



The Impact of Sustainable Green Operations on Financial Flexibility: Based on Small and Medium-sized Enterprises

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Abstract: Against the backdrop of carbon neutrality and tightening global environmental regulations, the capital constraint of green transformation among small and medium-sized enterprises (SMEs) has become prominent, and financial flexibility determines their capacity for low-carbon sustainable operations. Grounded in the Resource-Based View, Stakeholder Theory, and Signaling Theory, this paper systematically clarifies the bidirectional nonlinear interactive relationship between sustainable green operations and financial flexibility, summarizes four transmission paths of financing, innovation, operation, and reputation, and sorts out mediating and moderating mechanisms such as green finance, digital technology, and organizational flexibility. The study finds that green investment by SMEs has a cost threshold, which squeezes cash flow in the short term and releases financial dividends in the long run. However, existing literature mostly focuses on large enterprises, leaving obvious gaps in the subdivision mechanisms, multiple context interactions, and qualitative research targeting SMEs. This paper constructs a conceptual analytical framework for the research, provides theoretical support for the green transformation of SMEs and the formulation of inclusive green policies, and proposes future research directions.

Keywords: Sustainable Green Operations; Financial Flexibility; Green Transformation; Organizational Resilience; Sustainable Development

1. Introduction

With the implementation of the global carbon neutrality strategy and the continuous upgrading of environmental regulatory standards in various countries, enterprises across the entire industrial chain are forced to promote green and low-carbon transformation (Omowole et al., 2024). SMEs account for more than 90% of the total market entities and undertake the main function of social employment absorption, but they generally suffer from shortcomings such

as scarce own resources, insufficient mortgage assets, and low information transparency. Large-scale green equipment transformation and low-carbon technology R&D can easily aggravate cash flow pressure, and financial flexibility directly determines whether the green transformation of SMEs can be promoted in a long-term and stable manner (Pu et al., 2021). Financial flexibility refers to an enterprise's financial buffer capacity to resist operational crises and seize green

investment opportunities by relying on its own cash reserves and remaining credit lines (Zhang et al., 2020); sustainable green operations cover six full-chain environmental practices including green investment, green manufacturing, circular remanufacturing, ESG information disclosure, green supply chain, and low-carbon innovation (Khan et al., 2023).

At present, the academic circle has formed two core research threads: first, financial flexibility supports enterprises' sustainable green investment, and sufficient financial buffer is the underlying capital guarantee for green innovation and environmental protection transformation (Hao et al., 2022; Teng et al., 2021); second, enterprises' green operation behaviors reversely optimize the external financing environment, stabilize long-term operating cash flow, and continuously improve the level of financial flexibility (Wang et al., 2025). Variables such as green finance, digital fintech, supply chain flexibility, organizational resilience, policy uncertainty, and public health crises can significantly regulate the intensity of their interaction (Sun et al., 2024; Khan et al., 2025).

However, most existing empirical literatures select large listed companies and leading enterprises in heavy pollution industries as research samples, systematic reviews specifically targeting SMEs are relatively scarce, a unified theoretical framework integrating bidirectional transmission paths has not yet been formed, and systematic induction is lacking. Based on this, this paper takes "sustainable green operations" and "financial flexibility" as core search terms, screens literatures in the past five years, systematically sorts out relevant theoretical foundations and cutting-edge research trends, builds a complete conceptual analytical framework, constructs a theoretical

transmission model of green operations acting on SMEs' financial flexibility, fills the gaps in existing review research, and has both theoretical value and practical guidance.

2. Concept Definition and Basic Theories

2.1 Sustainable Green Operations

Sustainable green operations is a long-term strategic operation mode in which enterprises deeply embed environmental governance and social responsibility into the entire business chain of procurement, production, warehousing and logistics, investment and financing, and product recycling, while simultaneously considering economic profitability, carbon emission reduction, and social value realization. Existing studies uniformly divide it into six core practice dimensions: green fixed asset investment, green manufacturing transformation, product circular remanufacturing, ESG standardized information disclosure, whole-chain green supply chain management, and low-carbon technology R&D innovation (Ye & Dela, 2023; Sarkar & Bhuniya, 2022; Bai et al., 2020).

