev is 1.005, which remains positive and significant (1.005***), indicating that enterprises with a higher financial leverage ratio will bear greater debt repayment pressure. This huge financial burden will further constrain the financing ability of enterprises. In line with economic expectations. As for the other remaining control variables, the values of ROE, EM1, DLCR and EBIT are all significantly positive (see Table 3). This shows that there is a complex nexus between the profitability, solvency, operating capacity and development capacity of listed companies and financial constraints. This means that firms with different financial management capabilities have greater heterogeneity when facing financing constraints. Among the remaining financial controls, the values of REC, INV and FIXED remain significantly negative. This further shows that the difference in financial constraints of enterprises is related to the accounts receivable, fixed assets and inventory of enterprises. Optimizing the financial conditions of these parts helps enterprises to ease their financing constraints.

In the former parts, we are more concerned about whether the significance, coefficient sign and estimated value of vESG are consistent with the economic significance and economic background. From here, we need to analyze the model fit of TWFE with the main issues studied in this paper from the fit of the two-way fixed effects model. In the TWFE econometric model, we need to first analyze the sample sizes of the two sets of benchmark regression models. Purely from the perspective of the sample size of panel data, the observed values of the two groups of models are 30,149. Compared with the results of descriptive statistics, the results are statistically significant. While the quantity of panel data reaches the decent amount, it can better discuss the variable mechanism through empirical analysis. In addition, the fitting data of the second analysis model are mainly R^2 . In Table 3, the R^2

value of Model (1) is 0.935, and that of Model (2) is increased to 0.950. This shows that adding more financial control variables can help the econometric model to further explain the variable mechanism. Therefore, the fitting degree and reliability of the model can be further improved. In addition, we should not only focus on R^2 values when examining the fit. Finally, the regression results of vESG are in line with the expectations of H1, which verifies the correlation.

Overall, the TWFE benchmark regression results established in this paper can significantly support H1 and the main research questions of this paper. In addition, the improvement of ESG performance can help to lower financing constraints. This regression conclusion can provide a very good beginning and empirical modelling basis for the subsequent mediating effect mechanism of OFDI, the nonlinear association of OFDI and the endogenous treatment methods such as system GMM and RDIT. Our subsequent empirical hypotheses are based on the assumptions of the benchmark regression.

4.2 Mediation Effect and Nonlinear Relationship Results

Table 4. The Mediation Effect and Nonlinear Mechanism Test of OFDI

| VARIABLES | (1) | (2) | (3) | (4) |
|---------------------|--------------------------------------|----------------------|------------------------|------------------------|
| | Panel A: Three-step mediation effect | | | Panel B: Non-linear |
| | FC | OFDI | FC | FC |
| vESG | -0.134*** (-3.452) | 2.708* (1.712) | -0.136*** (-3.504) | -0.135*** (-3.481) |
| OFDI | | | 0.001*** (2.848) | 0.004*** (4.361) |
| OFDI Squared | | | | -0.000*** (-3.762) |
| PB | -0.068*** (-18.295) | -0.044 (-1.019) | -0.068*** (-18.290) | -0.068*** (-18.293) |
| Lev | 1.005*** (10.249) | 1.822 (1.331) | 1.003*** (10.222) | 1.002*** (10.218) |
| ROE | 0.555*** (6.826) | 3.517*** (2.762) | 0.552*** (6.793) | 0.552*** (6.790) |
| EM1 | 0.059*** (3.485) | -0.129 (-0.654) | 0.059*** (3.487) | 0.059*** (3.489) |
| REC | -0.418*** (-2.730) | 3.244* (1.691) | -0.420*** (-2.745) | -0.419*** (-2.740) |
| INV | -0.309** (-2.502) | -3.593** (-2.170) | -0.307** (-2.481) | -0.307** (-2.486) |
| FIXED | -0.817*** (-7.806) | -0.657 (-0.495) | -0.817*** (-7.803) | -0.817*** (-7.804) |
| DLCR | 0.819*** (10.040) | 5.220*** (3.444) | 0.816*** (10.007) | 0.816*** (10.010) |
| EBIT | 0.276*** (6.113) | -1.225* (-1.783) | 0.277*** (6.132) | 0.277*** (6.138) |
| Constant | 4.703*** (114.295) | 1.405*** (2.625) | 4.702*** (114.266) | 4.709*** (114.268) |
| Observations | 28,569 | 28,569 | 28,569 | 28,569 |
| R-squared | 0.950 | 0.379 | 0.950 | 0.950 |
| Firm FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

In table 4, the mediating effect test results of FC as the explained variable, OFDI as the mediating variable, and vESG as the core explanatory variable. Subsequently, we further examine the nonlinear relationship and influence of OFDI variables on financial constraint variables. As for the mechanism of establishing the mediation effect model, the previous part has been theoretically analyzed in the literature review. The three-step mediating effect model in this paper is still based on the two-way fixed effect model (TWFE) and clustering robust SE in the benchmark regression. The regressions also include the same set of financial control variables as the benchmark model, including PB, Lev, ROE, EM1, REC, INV, FIXED, DLCR and EBIT. Column (1) corresponds to the first step of the mediation test.

Panel A presents the three-step mediation test. In Column (1), vESG is again significantly negative, with a coefficient of -0.134. This confirms the benchmark result that better ESG performance reduces financing constraints. Column (2) then uses OFDI as the dependent variable and vESG as the explanatory variable. The coefficient of vESG is 2.708 and is statistically significant, suggesting that better ESG performance is positively associated with the scale of OFDI. This result is consistent with the first part of the proposed mediation mechanism. Better ESG performance may improve corporate transparency, governance quality, risk-management ability and external financing image. These conditions can make it easier for firms to obtain support from financial institutions and policy departments, thereby increasing their capacity to undertake overseas investment. In this sense, ESG performance may help firms expand OFDI by improving both external recognition and financing capacity.

In column (3) of Panel A: The third step of the mediating effect simultaneously incorporates vESG and OFDI into the benchmark regression TWFE model of financing constraints to examine whether OFDI plays a mediating effect and transmission role between ESG and financing constraints. From the role of the core explanatory variable (vESG), vESG is negative (-0.136***) in the regression results of column (3). It indicates that the benchmark regression conclusion and hypothesis H1 still hold. In column (3), the estimated coefficient of OFDI is 0.001, maintaining positive significance (0.001***). This indicates that even after controlling for the OFDI variable, the direct mitigating effect of ESG on financing constraints still exists. That is to say: OFDI has not fully absorbed the direct impact of ESG on financing constraints. OFDI is more likely to play a partial mediating role in the mediating effect rather than a complete mediating effect. The three-step mediating effect model has analyzed ESG, OFDI and financing constraints within a unified framework, rather than merely regarding the three as simple parallel cooperative relationships. Its economic significance lies in the following: Firstly, ESG alleviates the financing constraints of enterprises by enhancing their information transparency, corporate governance level and social image. Meanwhile, the

improvement of ESG has also enhanced enterprises' ability to actively carry out OFDI. Finally, successful OFDI enterprises will receive stronger external financing attention and higher revenue and profits, which is conducive to improving the financing constraint situation. In this mediating effect framework, ESG is the starting point, OFDI is the transmission channel playing the mediating role, and financing constraints are the end point. This result supports the core hypothesis H2 of this paper in the literature review and theoretical research sections: OFDI plays a mediator between ESG performance and financing constraints.

Third, in Panel B, we focus on the significance of regression results and parameter estimates of the squared term of OFDI. This model is used to test whether there is a nonlinear relationship between OFDI and financing constraints. Column (4) shows that the coefficient of OFDI squared term is -0.0006^{***} , which remains negative; The coefficient of OFDI is 0.004^{***} , which remains positive and significant. This indicates that there is a significant inverted U-shaped relationship between OFDI and financing constraints. In other words, at a low scale or in the early stage of OFDI expansion, OFDI may consume a lot of cash flow and increase a lot of capital expenditure due to various behaviors such as expanding overseas markets, overseas mergers and acquisitions, and overseas employment. As a result, financing constraints are aggravated. However, in the long run, when an enterprise's OFDI exceeds the threshold (maximum point or turning point) of the inverted U-shaped curve, OFDI behavior may still gradually relieve financing constraints by improving the enterprise's international reputation, diversifying its income sources, improving the recognition of external financing and other behaviors. The values of other remaining control variables, such as ROE, EM1, DLCR and EBIT, are all significant. This shows that there is a complex correlation between the profitability, solvency and development capacity of listed companies and financial constraints.

4.3 Heterogeneity Analysis Results

From Appendix Table A1. Heterogeneity Analysis: Grouping - Quantile TWFE Regression Results, it shows this paper's heterogeneity analysis results. From the results in columns (1) to (6), it can be seen that there is huge heterogeneity in the mitigating effect of ESG on corporate financing constraints, which verifies the core hypothesis H4. This article chooses to use the dummy variable SOE as the basis for grouping. At the same time, the median of the PB variable and the median of the EBIT variable are also the grouping basis for quantile regression.

Firstly, in the property rights nature (SOE/Non-SOE) grouping, the vESG coefficient of the SOE group was -0.237 and was significant at the 1% level; The coefficient of the

Non-SOE group was -0.078, but it was not significant. This result holds that the optimization of ESG performance is more likely to improve the financing constraints on state-owned firms. The possible reason is that state-owned enterprises themselves are more likely to obtain policy support and the investment willingness of external investors. Therefore, when its ESG score is improved and enhanced, it is naturally more likely to be identified by external financial institutions as a financing target with high-quality credit. Thus, ESG can more easily alleviate financing constraints through signal mechanisms.

