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Green Investment Heterogeneity and Enterprise Productivity: An Analysis From the Perspectives of Resulting Environmental Investment and Green Innovation Mediation

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ABSTRACT

Green investment plays a critical role in upgrading pollution control and improving environmental quality. Ecological development is the primary focus when striving for the goals of “carbon peak and carbon neutrality”, and green investment is a critical step towards that end. As a decision-making before the event, green investment shifts the focus from post disposal of pollution to the early prevention. Stakeholders expect environment-friendly products from their enterprises to minimize their impact to the natural environment. The stakeholder pressure perceived by the managers not only affects enterprises’ decisions on environmental strategy, but also correlates with the innovation output derived from environmental governance. However, in the available researches on topics including production, business operation, business management and decision-making, there is still a gap in the analysis of causal chain between green investment and enterprises’ output and the specific mechanism of how they work. The foundation of writing this thesis is building the framework of “environmental pressure from internal and external stakeholders – autonomous green investment – heterogeneity of environmental input – innovation driving mechanism - Total factor productivity (TFP)”. It incorporates a number of factors around green investment, such as the ex-ante decision-making, ex-post feedback, and final output, with aim of finding the cause of the heterogeneity of resulting environmental input and analyzing green innovation mechanism. It is expected to provide companies with suggestions on their green financing and final output after events.

This thesis begins with the discussion on driving forces of green investment. By setting up a stakeholder framework based on enterprises’ production process and decision-making, this research aims to answer the question “why enterprises introduce green investment”. As the main actor of pollution control in the national economy, enterprises’ environmental protection behavior has a significant impact on their productivity, which in turn decides the green development of the manufacturing industry. Green Investment (GI), the specific efforts made by manufacturers in their green practice, can be deconstructed into various types of resulting environmental investment, based on enterprises’ stakeholder pressures, so as to decompose the

heterogeneous response of the enterprises to external environmental protection pressures. Another primary question to be answered in this paper is whether different types of resulting environmental investment may have heterogeneous effects on productivity. In addition, this paper intends to further analyse whether the government needs to intervene in enterprises' green investment decisions with a high level of environmental regulations, or to encourage enterprises, as market subjects, to independently choose their green investment timing and make investment decisions through incentives, and also whether heterogeneous green investment forms can generate more value and more effective green technology innovation.

Enterprises' general technology acts as a critical but conventional force driving productivity forward, while green technological innovation results from both the economic and environmental performance. How these two factors play their intermediary role and "strong and weak versions of Porter hypotheses" affect the internal environment of enterprises are the third academic question this research tries to answer. To answer the above academic questions, this research collects the data from companies listed between 2008 to 2020, trying to deconstruct green investment by analysing the mechanism and result of how each of its resulting environmental input affects productivity. This thesis supplements the research findings in the field of enterprises' investment and environment management. Besides, it provides new empirical evidence to verify the "Porter hypothesis" within the Chinese context. The main conclusions of this research include:

First, by applying induction and deduction in literature review, this research finds that governmental and non-governmental regulations as well as market competition are the two major factors that force Chinese listed companies to make green investment. These two factors generate combined effect on enterprises' green investment behaviour. The literature review also implies that, regarding green investment motivations, a passive response is possible to convert into an active action. Therefore, this research takes four dimensions including the legitimacy of environmental strategy, practices in organizing and planning, production practices, and exchange practices to analyse the stakeholder pressure facing the companies requiring green investment. Empirical analysis indicates that the pressures from environmental legitimacy, organizing and planning environmental protection, clean production practice, and

environmental protection exchanges are all factors that drive an increase green investments. By further analysing the motivations, the research found that the elite governance by top management has a positive effect on green investment. Their personal capability and prestige drive enterprises' green practice forward. Additionally, their structural power can mobilize the available social resources, helping enterprises to make positive environmental strategy. Since top managers attach great importance to the enquiries on environmental protection from public and media, they are responsive to adapt the environmental strategy to the public opinion and increase green investment ultimately. The stronger the overall capability of top managers is, the more solutions they can find to lower the environmental pressure among suppliers and clients. Top managers' social connection weakens companies' perception of environmental pressure from other stakeholders to some extent. More specifically, top managers' political connection weakens the regulative limitation on enterprises, providing them with more space for manoeuvre and thus reducing their green investment and environmental protection cost. Last, top managers' business connection facilitates one company's green production to be learned and followed as an example by others. Such practices, therefore, lower the cost of green production and investment through more extensive sharing and dissemination of expertise.