There are significant differences in green operation practices among enterprises of different sizes: large enterprises have abundant cash flow and sufficient mortgageable assets, and can invest huge amounts of funds at one time to complete the replacement of low-carbon equipment in the entire production line and energy-saving transformation of the whole process; restricted by capital scale, SMEs' green operations present typical characteristics of lightweight, low cost, and gradual iteration. In practice, they mostly focus on the recycling and reuse of production waste, centralized procurement of green raw materials, and minor updates of simple energy-saving equipment, and rarely carry out long-cycle and high-

investment cutting-edge low-carbon R&D projects (Omowole et al., 2024; Afum et al., 2020).

In scenarios of sudden crises such as epidemics and market downturns, SMEs' green practices and technological innovation form a deep binding relationship. Normalized green manufacturing can continuously optimize production and operation efficiency, reduce administrative fines and compensation expenditures caused by excessive pollutant discharge, and indirectly smooth the fluctuation of enterprise operating performance (Alraja et al., 2022). Digital tools further broaden the boundary of SMEs' green operations. Khan et al. (2025) proposed that digital tools such as blockchain evidence storage and green big data risk control can simplify the verification process of upstream and downstream green supply chains, and continuously reduce the compliance cost of green management for SMEs.

2.2 Financial Flexibility

The core connotation of financial flexibility was first defined by Zhang et al. (2020), which refers to the comprehensive financial buffer capacity of enterprises to freely use idle monetary funds and undrawn bank credit lines to cope with sudden operational risks and capture high-quality green investment projects. The academic circle divides it into three sub-indicators: cash flexibility, debt flexibility, and equity financing flexibility. Cash flexibility represents the scale of an enterprise's own cash flow reserve; debt flexibility represents the remaining debt-raising space and the ability to obtain green credit; equity financing flexibility represents the financing convenience of enterprises through equity capital increase and introduction of green investment.

Early studies only used single indicators such as the scale of cash holdings at the end of the period and

asset-liability ratio to measure financial flexibility, with a one-sided evaluation dimension; subsequent scholars expanded the conceptual boundary combined with organizational resilience and strategic flexibility, and proposed that financial flexibility is the underlying core foundation for enterprises to carry out long-term sustainable risk management, which determines the survival and transformation space of enterprises in the face of external shocks (Settembre-Blundo et al., 2021).

Teng et al. (2021) empirically found based on the panel data of enterprises during the COVID-19 epidemic that physical SMEs with a higher proportion of tangible assets such as factories and equipment have stronger dependence on external funds for operation and turnover, so their demand for financial flexibility reserves is significantly higher than that of asset-light service industries; enterprises with sufficient financial flexibility reserves can smoothly survive market crises and maintain a stable pace of green equipment renewal and low-carbon R&D investment.

2.3 Resource-Based View and Dynamic Capability Theory

The Resource-Based View holds that the scarce and difficult-to-replicate heterogeneous resources within an enterprise are the source of core competitiveness, and the Dynamic Capability Theory further emphasizes the dynamic adjustment ability of enterprises to integrate and iterate resources to adapt to changes in the external environment. By continuously carrying out green operations, SMEs can gradually accumulate exclusive scarce resources such as green patents, low-carbon standardized production processes, and long-term stable green supply chain cooperative relationships, forming green competitive barriers different from peers; such green

heterogeneous resources can transmit operational advantages to financial institutions, effectively alleviate bank credit constraints, broaden long-term credit channels, continuously improve the scale of enterprise cash reserves and remaining debt-raising space, and optimize the overall level of financial flexibility from the two dimensions of cash flexibility and debt flexibility (Ni et al., 2020; Alkaraan et al., 2024). Green big data and digital analysis tools can improve the efficiency of identification, integration and realization of green resources, and amplify the improvement effect of green operations on financial flexibility (Edwin Cheng et al., 2022).

2.4 Stakeholder Theory

Stakeholder Theory points out that enterprise operation behaviors need to take into account the demands of multiple subjects such as government regulatory authorities, commercial banks, equity investors, end consumers, and upstream and downstream cooperative suppliers. Normalized green operations and active disclosure of complete ESG information by SMEs can meet the requirements of government environmental supervision, reduce the probability of environmental violation penalties, and at the same time enhance consumer brand recognition and strengthen long-term cooperation trust in the supply chain; for the needs of green assessment and risk control, financial institutions are willing to grant larger green credit lines and lower loan interest rates to compliant green operation enterprises, continuously alleviating the long-term capital pressure of SMEs (Feng & Wu, 2023; Zhai et al., 2022). The green banking system built with commercial banks as the core is the core channel for SMEs to obtain low-cost medium and long-term green funds (Chen et al., 2022; Zheng et al., 2021).