Secondly, in the PB grouping, the vESG coefficient of the Low PB group was -0.129, which was statistically significant. The value of the High PB group was -0.062, but it was not significant. This result confirms that the effective mitigation effect of ESG on financing constraints is mainly manifested in enterprises with lower market valuations. For enterprises with a low PB ratio: Due to the relatively weak attention and recognition from the capital market towards themselves, external investors have a stronger sense of information asymmetry and risk concerns when investing in such enterprises. Therefore, when the ESG scores of such enterprises suddenly improve significantly, the investment confidence of external investors will be greatly strengthened, and they will subsequently increase their investment intensity

Finally, in the EBIT grouping, the vESG coefficient of the Low EBIT group was -0.121 and remained negatively statistically significant. The coefficient of the High EBIT group was 0.041, and it did not have statistically significant significance. This result further shows that the optimization of ESG has a more obvious effect on promoting the financing constraints of enterprises with weaker profitability. For low EBIT enterprises, insufficient profitability is mainly manifested in weakening their internal financing capabilities and simultaneously increasing the difficulty of their own external financing. Therefore, the signal mechanism of governance improvement and information transparency released by the improvement of ESG scores is more likely to take effect. On the contrary, high EBIT enterprises themselves have stronger profitability, relatively lower financing pressure, and diversified financing channels. Their own emphasis and reliance on ESG scores are inherently insufficient.

4.4 System GMM Results

Table 5. System GMM Results

| VARIABLES | (1) | (2) |
|--------------|------------------------------|------------------------------|
| | Panel A: System GMM result 1 | Panel B: System GMM result 2 |
| | FC | FC |
| FC_(i, t-1) | 0.961*** (109.945) | 0.959*** (122.246) |
| vESG | -0.824** (-2.148) | -0.803** (-2.268) |
| PB | 0.033*** (5.199) | -0.002 (-1.202) |
| Lev | 0.337*** (7.220) | 0.219*** (6.664) |
| ROE | 0.868*** (18.100) | 0.929*** (21.690) |
| EM1 | -0.033*** (-3.190) | 0.004 (0.793) |
| REC | -0.101*** (-2.736) | -0.057* (-1.893) |
| INV | -0.095*** (-3.372) | -0.170*** (-8.027) |
| FIXED | -0.139*** (-7.119) | -0.193*** (-12.525) |
| DLCR | 0.374*** (9.692) | 0.248*** (8.901) |
| EBIT | 0.047* (1.913) | 0.034 (1.516) |
| Constant | 0.076 (1.635) | 0.220*** (6.398) |
| AR(1) | 0.000*** | 0.000*** |
| AR(2) | 0.493 | 0.940 |
| Observations | 25,272 | 25,272 |
| Firm FE | YES | YES |
| Year FE | YES | YES |
| Robust SE | YES | YES |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Firstly, based on TWFE and mediating effect regression, we adopt the two-step system GMM to handle the dynamic endogeneity problem, omitted variable problem and reverse causality problem existing between ESG performance and financing constraint variables. A firm's current financing condition may be affected by its financing condition in the previous period. Therefore, the dynamic model includes the lagged dependent variable, $FC_{(i,t-1)}$, in the benchmark equation. If the model with the lagged dependent variable were estimated directly by TWFE, dynamic panel bias could arise. System GMM is therefore used to estimate both the differenced equation and the level equation, using lagged values of the relevant variables as internal instruments.

Secondly, this paper reports two system GMM specifications. In Column (1), $FC_{(i,t-1)}$, $vESG$ and PB are treated as endogenous GMM variables, and higher-order lagged instruments are used. Column (2) adopts a more conservative setting: only $FC_{(i,t-1)}$ and $vESG$ are treated as GMM-style endogenous variables, while PB and the other controls are included as exogenous or predetermined instruments. Comparing these two specifications helps assess whether the GMM results are sensitive to the treatment of the controls. In both specifications, the coefficient of the lagged financing-constraint variable is positive and highly significant, with estimates of 0.961 and 0.959. This indicates strong dynamic persistence in financing constraints. The financing-constraint level in the previous period has a substantial effect on the current level of financing constraints, which supports the use of a dynamic panel framework.

Thirdly, in the regression results of A-B Panels: The core explanatory variable $vESG$ is significantly negative in both column (1) and column (2). In column (1) : The coefficient of $vESG$ is -0.824^{**} , remaining negatively significant; In column (2): The coefficient of $vESG$ is -0.803^{**} , which also remains negatively significant. Because the larger the SA-Index value constructed in this paper, the stronger the financing constraint level of the enterprise. Therefore, the negative significance coefficient of $vESG$ indicates that after controlling for the lagging one-period financing constraint variable, the enterprise financial index control variable, and the impact of the year effect, the improvement of the enterprise's ESG performance can still significantly reduce the degree of financing constraint. This reflects the practice and application of the endogenous solution approach in this article. Meanwhile, the estimated GMM results remain consistent with the previous TWFE benchmark regression conclusions. Therefore, the GMM estimates indicate that the mitigation effect of ESG on financing constraints is not entirely driven by omitted variables or reverse causality.

Fourthly, from the model diagnosis results, the $AR(1)$ test of the two groups of models is

significant, which is very consistent with the expected setting of the difference equation. Meanwhile, the values of AR(2) are 0.493 and 0.940, respectively, which remain insignificant. Therefore, AR(1) and AR(2) instrumental variables pass a series of assumptions and basically meet a series of requirements of system GMM. Combined with robust standard errors, these two groups of GMM estimates and methods have good robustness and reliability. To sum up, the system GMM results can better alleviate the endogeneity problem of TWFE estimator, thus further supporting the core hypothesis H1 of this paper: the improvement of ESG performance of enterprises can significantly improve financing constraints.

Overall, The system GMM evidence also complements the mediation results. Since OFDI decisions and financing constraints may both be persistent over time, a static model may understate the role of dynamic adjustment. By introducing lagged FC and using internal instruments, the system GMM model helps separate the current ESG effect from the persistence of financing constraints. The negative and significant vESG coefficient under both GMM specifications therefore provides additional evidence and proof for the robustness.

4.5 RDiT Analysis Results

Table 6. First-Order RDiT Results for Financing Constraints

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|-----------------------------|---|------------|------------|--|------------|------------|
| | Panel A:RDiT without controls-first order | | | Panel B:RDiT with controls-first order | | |
| | Triangular | Epanech. | Uniform | Triangular | Epanech. | Uniform |
| | FC | FC | FC | FC | FC | FC |
| Post | -0.0829*** | -0.0870*** | -0.0862*** | -0.1362*** | -0.1455*** | -0.2076*** |
| | (-10.8866) | (-10.9225) | (-10.0257) | (-18.2777) | (-18.5961) | (-21.1690) |
| t (Running variable) | 0.1704*** | 0.1701*** | 0.1670*** | 0.1447*** | 0.1471*** | 0.1717*** |
| | (34.1006) | (33.7995) | (36.8007) | (31.0924) | (31.7241) | (42.0338) |
| Post × t | -0.0610*** | -0.0603*** | -0.0588*** | -0.0396*** | -0.0429*** | -0.0725*** |
| | (-10.2708) | (-10.1224) | (-10.5133) | (-7.4037) | (-8.0784) | (-14.5805) |
| Controls | NO | NO | NO | YES | YES | YES |
| Observations | 28,068 | 28,068 | 30,149 | 28,068 | 28,068 | 30,149 |
| R-squared | 0.9583 | 0.9533 | 0.9353 | 0.9632 | 0.9589 | 0.9442 |
| Firm FE | YES | YES | YES | YES | YES | YES |
| Year FE | NO | NO | NO | NO | NO | NO |
| Polynomial order | First | First | First | First | First | First |
| Bandwidth | ±5.000 | ±5.000 | ±5.000 | ±5.000 | ±5.000 | ±5.000 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

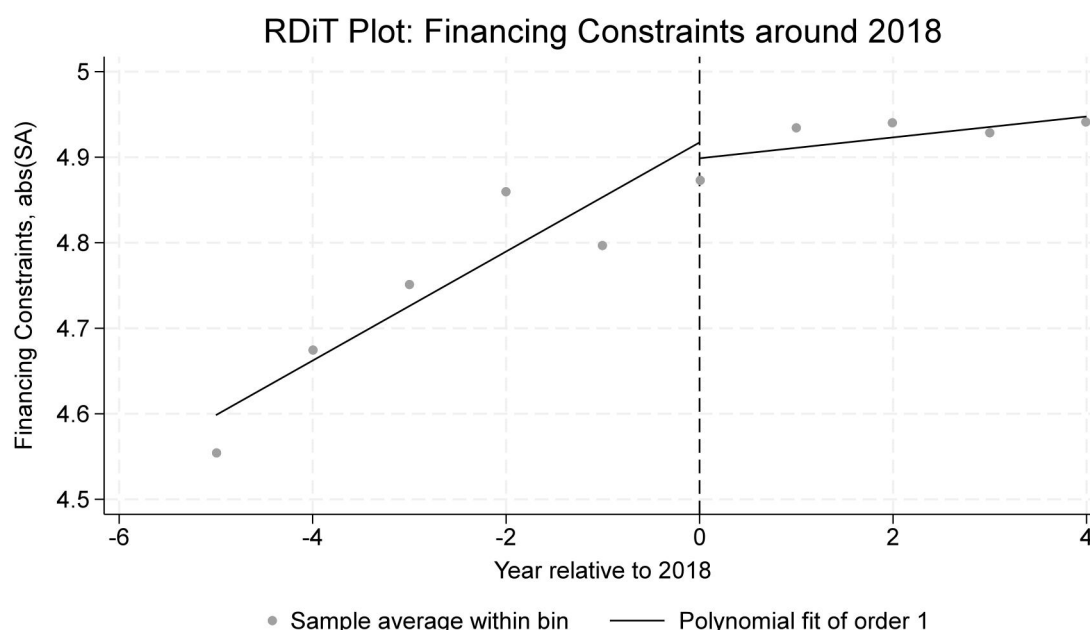


Figure 2. RDiT Plot Analysis

Source: autor

RDiT analysis: In addition to the TWFE benchmark model, this paper uses Regression Discontinuity in Time (RDiT) as a causal-inference strategy to address potential endogeneity issues such as omitted variables, reverse causality and dynamic lag. The RDiT design is used as a second empirical approach to support H1 and H3. As explained in the literature review and the China context section, 2018 is treated as a policy cutoff because the Chinese government introduced ESG-related guidance and regulatory policies during this period. The RDiT framework examines whether the policy environment after 2018 changed the nexus between ESG performance and financing constraints. This design is therefore used both for policy evaluation and as an additional check on the benchmark TWFE results.