Second, built upon the RDAP theory in corporate initiative of green investment strategy, the "R&D in early prevention" and "end-of-pipe treatment" environmental protection strategies are discussed within the stakeholder-induced environmental protection input framework. The relationship between these strategies and corporate productivity are further analysed empirically. On this basis, the level of green finance development is introduced as a variable. The impact of its threshold effect on productivity is analysed from the intermediary perspective of resulting environmental protection input. The empirical study indicates that the green investment can significantly boost their TFPs if the investment is induced by corporate proactive strategies in environmental protection and clean production. On the contrary, the input is unable to increase productivity if it is enterprises' passive response to the environmental compliance and public media's supervision. Regarding the methodology, Two-Stage Least Squares (2SLS) is used as a reasonable instrumental variables technique to respectively verify the causal relationship between "early prevention" input and TFP as well as "end-of-pipe

treatment" input and TFP. Early prevention input lifts up the overall productivity by driving strategic plans forward, optimizing organizational structure, improving efficiency of business process, and integrating product strategies. End-of-pipe treatment, on the other hand, requires enterprises to input in fixed assets after the pollution events so as to pass the environmental evaluation. This treatment cannot contribute to the overall improvement of productivity. Additionally, according to panel threshold regression model of TFP, the impact of "early prevention" input on TFP is changing if the level of green finance as threshold variable improves. To be specific, as the level of green finance keeps increasing, "early prevention" input initially shows negative effect on productivity. Once the level of green finance reaches a certain level, variable green finance tools can put corporate environmental protection decision into effect. For the enterprises with a lack of environmental protection awareness, "early prevention" project can provide green credit and support those enterprises to obtain competitive strength and improve the overall productivity to some extent. When a company has low "end-of-pipe treatment" input, its level of green finance hardly plays any role in the end-of-pipe treatment project. If a company's production and operations rely heavily on green finance, it may face a severe fund turnover problem in a short period as the level of green finance grows. This can lead to a competitive disadvantage and ultimately result in decreased return on investment.

Third, within the framework of stakeholder-induced environmental protection input, the mechanism of how two types of inputs, "early prevention" and "end-of-pipe treatment", operate on TFP is analysed. The analysis of mechanism verifies the intermediary effect of general technological innovation and green technological innovation. From the perspective of general technological innovation, enterprises' end-of-pipe investment caused by environmental regulations and public pressure cannot lead to technological innovation, whereas their proactive environmental strategy exercises notable crowding out effect on the general technological innovation. Such a result indicates the Chinese enterprises' limitations in planning their environmental protection investments and the incapability in producing spillover effect on innovation throughout the production process. Nonetheless, general technological innovation acts as an intermediary variable between "early prevention" environmental protection input and

TFP. Specifically, “early prevention” input lowers the enterprises’ TFP by weakening their general technological innovation. From the perspective of green technological innovation as an intermediary variable, enterprises’ end-of-pipe treatment cannot level up the green technological innovation, whereas their proactive measures in prevention can. The stepwise regression result confirms the intermediary role of green technological innovation between front-end treatment input and TFP, which indicates that the proactive strategy in environmental protection can improve TFP by enhancing green technological innovation. The combined effect of two technological innovations enables a link between enterprises’ early prevention and its external green finance context, as well as a link with the environmental innovation awareness of its internal management and a link with its innovation potential. From the perspective of general technological innovation, again, the environmental awareness of top management mediates the intermediary effect of general technological innovation between early prevention input and TFP. To be specifically, top managers’ environmental awareness can reverse the crowding out effect of early prevention on general technological innovation as an intermediary variable to some extent, thus helping enterprises to reach a balance between general business operation and environmental protection strategy. Ultimately, it would be possible to keep their current productivity. From the perspective of green technological innovation, top managers’ environmental awareness mediates the intermediary role of green technological innovation between early prevention input and TFP. Early prevention input enables higher productivity, energy saving, emission reduction, and green innovation through enterprises’ clean production. Therefore, it provides a foundation for the improvement of productivity. With their awareness, practices, and experiences in environmental protection, top managers can offer valuable suggestions in enterprises’ decision-making on environmental strategies, production process, and investment. Those valuable suggestions reduce the cost of making mistake and ineffective production, in turn, improving enterprises’ productivity.

The research findings can provide useful references for government to make appropriate environmental regulations and build a thriving green finance market; and for enterprises, to make environmental strategies in a more science-based way. Against the stakeholder pressure, enterprises must attach great importance to “early prevention” input and targeted inventive

mechanism of innovation, so as to secure the real benefits from environmental input. To address resource and environmental issues and promote sustainable social and economic development, the government needs adaptive environmental policies, laws, and regulations that a lign with market mechanisms. It, therefore, can encourage enterprises' initiative and competitive strength in green practices.

Keywords: Green Investment; Resulting Environmental Input; Early Prevention; End-of-pipe Treatment; Total Factor Productivity (TFP); Green Technological Innovation.

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