2.5 Signaling Theory

SMEs naturally have the

characteristics of small scale, imperfect information disclosure, and low operation transparency, and there is serious information asymmetry between the capital market, banks and enterprises, which pushes up financing costs and compresses financing space. Signaling Theory explains the underlying logic of green operations improving financial flexibility: SMEs' active investment in green transformation, public disclosure of complete environmental performance data, and layout of circular manufacturing businesses can transmit positive and credible signals of compliant operation, low environmental risk, and steady long-term development to the external capital market; relying on this signal, external capital suppliers reduce risk identification costs, lower debt financing interest rates, expand remaining financing lines, and simultaneously improve the three types of financial flexibility of enterprises: cash, debt, and equity (Yang et al., 2024; Deschryver & De Mariz, 2020).

3. Literature Review

3.1 Bidirectional Interaction and Nonlinear Threshold Effect Between Green Operations and Financial Flexibility

The academic research context presents obvious stage evolution characteristics. Early literatures unilaterally focused on the supporting role of financial flexibility on enterprises' sustainable green investment, and later gradually turned to the reverse empowerment of financial flexibility by green operations, and verified that there is a significant nonlinear threshold characteristic between the two. Zhang et al. (2020) confirmed based on a sample of multinational enterprises that sufficient financial flexibility is a necessary prerequisite for enterprises' long-term sustainable green equipment and R&D

investment; Hao et al. (2022) further refined the mechanism and proved that financial flexibility can buffer the cash flow loss caused by the failure of green innovation and positively drive enterprises' sustainable low-carbon innovation activities.

With the deepening of research, scholars began to pay attention to the reverse impact of green operations on financial flexibility and identified a significant threshold effect: there is a critical threshold for green operation investment. In the initial stage, the procurement of environmental protection equipment and low-carbon transformation will directly increase the fixed operating costs of enterprises, continuously compress operating cash flow, and inhibit financial flexibility; when the scale of green investment crosses the critical threshold, the continuous dividend of emission reduction and cost reduction and the dividend of green credit financing are gradually released, which will steadily improve the financial buffer capacity of enterprises in the long run (Yang et al., 2024). Wang et al. (2025) built a complete closed-loop transmission chain of "financial flexibility – organizational resilience – green innovation", and the differentiated competitive advantage formed by green innovation can stabilize long-term profitability, continuously increase enterprise cash reserves, and form a two-way virtuous cycle with financial flexibility.

3.2 Macro Transmission Path of Green Finance, Green Bonds and Green Credit

Green finance is the core intermediary bridge connecting macro environmental policies, industrial regulations and micro green operations and financial levels of enterprises. Various green financial instruments and regional green finance development levels together constitute the macro

transmission channel through which green operations affect financial flexibility. Ma et al. (2023) selected G20 transnational panel data and found that the development of green finance industry and environmental sustainable governance jointly drive regional green economic growth and improve the overall financial stability of green industries in the region in the long run; Xiong & Dai (2023) verified that technological innovation and renewable energy project investment play a mediating role in the process of green finance empowering enterprises' sustainable development, and the reduction of production costs brought by technological iteration is finally transformed into the long-term financial competitive advantage of enterprises.

From the perspective of banking green credit instruments, green credit products implemented by commercial banks in many countries directly improve the financing availability of SMEs. Zheng et al. (2021) and Rahman et al. (2023) compared the implementation practices of green credit by commercial banks in Bangladesh and India, and found that special green credit lines can significantly expand the scale of credit access for SMEs; Chen et al. (2022) proposed that a sound green banking system can help enterprises complete green recovery in the post-epidemic era and strengthen their long-term financial risk resistance ability. As a direct financing tool, green bonds have the advantage of long-term low cost. Deschryver & De Mariz (2020) sorted out the development bottlenecks of the global green bond market, and improving supporting policies and simplifying the threshold for SMEs to issue bonds can release the potential of green bond financing and broaden the long-term low-cost financing channels for SMEs. Sharma et al. (2022) pointed out that renewable energy projects such

as wind power and photovoltaics have long investment cycles and slow capital return, so enterprises need to coordinate the management of green financial instruments and internal financial flexibility to avoid capital turnover risks (Taghizadeh-Hesary & Yoshino, 2020).