Table 6 reports the first-order RDiT results with 2018 as the policy-time cutoff. The time running variable is defined as $t = \text{year} - 2018$. The treatment dummy Post equals 1 for observations in and after 2018 and 0 otherwise. Because RDiT identifies the treatment effect from the local discontinuity around the time cutoff, year fixed effects are not included. If year fixed effects were absorbed, they would remove the explanatory variation of the policy cutoff and the time trend. Therefore, the RDiT regressions control only for firm fixed effects and use firm-level clustered robust standard errors.

The first-order RDiT model is estimated using local polynomial regression with an MSE bandwidth of ± 5.000 . The dependent variable is FC, and the key treatment variable is Post. The model also includes the distance between the running variable and the cutoff. To test whether the results are sensitive to kernel-function choice, the paper reports estimates using

three kernels: Triangular, Epanechnikov and Uniform.

Table 6 is divided into two panels. Panel A reports the first-order RDiT estimates without financial control variables. Panel B adds the same financial controls used in the benchmark regressions. Across all six specifications, the coefficient of Post is negative and significant at the 1% level. Without controls, the Post coefficients are around -0.083 to -0.087 across the three kernels. After adding controls, the coefficients remain negative and become larger in magnitude, ranging from about -0.136 to -0.208. Since a higher FC value indicates stronger financing constraints, these negative coefficients imply that firms' financing constraints declined significantly after the 2018 policy cutoff. The consistency of the results across kernels and control settings supports the interpretation that the post-2018 policy environment is associated with a reduction in financing constraints.

The time-trend variables provide further information. The coefficient of the running variable t is positive and significant in the models, indicating that financing constraints had an upward trend near the cutoff before accounting for the post-policy shift. However, the interaction term $\text{Post} \times t$ is negative and significant, suggesting that this trend changed after 2018. In other words, although the underlying trend may have pushed financing constraints upward around the cutoff, the post-2018 policy environment weakened or reversed this tendency. This pattern is also consistent with the graphical RDiT evidence. Overall, the first-order RDiT results support the view that 2018 represents a structural policy turning point in the path of financing constraints, thereby supporting H1 and H3.

The first-order specification is especially useful because it provides a transparent local comparison around the policy year. In an RDiT setting, the main identifying assumption is that other determinants of financing constraints would have evolved smoothly around 2018 in the absence of the policy shock. Under this assumption, a discrete decline in FC at the cutoff can be interpreted as evidence that the post-2018 institutional environment mattered. The result is also consistent with the economic background of China, where ESG disclosure, sustainable finance and corporate governance reforms became more visible after 2018. Therefore, the first-order RDiT estimates provide a policy-based complement to the firm-level TWFE evidence.

In this first-order setting, the negative Post coefficient should not be interpreted as proving that all firms benefited equally after 2018. It shows an average local shift in financing constraints around the policy cutoff. The size of this shift may differ by ownership, audit quality, cash-flow condition and OFDI intensity. This is why the later heterogeneity analysis remains important. Still, the consistent negative sign across kernel choices gives a clear indication that the post-2018 environment reduced financing constraints on average.

Table 7. Second-Order RDIT Results for Financing Constraints

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---|--|------------|------------|---|------------|------------|
| | Panel A:RDIT without controls-second order | | | Panel B:RDIT with controls-second order | | |
| | Triangular | Epanech. | Uniform | Triangular | Epanech. | Uniform |
| | FC | FC | FC | FC | FC | FC |
| Post | -0.0389*** | -0.0416*** | -0.0801*** | 0.0300** | 0.0361*** | -0.0464*** |
| | (-3.1522) | (-3.3014) | (-7.1473) | (2.4385) | (2.8332) | (-4.3251) |
| t (Running variable) | 0.1260*** | 0.1257*** | 0.1647*** | -0.0539*** | -0.0686*** | -0.0032 |
| | (9.0182) | (8.8684) | (14.7645) | (-3.1913) | (-3.9386) | (-0.2375) |
| t² (Running variable squared) | -0.0098*** | -0.0096*** | -0.0004 | -0.0435*** | -0.0461*** | -0.0297*** |
| | (-3.3430) | (-3.2629) | (-0.2167) | (-12.6549) | (-13.1160) | (-12.8363) |
| Post × t | -0.0287** | -0.0263* | -0.0634*** | 0.1770*** | 0.1980*** | 0.1501*** |
| | (-1.9741) | (-1.7874) | (-5.1484) | (9.4651) | (10.2669) | (9.3957) |
| Post × t² | 0.0133*** | 0.0124*** | 0.0021 | 0.0385*** | 0.0394*** | 0.0182*** |
| | (4.1375) | (3.8726) | (0.9979) | (11.5440) | (11.6610) | (8.3314) |
| Controls | NO | NO | NO | YES | YES | YES |
| Observations | 28,068 | 28,068 | 30,149 | 28,068 | 28,068 | 30,149 |
| R-squared | 0.9583 | 0.9533 | 0.9353 | 0.9634 | 0.9592 | 0.9447 |
| Firm FE | YES | YES | YES | YES | YES | YES |
| Year FE | NO | NO | NO | NO | NO | NO |
| Polynomial order | Second | Second | Second | Second | Second | Second |
| Bandwidth | ±5.000 | ±5.000 | ±5.000 | ±5.000 | ±5.000 | ±5.000 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Table 7 reports the second-order RDiT estimates with 2018 as the policy-time cutoff. The purpose is to test whether the discontinuity in financing constraints around 2018 remains visible after allowing for a quadratic time trend. As in the first-order RDiT model, the running variable is defined as $t = \text{year} - 2018$, and Post equals 1 for observations in and after 2018. The second-order specification is generally consistent with the first-order specification, but it additionally includes the squared term of the running variable. This allows the model to capture a more flexible local time trend around the cutoff. Local polynomial regression under the MSE bandwidth is commonly used in RDiT because it focuses on local changes near the discontinuity.

The second-order RDiT model is also estimated using local polynomial regression with an MSE bandwidth of ± 5.000 . The dependent variable is FC, while the key treatment variable is Post. The running variable, its squared term and the relevant post-cutoff interaction terms are included. The estimates are reported under the Triangular, Epanechnikov and Uniform kernels to examine sensitivity to kernel choice.

Table 7 is divided into two panels. Panel A reports second-order RDiT estimates without financial controls, while Panel B includes the control variables. The results show that the coefficient of Post is negative and significant in four of the six models, indicating that the main discontinuity remains visible after allowing for a quadratic time trend. However, the Post coefficients in Columns (4) and (5) are not consistent with the expected sign after financial controls are added under the Triangular and Epanechnikov kernels. This suggests that the second-order specification is more sensitive to kernel choice and control-variable adjustment than the first-order model. One possible reason is that the higher-order polynomial absorbs part of the local variation around the time cutoff. The Uniform-kernel estimate in Column (6) remains negative and significant, which provides additional support for the main RDiT conclusion. Overall, the second-order RDiT results are supportive but less stable than the first-order RDiT results.

The time-trend variables also show some variation across specifications. The coefficients of $t = \text{year} - 2018$ differ across models, reflecting the more flexible polynomial structure. In the specifications without controls, the interaction term $\text{Post} \times t$ is negative and significant, suggesting that the trend in financing constraints changed after the 2018 cutoff. This result is broadly consistent with the first-order RDiT findings. However, because the second-order model shows greater sensitivity, the first-order RDiT estimates should be treated as the main RDiT evidence, while the second-order estimates serve as a robustness check.

The second-order estimates should be reported with caution because higher-order polynomials can sometimes overfit local data, especially when the running variable is time

and the number of available years is limited. This does not invalidate the RDiT design, but it means that the second-order results should be interpreted as a sensitivity test rather than the preferred specification. The fact that several second-order estimates remain negative and significant still supports the main argument. At the same time, the instability in some controlled specifications reminds us that the empirical conclusion should rely on the full set of evidence, including the first-order RDiT, the bandwidth tests, IV-RDiT and RDD robustness checks.

In the second-order model, the purpose of adding the quadratic term is not to replace the baseline model, but to check whether the local treatment effect survives a more flexible time trend. Since the available time span is limited, the model may become more sensitive once higher-order terms and interactions are included. For this reason, mixed results in the second-order specification are not unexpected. The main empirical message is that the negative Post effect is still present in several specifications, while the preferred evidence remains the more stable first-order model.

4.6 RDIT Multi-Bandwidth Analysis Results

Table 8. RDIT Multi-Bandwidth Sensitive Test Regression Analysis

| VARIABLES | (1) | (2) | (3) |
|-----------------------------|------------------|------------------|------------------|
| | Panel A:±3 Years | Panel B:±4 Years | Panel C:±5 Years |
| | Triangular | Triangular | Triangular |
| | FC | FC | FC |
| Post | -0.0476*** | -0.0763*** | -0.0829*** |
| | (-5.7421) | (-10.1097) | (-10.8866) |
| t (Running variable) | 0.1506*** | 0.1684*** | 0.1704*** |
| | (22.6622) | (30.5808) | (34.1006) |
| Post × t | -0.0464*** | -0.0576*** | -0.0610*** |
| | (-6.1538) | (-8.9526) | (-10.2708) |
| Controls | YES | YES | YES |
| Observations | 15,032 | 21,318 | 28,068 |
| R-squared | 0.9799 | 0.9690 | 0.9583 |
| Firm FE | YES | YES | YES |
| Year FE | NO | NO | NO |
| Polynomial order | First | First | First |
| Bandwidth | ±3.000 | ±4.000 | ±5.000 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Table 8 reports the multi-bandwidth sensitivity test for the RDiT model with 2018 as the policy-time cutoff. Since RDiT has a limited number of available time running-variable values, and since the McCrary density test is not directly suitable for a time-running-variable setting, this paper uses bandwidth sensitivity as the first robustness check for the RDiT design. Some readers may question whether the 2018 policy cutoff can be treated as an exogenous policy shock affecting the ESG-financing-constraints mechanism. Therefore, the multi-bandwidth test examines whether the estimated discontinuity around 2018 depends on a specific bandwidth choice. The running variable is defined as $t = \text{year} - 2018$, and Post equals 1 for observations in and after 2018. In this section, the paper uses the first-order RDiT specification with the Triangular kernel and tests three bandwidths: ± 3.000 , ± 4.000 and ± 5.000 .

First, similar to the regression report of first-order RDiT, three sets of model results are reported in Table 7. Table 7 shows that in all three groups of models, the coefficients of the core treatment variable Post in four models are significantly negative and significant at the level of 1%, indicating good regression results. Specifically, under the ± 3 -year window, the coefficient of Post is -0.0476^{***} ; Under the window of ± 4 years, the coefficient is -0.0763^{***} ; Under the ± 5 -year window, the coefficient is -0.0829^{***} . Since the greater the FC value constructed by SA-Index in this paper indicates the stronger the degree of corporate financial constraints, the negative and significant coefficient of: Post can support that corporate financial constraints have significantly declined after the policy discontinuity point in 2018. This result supports the core judgment of RDiT. In addition, the sign and significance of Post remain consistent regardless of whether the narrow bandwidth or the wide bandwidth is selected in the model. This shows that the RDiT results in this paper do not depend on a specific bandwidth setting and are reliable and robust.

Second, from the perspective of time trend variables, the coefficients of running variable: $t = \text{year} - 2018$ are significantly positive in all models (0.1506^{***} , 0.1684^{***} , 0.1704^{***}), which is consistent with the conclusions of first-order regression. However, in columns (1) - (3) : The coefficient of $\text{Post} \times t$ is significantly negative in the three models without control variables (-0.0464^{***} , -0.0576^{***} , -0.0610^{***}), indicating that the time trend of financing constraints has changed significantly after 2018, which also verifies the conclusion of first-order regression.

4.7 IV-RDiT Analysis Results

Table 9. IV-RDiT Regression Results

| VARIABLES | (1) | (2) |
|---|------------------------------|-------------------------------|
| | Panel A: First stage IV-RDiT | Panel B: Second stage IV-RDiT |
| | vESG | FC |
| Post | -0.0148007*** (-4.44) | |
| vESG (IV) | | -2.0274** (-2.1161) |
| t (Running variable) | 0.0189835*** (6.20) | -0.0154* (-1.7121) |
| t² (Running variable squared) | 0.0031602*** 5.16 | -0.0371*** (-17.7790) |
| Post × t | -0.0272104*** (-8.28) | 0.1218*** (7.9190) |
| Post × t² | -0.0010377 -1.58 | 0.0364*** (12.6100) |
| F-Test/K-P F Test | 19.74/19.75 | - |
| Controls | NO | YES |
| Observations | 28,068 | 28,068 |
| R-squared | -12.1113 | 0.3331 |
| Firm FE | YES | YES |
| Year FE | NO | NO |
| Bandwidth | ±5.000 | ±5.000 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Table 9 reports the local polynomial regression results of the Instrumental Variable RDiT (IV-RDiT) model with 2018 as the policy-time cutoff. Because the number of time running-variable values in RDiT is limited, and because some readers may question whether the 2018 policy shift truly works as an exogenous driver of the ESG-financing-constraints mechanism, this paper uses IV-RDiT as a further robustness check. The IV-RDiT approach combines RDiT with a two-stage instrumental-variable logic. Its purpose is to test whether the policy shock at the 2018 cutoff affects financing constraints through its effect on ESG performance. This idea is close to Fuzzy RDD or IV-RDD: when a cutoff affects an endogenous treatment variable rather than directly and fully determining the outcome, the cutoff can be used to identify a local causal effect through treatment intensity. This approach is consistent with the RD-IV logic discussed by Imbens and Lemieux (2008) and Lee and Lemieux (2010).

The IV-RDiT model is estimated in two stages. In the first stage, the outcome variable is replaced by vESG in order to test whether the 2018 policy shock is statistically associated with firms' ESG performance. If Post is significant in the vESG equation, this indicates that the policy cutoff is related to the endogenous treatment variable. In the second stage, the predicted ESG component is then used to examine whether the policy-induced variation in ESG performance is associated with changes in FC. If the first-stage relationship is significant and the weak-instrument tests are passed, the use of 2018 as the policy cutoff becomes more convincing. IV-RDiT therefore serves as a robustness test for the traditional RDiT results rather than as the only identification strategy in the paper.

Panel A of Table 9 reports the first-stage IV-RDiT, while Panel B reports the second-stage estimates. The model uses the Triangular kernel and local polynomial regression under the MSE bandwidth. In Column (1), the coefficient of Post is -0.0148 and is statistically significant. This indicates that the 2018 cutoff is significantly associated with changes in vESG. In Column (2), the second-stage coefficient is -2.0274 and significant, indicating that the policy-related component of ESG performance is associated with financing constraints. The first-stage F-statistic is 19.74, and the KP Wald F-statistic is 19.75, both above the commonly used threshold of 10. This suggests that the model does not suffer from an obvious weak-instrument problem. Overall, the IV-RDiT results support the view that the 2018 ESG-related policy environment affected ESG performance and was associated with a reduction in firms' financing constraints.

The time-trend variables should be interpreted carefully. The running-variable coefficient is reported as negative and weakly significant, suggesting a downward trend near the cutoff in the first-stage setting. The coefficient of Post x t is positive and significant,

indicating that the post-2018 trend changed after the cutoff. These results are broadly consistent with the previous RDiT evidence, but the IV-RDiT design also has limitations. The effect of China's ESG guidance and regulatory policies on corporate ESG performance may be dynamic and lagged. In addition, these policies aimed not only to raise ESG scores mechanically, but also to standardize ESG evaluation and disclosure practices. This may explain why the first-stage coefficient has a negative sign. Therefore, IV-RDiT should be viewed as an auxiliary robustness test. Future research could further improve this part by using alternative policy shocks or external instruments.

Although IV-RDiT provides useful supporting evidence, its interpretation remains narrower than the benchmark and RDiT estimates. The instrument is based on the post-2018 policy cutoff, and the first-stage effect captures the policy-related change in vESG rather than all ESG variation. Therefore, the estimated second-stage coefficient should be interpreted as a local effect linked to the policy-induced ESG change around 2018. This is why the IV-RDiT result is used as an auxiliary robustness test rather than the central empirical result. Even with this limitation, the absence of a weak-instrument problem and the negative second-stage coefficient are consistent with the paper's main mechanism.

The IV-RDiT interpretation should therefore be cautious but useful. The first stage shows that the policy cutoff is related to ESG performance, while the second stage links this policy-induced ESG variation to financing constraints. This two-stage structure provides a bridge between the policy background and the firm-level ESG mechanism. It also helps explain why the paper treats the 2018 cutoff as more than a simple time dummy. The cutoff is used because it is connected to an institutional change that affected corporate ESG disclosure, evaluation and financing conditions.

This discussion also clarifies the role of IV-RDiT in the empirical design. It is not presented as a perfect solution to all identification problems. Instead, it is used to test whether the same direction of effect appears when the policy cutoff is linked first to ESG performance and then to financing constraints. This additional layer of evidence makes the RDiT results less dependent on a single reduced-form specificati

4.8 Robustness Check and Analysis with RDD

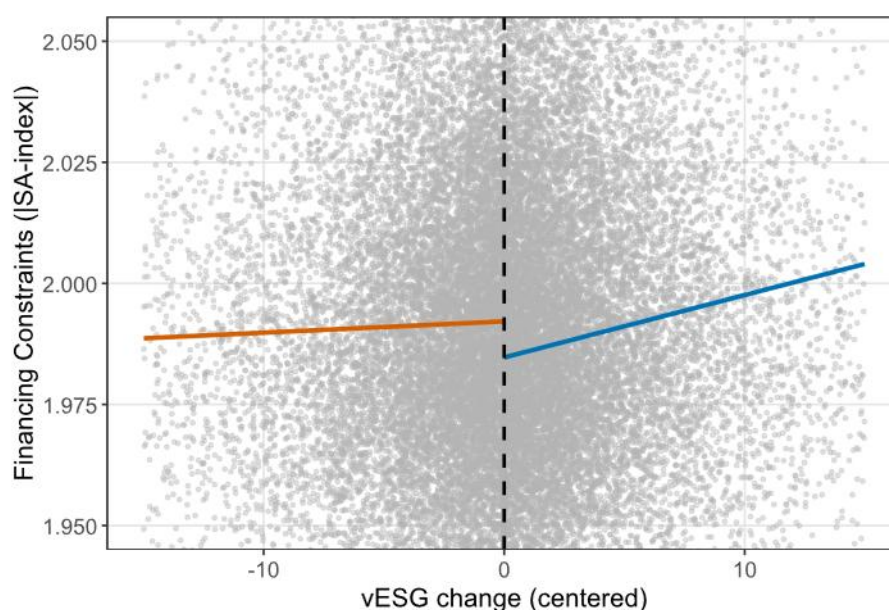


Figure 3. Regression Discontinuity Fit (Full-sample)