Regional institutional differences will restrict the implementation effect of green finance. Guild (2020) took Indonesia as a research sample and found that regional political barriers and the lack of supporting systems for green finance will hinder the implementation of green credit and green subsidy policies; Liu & Lai (2021) studied the Islamic green finance system in Malaysia and showed that diversified and differentiated green financial products can adapt to the financing needs of SMEs in different industries and scales. Wang & Wang (2021) empirically proved that the development of green finance can promote the green transformation and upgrading of regional traditional industries and create a more friendly external green operation environment for local SMEs. Akomea-Frimpong et al. (2022) systematically sorted out literatures related to green finance in the banking industry and summarized existing research gaps and pain points in industry implementation practices.

ESG information disclosure is the core micro channel through which green operations are transmitted to financial flexibility, connecting macro green finance policies and internal financial levels of enterprises. Feng & Wu (2023) selected a sample of real estate trust enterprises and empirically found that standardized ESG information disclosure can reduce the degree of information asymmetry in the capital market, optimize bank debt financing terms, and simultaneously improve enterprise market value and long-term financing space; Zhai et al. (2022)

constructed a complete mediating transmission chain: high-quality ESG performance → alleviating enterprises' external financing constraints → expanding the scale of green innovation investment → improving long-term financial sustainability. Yang et al. (2024) verified that there is a U-shaped relationship between ESG ratings and enterprises' green innovation investment, which can reasonably explain the realistic operating characteristics of high cost and financial pressure in the early stage of green transformation of SMEs.

3.3 Multi-layer Mechanism of Green Operations Affecting Financial Flexibility

3.3.1 Green Fintech and Digital Transmission Mechanism

Digital technology, green fintech, and blockchain big data are new underlying tools for SMEs to break through traditional financing constraints and release the financial dividends of green operations, which can optimize the cash flow of SMEs' green operations from multiple dimensions such as information identification, process management, and risk control pricing. Macchiavello & Siri (2022) formally put forward the concept of green digital finance. Big data and blockchain digital technology help financial institutions accurately identify compliant green SMEs and greatly reduce information screening costs; Aboalsamh et al. (2023) combined smart city scenarios to verify the practical value of green fintech in the implementation of green services for SMEs; Chueca Vergara & Ferruz Agudo (2021) empirically proved that there is a two-way promotion relationship between fintech and enterprises' sustainable green development. Wang et al. (2024) empirically proved from the perspective of enterprise carbon emissions that fintech can optimize bank credit risk control models, lower the threshold of green credit for SMEs, and

provide inclusive green financing support. Khan et al. (2025) specifically selected SMEs as empirical samples. Green data analysis and blockchain evidence storage technology simplify the qualification verification process of upstream and downstream of the green supply chain, continuously reduce the compliance and operation costs of SMEs, stabilize operating cash flow, and indirectly improve the two types of financial flexibility of cash and debt.

3.3.2 Mediating Mechanism of Organizational Resilience and Flexibility

Enterprises' internal organizational resilience, strategic flexibility, and organizational innovation are core mediating variables for green operations to be transformed into financial flexibility, which determine whether enterprises can transform green resources into risk resistance capabilities. Wang et al. (2025) empirically confirmed that organizational resilience and green innovation play a dual mediating role between financial flexibility and enterprises' sustainable development; Hao et al. (2022) proposed that sustainable low-carbon innovation is the key transmission path for enterprises to convert reserved financial flexibility into long-term market value. Settembre-Blundo et al. (2021) constructed a sustainable risk management system oriented to uncertainty, and the internal decision-making flexibility of the organization can improve the efficiency of enterprise crisis response and stabilize long-term financial levels; Ni et al. (2020) proved that organizational flexibility enhances enterprise market competitiveness and strengthens overall financial resilience by driving internal organizational innovation; Shahzad & Jasińska (2024) studied based on a sample of the energy industry and found that strategic flexibility is the core underlying ability

for traditional energy enterprises to maintain financial sustainability in the process of low-carbon transformation.

3.3.3 Green Supply Chain Flexibility Transmission Mechanism

The construction of green supply chain flexibility and circular manufacturing system can directly reduce enterprise production, procurement, and logistics costs, form stable cash flow returns, and finally be transmitted to the level of financial flexibility, which is the core transmission path for manufacturing SMEs. Bai et al. (2020) put forward the professional concept of sustainable supply chain flexibility and empirically proved that it is significantly positively correlated with enterprises' circular economy performance; Edwin Cheng et al. (2022) integrated three elements of big data analysis, circular economy mode, and supply chain flexibility, and their synergistic linkage can significantly improve the sustainable operation performance of manufacturing enterprises; Bag & Rahman (2023) from the perspective of enterprises' underlying resource capabilities, the benefits of raw material saving and waste recycling brought by supply chain flexibility are finally transmitted to enterprise financial indicators, increasing the financial buffer space.

Sarkar & Bhuniya (2022) constructed a mathematical model of flexible manufacturing-remanufacturing under demand fluctuation scenarios, and green fixed asset investment combined with flexible production system can simultaneously achieve environmental emission reduction and enterprise financial income increase; Khan et al. (2022) empirically proved that green supply chain management improves overall operational performance relying on low-carbon technological innovation; Afum et al. (2020) completely sorted out the transmission path of "green

manufacturing upgrading – operational competitiveness improvement – enterprise brand reputation appreciation – sustainable financial performance improvement"; Siagian et al. (2021) took the COVID-19 epidemic as an external shock scenario and verified that the synergy of supply chain integration, flexible management, and technological innovation improves enterprise operation and financial performance; Trivellas et al. (2020) and Lee (2021) respectively verified the positive effect of supply chain green practices on enterprise financial performance from the perspectives of green logistics management and long-term supply chain strategy; Dwivedi et al. (2021) systematically sorted out the practical constraints and challenges in the process of implementing value chain flexibility for sustainable development; Jain et al. (2020) proposed that organizational flexibility can help enterprises transform external environmental institutional pressure into circular economy financial benefits.

3.3.4 Moderating Mechanism of External Crises and Policy Environment

Sudden public crises, climate policy uncertainty, and green industry support policies are external moderating variables, which can change the intensity and direction of green operations acting on financial flexibility, and are important constraints at the macro-environmental level. Su et al. (2022) reviewed the reshaping effect of the epidemic shock on corporate sustainable strategies, and SMEs with sufficient financial flexibility reserves can continuously and steadily promote green transformation; Teng et al. (2021) empirically proved that the supporting effect of financial flexibility on enterprises' sustainable green development is significantly amplified during the crisis stage; Pu et al. (2021)

focused on the SME group, and special government support and innovative green financial instruments play a moderating role under the impact of the epidemic, making up for the capital shortboard of SMEs' green transformation; Alraja et al. (2022) proved that green production practices and low-carbon technological innovation can synergistically improve the operating performance of SMEs during the crisis stage. Heffron et al. (2020, 2021) based on the energy industry, demand-side flexibility and enterprise strategic flexibility help energy SMEs smoothly survive external market crises and achieve long-term sustainable development; Davidescu et al. (2020) supplemented the supporting role of enterprises' internal flexibility on sustainable operation from the perspective of human resource flexibility.

Sun et al. (2024) empirically proved that climate policy uncertainty will inhibit enterprises' green innovation investment, but sufficient financial flexibility can effectively buffer this negative impact; Zhang et al. (2021) proved that China's green credit policy has an environmental governance effect, and the effectiveness of policy implementation will be regulated by the enterprise's own financial flexibility level; Hung (2023) based on a sample of Vietnamese enterprises, the scale of green investment, regional financial development level, and digital transformation degree jointly affect the level of enterprise economic sustainability.

3.4 Supplementary Research in Industries, Energy and Other Fields

In addition to general manufacturing SMEs, existing studies have expanded to segmented industries such as aviation, new energy, cultural tourism, and electric power, enriching the differentiated research conclusions

of green operations and financial flexibility in different heavy-asset and light-asset industries. Manigandan et al. (2023) focused on hydrogen fuel in the aviation industry and studied the balance between fuel flexibility, exhaust emission reduction effect and long-term financial investment of enterprises; Salkuti (2022) focused on new green energy technologies and analyzed the linkage logic between grid system resilience and financial sustainability of energy enterprises; Lu et al. (2021) took green smart cities and cultural tourism industries as research objects, expanding the research boundary of green operations of light-asset SMEs in the service industry; Zhu et al. (2020) based on the background of carbon tax policy, analyzed the green financial behaviors of high energy-consuming enterprises in the electric power industry, and improved the sample analysis of heavy-asset industries.