Source: autor

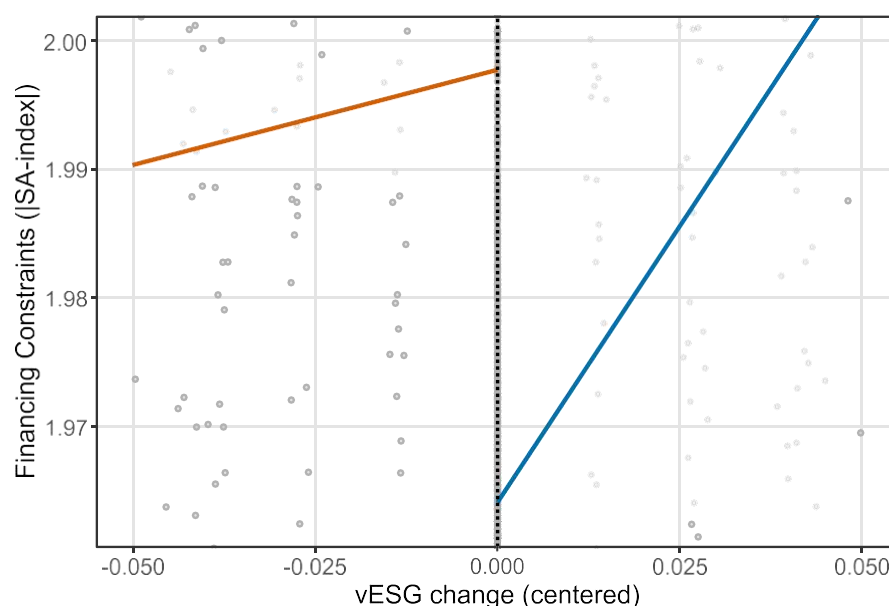


Figure 4. Regression Discontinuity Fit (Zoomed)

Source: autor

From figure 3-7, In the design of Regression Discontinuity, we adopted the verification method of polynomial regression and output linear, quadratic and cubic regression discontinuity fitting graphs to support whether our causal recognition strategy is correct. The fitting graph shows that when the ESG score of listed companies exceeds the cutoff (0), the financing constraint (FC) will maintain a downward jumping trend at the cutoff. This further indicates that when the ESG score of listed companies improves, the financing constraint problem of the enterprises will be alleviated. We also need further global polynomial regression output results to confirm our hypotheses and conclusions.

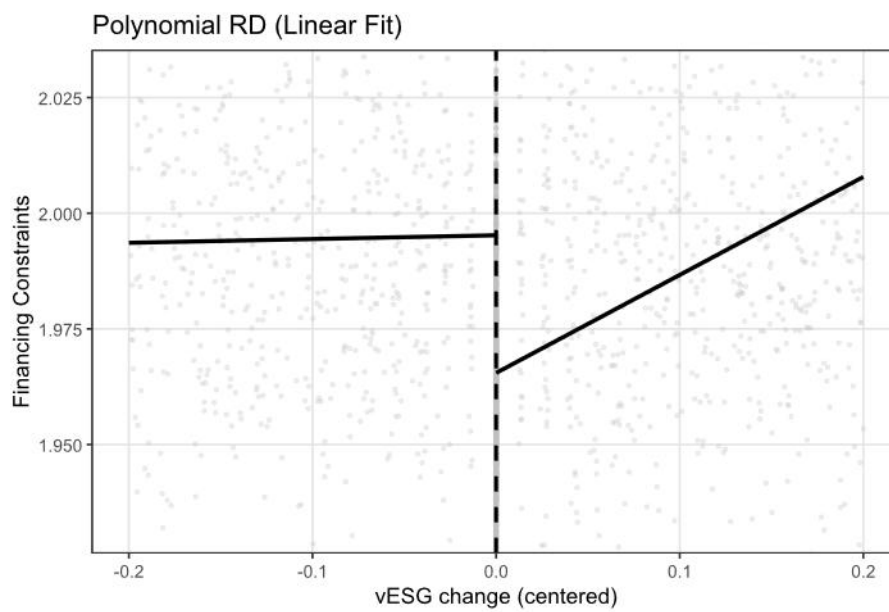


Figure 5. Regression Discontinuity Polynomial Fit (Linear)

Source: autor

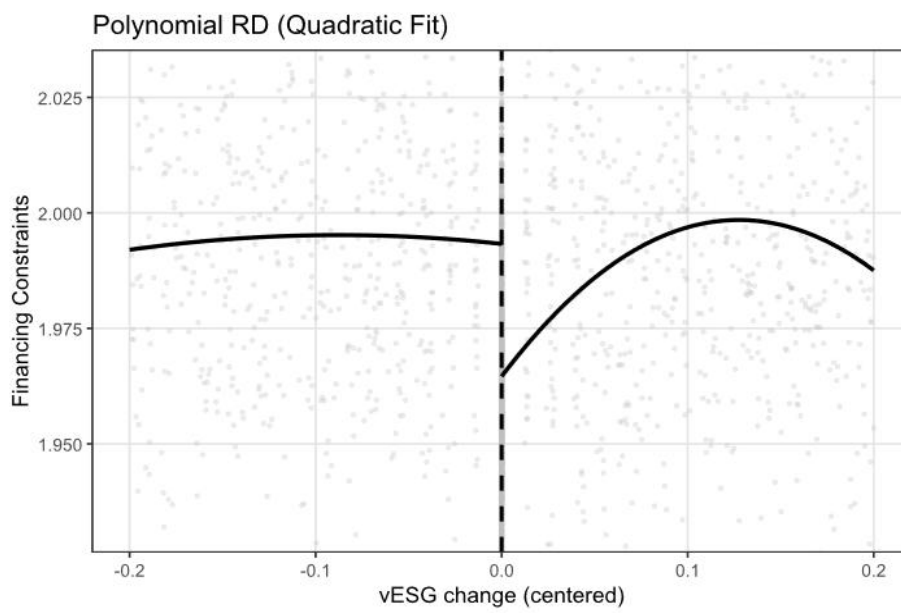


Figure 6. Regression Discontinuity Polynomial Fit (Quadratic)

Source: autor

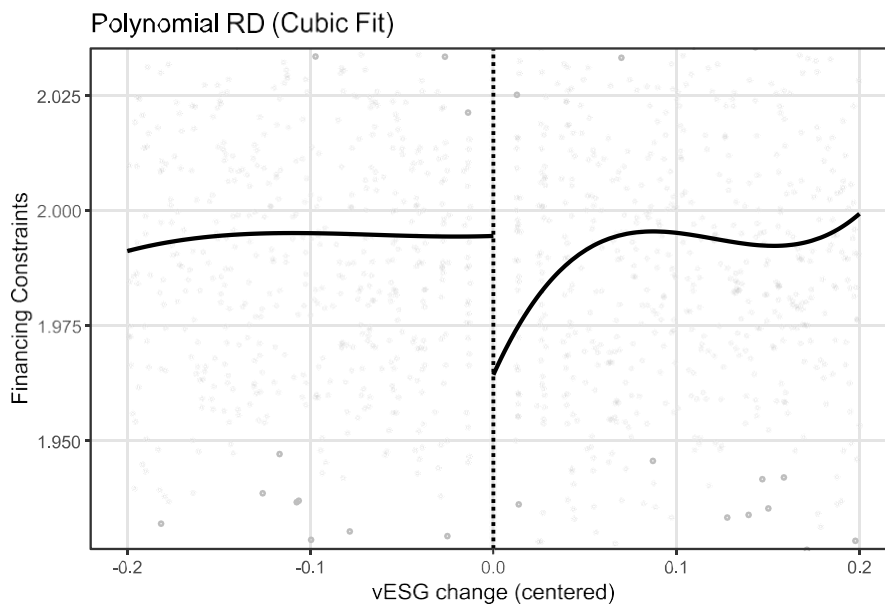


Figure 7. Regression Discontinuity Polynomial Fit (Cubic)

Source: autor

From Figure 8, we use the McCrary Density Test in the breakpoint regression design to support whether there are traces of artificial data manipulation at the breakpoints in our recognition strategy. It can be seen from the density test graph that the variables remain in a continuous and smooth state, with no data manipulation phenomena.