3.5 Research on Differentiated Characteristics of SMEs' Green Operations and Financial Flexibility

SMEs have essential differences from large enterprises in resource endowment, internal governance, and external financing channels. Existing literatures have formed a unified conclusion: first, SMEs have stronger capital constraints on green operations, lack of sufficient mortgage assets and meager internal cash flow, and short-term green equipment procurement and low-carbon R&D will directly squeeze cash reserves and weaken financial flexibility, which can only be alleviated by green credit, special government subsidies, and green fintech (Khan et al., 2025; Pu et al., 2021); second, the benefits of SMEs' green operations have obvious lag, short-term environmental protection investment pushes up operating costs, but long-term green practices can continuously improve the overall financial performance, so SMEs

should give priority to low-cost lightweight green transformation to balance environmental protection investment and short-term financial security (Kumar et al., 2022; Macchiavello & Siri, 2022); third, digitalization and blockchain technology are the core starting points for SMEs to narrow the green competition gap with large enterprises. Green big data and blockchain simplify the green supply chain management process, reduce compliance and operation costs, stabilize operating cash flow, and green digital finance can break the natural financing information barrier of SMEs and continuously optimize the three types of financial flexibility levels (Boakye et al., 2020; Omowole et al., 2024).

4. Discussion and Conceptual Framework

Based on the previous literature sorting results, sustainable green operations and financial flexibility form a two-way dynamic interactive closed loop. There is a significant nonlinear threshold constraint between the two, and multiple mediating and moderating variables jointly affect the transmission effect. The SME group naturally has the shortboard of resource endowment, and green finance, digital technology, and government support are the core external tools to resolve capital constraints. Financial flexibility provides stable capital guarantee for enterprises' green equipment and low-carbon innovation investment; green operations improve organizational resilience through four basic paths of financing optimization, low-carbon innovation, operation cost reduction, and reputation appreciation, and then improve the three types of financial flexibility of cash, debt, and equity, forming a long-term positive cycle; there is a critical cost threshold for SMEs' green investment. When the investment is lower than the threshold, it

will compress cash flow and inhibit financial flexibility; after crossing the threshold, environmental and financing dividends are continuously released, while excessive idle financial flexibility will generate agency costs and weaken enterprises' motivation for green transformation; green innovation, organizational resilience, and supply chain flexibility are core mediating variables, and policy uncertainty, sudden public crises, digitalization level, enterprise scale, and industry attributes are key moderating variables, which can change the intensity and direction of the main effect.

On the whole, the existing research system still has five prominent shortcomings, and there are obvious limitations in existing literature samples, mechanism disassembly, research design, measurement methods, and subdivision dimensions: first, exclusive empirical samples of SMEs are scarce, most literatures select large listed enterprises and leading enterprises in heavy pollution industries, special research on unlisted micro, service industry, and county-level SMEs is insufficient, and existing conclusions have limitations in adapting to SME scenarios; second, the identification of two-way causality and the disassembly of subdivision transmission mechanisms are insufficient, most studies focus on the one-way path of financial flexibility driving green development, lacking comparative analysis of green operations

acting on cash, debt, and equity flexibility respectively, and the mining depth of threshold effect and dynamic lag effect is insufficient; third, research on multiple context interactive moderation is missing, existing achievements only discuss single variables such as epidemic, green finance, and digital technology separately, and have not incorporated policy uncertainty, digital transformation, and supply chain constraints into a unified framework to carry out interactive effect analysis; fourth, the research method is single and qualitative cases are scarce, mainstream literatures adopt static panel regression, dynamic PVAR, difference-in-differences, and threshold models are less applied, and qualitative studies such as grounded theory and field investigation of SMEs are scarce, making it difficult to excavate the real green financial decision-making logic of SMEs; fifth, the comparative study on the subdivision dimensions of green operations is weak, and few studies distinguish different green practice dimensions such as green investment, green logistics, circular manufacturing, and ESG disclosure, lacking comparative analysis on the differentiated impacts of various green behaviors on financial flexibility.