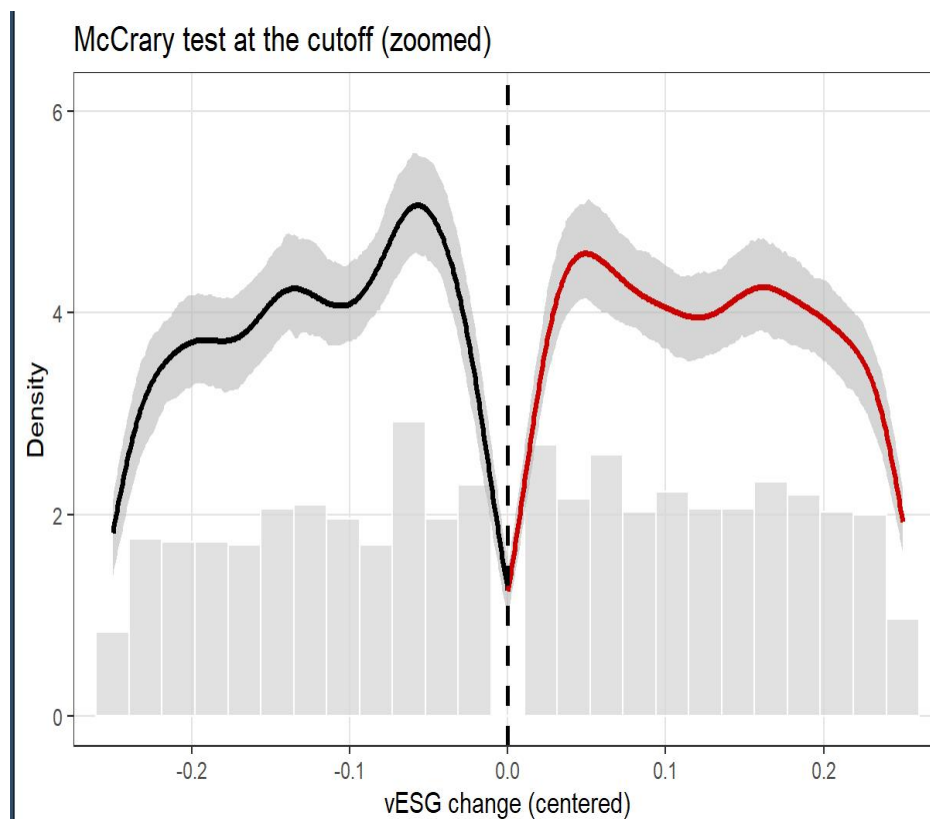


Figure 8. McCrary Density Test

Source: autor

Table 10. RDD Results with Linear and Quadratic Form

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|--------------------------|------------------------|------------|----------------------|------------|---------------------|------------|
| | Panel A:RDD-Triangular | | Panel B:RDD-Epanech. | | Panel C:RDD-Uniform | |
| | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| | FC | FC | FC | FC | FC | FC |
| D (Treatment) | -0.136*** | -0.122*** | -0.134*** | -0.119*** | -0.141*** | -0.122*** |
| | (-5.550) | (-4.888) | (-5.638) | (-4.914) | (-6.311) | (-5.337) |
| x-c | 12.304*** | 11.032*** | 11.470*** | 10.181*** | 10.430*** | 9.076*** |
| | (5.432) | (4.795) | (5.348) | (4.660) | (5.699) | (4.835) |
| (x-c)² | | 757.692*** | | 696.570*** | | 596.796*** |
| | | (3.111) | | (3.062) | | (3.312) |
| Constant | 4.660*** | 4.640*** | 4.723*** | 4.701*** | 4.796*** | 4.766*** |
| | (285.813) | (265.256) | (312.261) | (282.439) | (358.738) | (298.234) |
| Observations | 7,079 | 7,079 | 7,079 | 7,079 | 7,079 | 7,079 |
| R-squared | 0.961 | 0.961 | 0.958 | 0.958 | 0.955 | 0.955 |
| Controls | No | No | No | No | No | No |
| Firm FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Polynomial order | First | Second | First | Second | First | Second |
| Bandwidth | 0.011 | 0.011 | 0.011 | 0.011 | 0.011 | 0.011 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Table 11. RDD Results with Cubic Form

| VARIABLES | (1) | (2) | (3) |
|--------------------------|------------------------|----------------------|---------------------|
| | Panel A:RDD-Triangular | Panel B:RDD-Epanech. | Panel C:RDD-Uniform |
| | Cubic | Cubic | Cubic |
| | FC | FC | FC |
| D (Treatment) | -0.179*** | -0.180*** | -0.173*** |
| | (-6.291) | (-6.519) | (-6.633) |
| x-c | 30.949*** | 29.903*** | 23.235*** |
| | (6.331) | (6.412) | (5.489) |
| (x-c)² | 584.977** | 528.387** | 483.720*** |
| | (2.407) | (2.327) | (2.651) |
| (x-c)³ | -300,678.132*** | -277,320.515*** | -152,523.969*** |
| | (-5.602) | (-5.560) | (-3.784) |
| Constant | 4.680*** | 4.743*** | 4.800*** |
| | (236.258) | (252.881) | (266.737) |
| Observations | 7,079 | 7,079 | 7,079 |
| R-squared | 0.961 | 0.958 | 0.955 |
| Controls | NO | NO | NO |
| Firm FE | YES | YES | YES |
| Year FE | YES | YES | YES |
| Polynomial order | Third | Third | Third |
| Bandwidth | ±0.011 | ±0.011 | ±0.011 |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

For the data and variable setting, research uses panel data for listed firms in the Chinese A-share market from 2013 to 2023, with approximately 30,532 observations. The running variable is vESG change, which reflects the annual change in ESG scores of listed firms. The centered running variable is defined as $xc = x - c$, where the cutoff is $c = 0$. The dependent variable is FC, which measures financing constraints using the SA-index. The treatment variable is D, which equals 1 if $x \geq c$ and 0 otherwise. The model also considers the quadratic term $(x - c)^2$ and the cubic term $(x - c)^3$ to test whether the estimated discontinuity is robust to different local polynomial specifications.

Tables 10 and 11 report the sharp regression discontinuity results using local polynomial regression with an MSE bandwidth of ± 0.011 . The regressions use the rdrobust optimal bandwidth and compare three kernel functions: Triangular, Epanechnikov and Uniform. The dependent variable is FC, and the key explanatory variable is the treatment dummy D. The centered distance from the cutoff is also included. In addition, the quadratic and cubic terms of xc are added in different specifications to test the robustness of the estimated discontinuity.

For the explanation of the baseline RD regression results:

First of all, the main variable of interest in this paper is Treatment (D). The estimated value of the regression coefficient of D and the positive and negative levels of the sign are one of the references of the policy treatment effect referred to in this paper. Econometrics model results are shown in three kernel density functions (Triangular, Epanechnikov, Uniform) and three polynomial regressions (Linear, Quadratic, Cubic). The treatment effect D in RD regression of Cubic is negative and significant. The regression results are: -0.136***, -0.122***, -0.179***; -0.134***, -0.119***, -0.180***; -0.141***, -0.122***, -0.173***. Since the treatment effects of the policy treatment effect variable D for the three kernel functions and the first-order, second-order, and third-order local polynomial regressions all remain negatively significant at the 1% statistical level, this has verified that the regression results of RDD are good and in line with economic significance. This also confirms the significantly and credibility of the RD empirical results in this paper, showing under the verification of the three kernel density functions and the three polynomial MSE local regression, there is a negative inhibitory trend between the changes in the ESG score of listed enterprises and the FC financing constraints variable, and there is an obvious decreasing jump trend at the cutoff. This support our hypothesis 1(H1): the improvement of an enterprise's ESG score and the optimization of its ESG performance can alleviate the financing constraints of the enterprise, optimize its own financing structure and asset-liability ratio,

enhance its ability to use leverage for financing, and thus make it easier to obtain credit and investment support from large financial institutions, ultimately promoting the sustainable development of the enterprise. The polynomial results of the $(x-c)$ variable also remain significant, which further validates the accuracy of the econometric model and the identification strategy. From the above two RD regression result reporting tables, we can see that the coefficients of the running variable and its second and third terms have been overly magnified by higher-order powers. High-order polynomial regression in RDD regression can cause problems such as coefficient distortion and rdplot analysis graph distortion; Therefore, in the empirical analysis of this paper, the regression coefficients of the running variable have lost their economic and statistical significance. We only focus on its significance status and coefficient symbols. Its significance and coefficient signs are in line with the empirical design expectations of this paper, and the results are good. Meanwhile, the estimated values of RD regression of listed enterprises under the control of the three kernel density functions remain stable and significant, demonstrating the reliability and credibility of the RD regression results. Also, the RDD empirical result has also significantly validate the robustness of this paper's TWFE baseline regression result and the RDiT empirical results.

5. Conclusion and Discussions

5.1 Main Conclusion

This paper mainly studies the nexus between the ESG performance of enterprises, foreign direct investment (OFDI), and the financing constraints (FC) of enterprises. The core research question of this article is: Can the optimization of an enterprise's ESG performance help it reduce or alleviate financing constraints? At the same time, due to this issue, this paper further raises the second question: Can ESG performance play a mediating role through OFDI to improve the financing constraints?

The research is based on a very realistic research problem: in the sustainable development of enterprises, especially listed companies, alleviating financial constraints is the key problem of corporate governance. When the enterprise lacks external and internal financing funds and the cash flow is consumed in large quantities, the enterprise must practice its own development and get out of the predicament by alleviating its own financing constraints and improving its financing ability. At the same time, when enterprises face strong financing constraints, they have to cut investment expenditure and net working capital expenditure, and at the same time slow down OFDI scale and overseas market expansion as well as M&A strategy. In this way, enterprises will lack the motivation and opportunity to occupy the market and actively expand, thus losing long-term expansion and development

opportunities. The issue is critical for public companies in emerging economies. Because as listed companies in rapidly developing emerging economies, they especially need a large number of external financing opportunities and cash assets to achieve their own industrial upgrading, scientific and technological innovation, efficiency progress, green transformation and overseas expansion. These specific corporate strategic behaviors need sufficient cash flow as support. In fact, these enterprises often face core financial operational problems such as information asymmetry, credit mismatch and single and unstable source of financing. Therefore, in addition to ESG and financing constraints, this paper focuses on the mediating variable OFDI. This is because OFDI can more directly and quickly connect the domestic financing conditions of listed companies with the overseas M&A and overseas expansion strategies of the parent company.

First, the optimization of ESG performance helps alleviate the financing constraints of enterprises. This is the core hypothesis H1 of this paper. In fact, ESG score is often closely related to the corporate governance performance. This means that ESG has gradually become an information signal that investors can incorporate into their investment strategies: enterprises with higher ESG scores are often regarded as having better management experience, more standardized governance structure, more stable stakeholder relations and more open and transparent information level. This also means that the enterprise has strong risk management ability and a very good social image, which is a positive investment signal worthy of the attention of foreign investors. When the ESG score of an enterprise is good, the information asymmetry of the enterprise will be better optimized, and external investors will obviously have more confidence in the enterprise, which is conducive to the alleviation of financing constraints.

Second, OFDI plays a mediating role in the transmission mechanism of ESG in alleviating the financing constraints of enterprises. This is the core assumption of this article H2. In fact, the previous paragraph has already summarized that improving ESG scores can effectively enhance a company's social reputation and international image. At the same time, ESG can enhance a company's own external financing capabilities. As OFDI needed to consume a large amount of cash flow and asset reserves from its parent company in the early stage, these funds were mainly used for implementing overseas mergers and acquisitions, establishing overseas factory bases, hiring overseas employees and absorbing advanced overseas technologies, etc. Therefore, when the improvement of ESG scores can help enterprises alleviate financing constraints, their financing capabilities are enhanced. This is beneficial for enterprises to bear the short-term costs of OFDI in the early stage. At the same time, enterprises with higher ESG scores often indicate a higher level of complex governance,

stronger risk control capabilities, and a more complete governance structure. In conclusion, enterprises with higher ESG scores are more likely to implement OFDI behaviors. This paragraph summarizes the research mechanism of "ESG→OFDI".

Next, OFDI can affect financing constraints. This effect can be summarized as two heterogeneous effects in the short run and the long run. In the short term, since OFDI is a massive capital consumption behavior, enterprises must consume a large amount of capital and cash flow for necessary overseas expansion, overseas mergers and acquisitions and a series of expenses when they first enter the overseas market. This will inevitably exacerbate the financing constraints of the parent company in the short term. In the long run, OFDI may change corporate financing constraints. The reason is that successful OFDI behavior can help enterprises explore overseas markets, enhance international reputation and absorb advanced management and technical experience of the host country, which is conducive to increasing the overseas revenue and net profit of enterprises, improving the international image and financing ability of enterprises, so as to obtain continuous credit supply and investment support from external investors. As for the description and verification of this nonlinear relationship, this paper has carried out sufficient regression test by adding OFDI square term to TWFE benchmark regression and mediating effect regression equation. It has been proved that there is indeed an inverted U-shaped nonlinear nexus between OFDI and FC variable of financial constraints. The significant regression results of the three-step mediating effect also fully support H2 of this paper and confirm the mediating relationship among ESG, OFDI and FC financial constraints. This supports the conclusion of this paper. To sum up, the mediating effect mechanism is established, and the nonlinear relationship results are also established.

Third, regarding the handling of endogeneity. The endogeneity problem is of great significance in the empirical analysis of econometrics. Therefore, in addition to focusing on the TWFE results of benchmark regression, this paper also adopts a variety of cutting-edge methods to alleviate and solve the endogeneity problem of this paper.

The first method is to lag the financing constraint FC variable by one period and construct a dynamic panel regression model. Subsequently, a systematic GMM method using multiple instrumental variables was employed to address the endogeneity issue. The estimation and regression results of the system GMM further support the hypothesis H1 of this paper. Due to the strong dynamic persistence and constraint of financing constraints, the lag of one period of the FC variable remains positively significant in the GMM regression estimation. However, after controlling for this dynamic effect and endogeneity issue, ESG performance still has a significant negative impact on financing constraints, which validates the conclusion of the TWFE benchmark regression. The estimation and regression results of

the system GMM reduce the bias caused by reverse causality and omitted variables in the econometric model, and handle the endogeneity problem quite well.

The second method is a more cutting-edge causal inference method in advanced econometrics. In this paper, RDiT is chosen as the causal identification strategy after benchmark regression analysis. This strategy mainly relies on H3, which has been proposed in the literature review section: The ESG industrial policies in 2018 can influence the mechanism by which ESG alleviates the financing constraints of enterprises. Therefore. The year 2018 was a year of exogenous policy shock and also the cutoff set in this article. After setting the cutoff, this paper distinguishes between the treatment and control group and conducts RDiT local polynomial regression. The regression results of RDiT also assisted in supporting the results H1 and core hypothesis H3 of the TWFE benchmark regression. The Post coefficient was negatively significant in both polynomial regression and the three kernel function test analyses. Meanwhile, the results of the time-driven variables also show that the changing path of financing constraints around 2018 has undergone a shift trend after the policy cutoff.

The third method is IV-RDiT. Iv-rdit is a method that combines the IV instrumental variable method with RDiT. The RDiT results verified the reliability of the RDiT regression results and provided additional basis. In the first stage of IV-RDiT, the policy breakpoints in 2018 significantly affected the vESG variable, indicating the existence of exogenous policy shock effects. In the second stage, the vESG variables processed by instrumental variables still maintained a very significant negative impact on financing constraints. The results supplemented and verified H3.

The fourth method is SRDD. SRDD is used as a robustness test and analysis method in this paper to supplement and support the conclusions of TWFE benchmark regression and RDiT regression. SRDD uses the zero of vESG as the cutoff, and the results show a negative jump in financing constraints when firms switch from negative to non-negative ESG changes. This implies that around the breakpoint, firms with improved ESG performance have lower financing constraints. This conclusion is still valid under the test of local polynomial and multiple kernel functions, and the TWFE regression and RDiT regression are verified from the perspective of robustness.

5.2 Theoretical Contributions

This paper has made multiple theoretical contributions.

Firstly, this article enriches the literature in the fields of ESG, accounting and finance, and corporate finance from the perspective of literature analysis and research. Many studies

merely use ESG as a scoring indicator for corporate social responsibility, green transformation, and the quality of information disclosure. However, in fact, ESG has also become a financial and investment analysis indicator in this article: ESG has become one of the investment decision-making indicators for external investors. This means that ESG can also be analyzed from the perspective of finance, serving as a financial signal to alleviate the financing constraints of enterprises.

Secondly, this paper expands the literature on financing constraints. Traditional research merely assesses the financing constraints of enterprises from the perspective of investment-cash flow sensitivity or other financial scores. This article incorporates ESG as a factor influencing financing constraints into the analytical framework. It's a completely new perspective.

Thirdly, this paper also makes new contributions to the literature of OFDI. This paper does not merely study the one-way impact of OFDI on financing constraints as in previous research. Instead, it incorporates OFDI as a mediating variable into the common research framework among ESG, OFDI and financing constraints, and analyzes the mechanism of the mediating effect exerted by OFDI. This is one of the innovative points. Meanwhile, this paper examines the inverted U-shaped nonlinear relationship of OFDI with financing constraints in the short term and the long term, which is the second innovation point.

Fourth, this paper also makes multiple contributions to the endogeneity treatment methods. In terms of dealing with endogeneity, in addition to using the traditional endogeneity solution of the dynamic panel system GMM, this paper also adopts a variety of cutting-edge causal inference methods to handle endogeneity. One of the core innovations of this paper is the inclusion of the exogenous policy shock effect in 2018, and it is the first research literature in the field of ESG and financing constraints to incorporate the RDiT causal identification strategy into the analysis. Previously, no task research literature attempted to apply the RDiT causal identification strategy to the ESG and financing constraint fields. This paper has achieved a pioneering approach in terms of method. Meanwhile, this paper is not limited to the identification strategy of RDiT. At the same time, IV-RDiT and SRDD are used as auxiliary causal identification strategies, which better ensures the robustness and reliability of the EDiT strategy.

5.3 Empirical Contributions

First of all, this article uses the three-step intermediary effect mechanism well from the perspective of theoretical and empirical analysis of the ESG performance, OFDI and

corporate financing constraints fuses in together, and support the mediation effect mechanism, the abundant empirical research contribution.

Second, this paper uses dynamic panel and the analysis of system GMM method to deal with endogenous problem, control the dynamic effect of endogenous financing constraints, won a good conclusion. Fourth, this paper first use RDiT causal identification strategy analysis applied in the field, ESG and financing constraints and collocation more frontier IV - RDiT model to support the benchmark return conclusion and hypothesis H1, H3. The cutting-edge advanced causal inference method has greatly enriched the innovation points of this paper, making the conclusions of this paper very convincing and groundbreaking.

Third, this paper uses SRDD as a robustness test methods. Although some reviewers have questioned and disputed the zero break point selection of vESG in this paper, it just proves that we should be more cautious in the regression of traditional RDD in the empirical analysis. Despite the controversy over the ship-carrying part, the results of SRDD regression in this paper can still support the results of TWFE and RDiT benchmark regression and core hypotheses H1 and H3 from the perspective of robustness. This supports the benchmark regression results from another perspective.

5.4 Policy Implications

First, traditional industrial policy makers and government departments should better guide and improve the ESG information disclosure system of market companies. When ESG score is used as the reference basis for financial investors to conduct investment activities and financing activities, capital market regulators must do a good job in guiding and standardizing the ESG score system correctly. Strict and clear ESG score reference basis should be released, which can better help all kinds of investors and financial institutions alleviate the role of information asymmetry, help enterprises relieve financing constraints while further standardizing capital market activities, and crack down on speculation and false information disclosure.

Second, focus on ascension ESG disclosure quality. ESG policy should not only focus on formal corporate reporting, but also improve the quality and credibility of ESG information disclosure. The low-quality ESG report and scoring system is not only not conducive to the alleviation of financing constraints for enterprises, but also may further distort the information asymmetry mechanism of the capital market due to false information disclosure and deliberate falsification of information, which ultimately leads to investment and financing chaos in the capital market. Therefore, efforts should be made to improve the quality of ESG information disclosure.