Based on the above discussion, the conceptual framework of this study is constructed as shown in Figure 1:

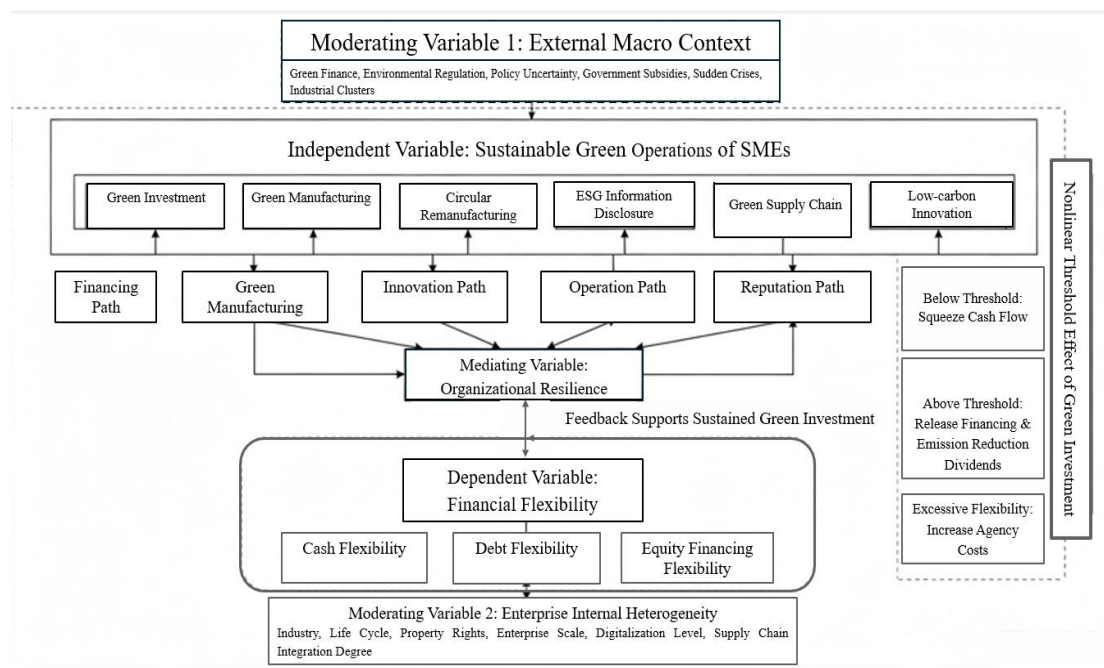


Figure 1. Conceptual Framework of This Study

5. Conclusions and Future Research Directions

This paper systematically sorts out relevant literatures in the past five years, completes systematic sorting and integrated review around five sections: core concept definition, three basic theories, two-way interactive context of green operations and financial flexibility, multi-layer mediating and moderating transmission mechanisms, and differentiated operation characteristics of SMEs, builds an integrated theoretical analysis framework, and fully clarifies the multi-layer transmission logic of sustainable green operations of SMEs acting on financial flexibility. Based on existing empirical literatures, the core conclusions can be drawn: first, there is a two-way nonlinear interactive relationship between green operations and financial flexibility, and financial flexibility is the prerequisite capital foundation for SMEs to carry out low-carbon transformation and green innovation. Second, green operations improve organizational resilience through four paths of financing, innovation, operation, and reputation,

reversely increase the financial buffer space of enterprises, and present an overall U-shaped threshold characteristic. Third, green innovation, organizational resilience, and supply chain flexibility are core intermediary channels, external policies, crisis shocks, and enterprises' own heterogeneity play a key moderating role, and green finance, digital technology, and government support can alleviate the natural resource constraints of SMEs and release the financial dividends of green operations.

In the future, relevant research boundaries can be expanded from multiple dimensions: first, carry out empirical research on the heterogeneity subdivision of SMEs, distinguish manufacturing, commercial circulation, and service industry SMEs, compare the differentiated threshold characteristics of green operations affecting financial flexibility of enterprises in different regions, life cycles, property rights, and scales, carry out special research on low-cost lightweight green transformation of micro enterprises, and build a subdivision theoretical system adapted to the SME group; second, deepen the

identification of two-way causality and the mechanism test of subdivision dimensions, adopt econometric models such as dynamic panel, threshold regression, and difference-in-differences to accurately identify the two-way causal relationship, split three sub-indicators of cash flexibility, debt flexibility, and equity financing flexibility, and respectively test the differentiated effects, lag cycles and threshold intervals of different green operation behaviors such as green investment, ESG disclosure, and green supply chain on the three types of financial flexibility; third, integrate multiple interactive contexts and expand diversified research perspectives, comprehensively analyze the interactive moderating effects of multiple variables such as green fintech, blockchain, environmental regulation, and policy uncertainty, jump out of the single micro enterprise perspective, explore the financial spillover effect of collaborative green transformation from the meso perspective of industrial clusters and upstream and downstream supply chain networks, and at the same time combine field case investigation, grounded theory qualitative analysis and large sample panel empirical research to enrich the research method system.

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