Third, continuous positive opening to the outside world policy, stable support high quality OFDI behavior of enterprises. Due to the nonlinear relationship between OFDI and corporate financing constraints, policy makers and implementing agencies should focus on issuing new industrial policies to guide enterprises to carry out high-quality OFDI. It should not only pay attention to the size of OFDI of enterprises, but also pay attention to the specific fields and ways of OFDI implementation of enterprises.

Finally, policy institutions should take the lead in encouraging large asset groups to actively promote OFDI, and then slowly encourage micro and medium enterprises to implement OFDI and go overseas strategies, and discourage enterprises from blindly expanding overseas. Fifth, policy and support shall be differentiated features. The reason lies in the heterogeneity of financing constraints of different enterprises. Policy makers should provide differentiated strategic guidance according to different industries, types and financial conditions of enterprises, so as to better promote enterprises to take a variety of powerful ways to alleviate their financial constraints.

5.5 Limitations and Future Research

This article also has some limitations. First of all, the measurement of financing constraints in this paper is relatively simple. Limited by the specific problem of financial data collection, this paper only uses SA-Index as the measurement standard of financial constraints. Although SA-Index is the most extensive and stable in the overall research on financing constraints, it still cannot fully represent the financing constraints of enterprises and capture the degree of financing difficulties used. However, no index can fully cover the indicator of financial constraints. In fact, in addition to financial constraints, external research can also comprehensively collect panel data of more indicators, and build three indexes such as SA, KZ and WW Index to total and examine financial constraints from all aspects, so as to analyze the nexus between ESG performance and corporate financial constraints in a more three-dimensional and comprehensive manner.

Second, ESG ratings measure levels may exist more white noise and the deviation value. In fact, ESG scores vary widely from rating agency to rating agency because they use different weights, methods, and data sources, making it impossible to be completely accurate. Although this paper has comprehensively considered all kinds of ESG score data, there is still some selection bias. In future research, we can consider using more accurate ESG rating coefficients comprehensively, so as to obtain more accurate scoring variables and estimates.

Third, the measures to further optimize and improve the OFDI. In the panel data collected in this paper, OFDI can be measured by multiple standards such as investment

finance, the number of overseas subsidiaries, the host country data of investment, the OFDI investment mode and the OFDI investment industry. This paper mainly uses the flow amount of OFDI of listed companies. In future research, we can further subdivide OFDI data, such as greenfield investment, innovation investment and other investment activities, to obtain more accurate data. In addition, some reviewer has questioned the DID and RD-DD models in the first draft of this paper. This means that this paper cannot build the most perfect DID or RD-DD causal inference model from the very beginning. In fact, any causal identification strategy cannot be perfect and completely eliminate the selectivity bias, so the causal inference model in this paper chooses a variety of robustness test methods. This has alleviated the endogeneity problem of the econometric model to the greatest extent.

Fourth, RDiT has several limitations. In the basic assumptions of RDiT, since cutoff and running variable can only be selected as specific time variables (2018), there will be problems such as too few driving variables and too large MSE optimal bandwidth in the annual panel data. Therefore, although the regression results of RDiT are very consistent with economic and statistical expectations, we still cannot regard RDiT as the best identification strategy. Therefore, in addition to IV-RDiT, more robustness test measures should be added in the future, such as RDiT-First Stage regression, Fuzzy RDD regression and RD-DD regression for comprehensive investigation of various causal inference models.

Fifth, the SRDD also needs careful interpretation. Using the zero point of the ESG score variable $vESG$ as a cutoff does make very clear intuitive sense, as it is able to distinguish thresholds: firms with improved ESG and firms without improved ESG. However, the zero of $vESG$ does not have natural policy implications, which means that it is difficult for this paper to interpret the RDD regression from the perspective of economic policy. Therefore, the RDD causal inference model in this paper is only suitable for robustness test and analysis, but not suitable for causal inference identification strategy of benchmark regression. In the future, we can more fully explore the economic policy background and economic significance behind $vESG$ variables, so that RDD regression can obtain more economic significance interpretation.

Sixth, the sample only focuses on Chinese firms situation right now. Since the panel data in this paper are all from the data of listed firms in China's A-share market, the research significance is only limited to China at present. In the future, we will collect more panel data from listed companies in other countries for comprehensive analysis, so as to expand the amount of panel data and extend the conclusion of causal inference to more countries and regions, such as CEE region, which is also in economic transition. Moreover, future research could compare China with other emerging markets. Many emerging economies face similar

financing constraints, ESG development and international expansion pressures. Cross-country comparison can test whether ESG-OFDI-FC mechanism is applicable outside China.

Seventh, 2018 of ESG specification guide policy is only the first time a Chinese ESG governance concept of systemic policy, also is not strong enough. Future causal inference research could use stronger policy shocks. If future ESG ESG disclosure rules become more mandatory and more clearly timed, they may provide a clearer quasi-natural experiment. This would improve the current causal identification strategy of this paper.

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Appendix

Appendix Table A1. Heterogeneity analysis: Grouping - Quantile TWFE Regression Results

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) |
|---------------------|------------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|
| | Non-SOE FC | SOE FC | Low PB FC | High PB FC | Low EBIT FC | High EBIT FC |
| vESG | -0.078 (-1.626) | -0.237*** (-3.992) | -0.129*** (-2.842) | -0.062 (-0.913) | -0.121** (-2.164) | 0.041 (0.756) |
| PB | -0.064*** (-15.748) | -0.069*** (-8.373) | | | -0.082*** (-14.880) | -0.045*** (-11.612) |
| Lev | 0.949*** (7.813) | 1.195*** (6.249) | 0.978*** (6.321) | 1.142*** (8.013) | 0.857*** (6.310) | 0.909*** (6.981) |
| ROE | 0.574*** (6.497) | 0.364*** (2.796) | 0.654*** (5.838) | 0.229** (2.173) | 0.562*** (8.484) | 0.744*** (6.215) |
| EM1 | 0.021 (0.907) | 0.079*** (3.232) | 0.112*** (4.154) | -0.064*** (-2.740) | 0.095*** (4.593) | 0.064** (2.242) |
| REC | -0.629*** (-3.725) | 0.092 (0.267) | -0.183 (-0.970) | -0.847*** (-3.724) | -0.150 (-0.792) | -0.776*** (-3.758) |
| INV | -0.324** (-2.092) | -0.157 (-0.720) | -0.390** (-2.526) | -0.296 (-1.639) | -0.396** (-2.406) | -0.266 (-1.511) |
| FIXED | -0.857*** (-7.356) | -0.680*** (-3.508) | -0.675*** (-5.384) | -1.000*** (-6.758) | -0.960*** (-6.577) | -0.849*** (-6.159) |
| DLCR | 0.939*** (9.302) | 0.544*** (4.112) | 0.818*** (8.190) | 0.815*** (6.047) | 0.733*** (7.731) | 0.888*** (8.286) |
| EBIT | 0.233*** (4.938) | 0.391*** (4.315) | 0.207*** (3.395) | 0.348*** (5.135) | | |
| Constant | 4.483*** (96.663) | 5.146*** (53.554) | 4.906*** (79.995) | 4.152*** (70.025) | 4.722*** (82.591) | 4.754*** (83.405) |
| Observations | 18,841 | 9,675 | 14,260 | 13,264 | 13,854 | 13,843 |
| R-squared | 0.931 | 0.962 | 0.970 | 0.908 | 0.955 | 0.964 |
| Firm FE | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |

Note: Robust t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.10

Source: calculated by author

Kokkuvõte

Käesolev töö uurib, kas ESG-tulemuslikkus mõjutab ettevõtete finantseerimispiiranguid ning kas väljapoole suunatud välismaised otseinvesteeringud (OFDI) toimivad selles seoses vahendava mehhanismina. Finantseerimispiirangud piiravad ettevõtete võimet saada välisfinantseerimist ja teha välisinvesteeringuid, mõjutades seeläbi nende kestlikku arengut. Parem ESG-tulemuslikkus võib finantseerimispiiranguid leevendada, parandades informatsiooni läbipaistvust, äriühingu juhtimist, pikaajalist riskijuhtimist ja ettevõtte sotsiaalse vastutuse mainet. Samal ajal võib parem ESG-tulemuslikkus suurendada ettevõtete võimekust teha OFDI-d, samas kui OFDI võib omakorda mõjutada finantseerimispiiranguid, muutes lühiajalist sisemist rahavoo survet ja pikaajalist välisfinantseerimise võimekust. Muutujate ja andmete osas kasutatakse töös Hiina A-aktsiate turul noteeritud ettevõtete paneelandmeid aastatest 2013 – 2023. Finantseerimispiiranguid mõõdetakse SA-indeksi abil ning ESG-tulemuslikkust ettevõtete ESG-skooride aastase muutuse kaudu. Empiirilises osas kasutatakse esmalt kahe-suunalist fikseeritud efektide mudelit (TWFE) baasmudelina. Seejärel rakendatakse kolmeetapilist vahendusmudelit, et testida mehhanismi „ESG → OFDI → FC“, ning lisatakse OFDI ruutliige, et hinnata OFDI ja finantseerimispiirangute vahelist ümberpööratud U-kujulist seost. Endogeensuse käsitlemiseks kasutatakse lisaks süsteemset GMM-meetodit, ajas esineva regressioonikatkestuse mudelit (RDiT), IV-RDiT mudelit ja teravat regressioonikatkestuse disaini (SRDD). Tulemused näitavad, et ESG-tulemuslikkuse paranemine võib leevendada ettevõtete finantseerimispiiranguid ning OFDI vahendab seda mõju.

Märksõnad: finantseerimispiirangud; ESG; OFDI; regressioonikatkestuse disain; GMM

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