

A Conceptual Framework for Green Financing: Integrating TOE and Dynamic Capabilities

Zidong Zhou, Rudzi Munap, Huiwei You, Dianxiang Wang

Faculty of Business, UNITAR International University, 47301 Petaling Jaya, Selangor, Malaysia

Corresponding Author Email: rudzi@unitar.my

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Abstract

Green financing (GF) is a key tool for global sustainable economic transformation, but enterprises still face challenges such as investor confidence, policy adaptability, and financing costs. Existing studies mainly focus on external drivers and overlook how enterprises build internal capabilities to optimize GF. The traditional technology-organization-environment (TOE) framework emphasizes static influences and lacks adaptability to the evolving green financial environment. This study integrates Dynamic Capabilities (DC) theory, introduces green innovation capabilities (GIC) as a mediating variable, constructs a GF conceptual framework, and uses a systematic literature review and theoretical modeling to explore how technology, organization, and environment dimensions of TOE directly support GF adoption and enhance its adaptability through GIC. In addition, DC strengthens GIC through sensing, seizing, and reconfiguring capabilities, enabling enterprises to dynamically adjust resources and optimize GF strategies, thereby expanding the applicability of the TOE framework. This study fills the gap in the TOE framework in the study of dynamic GF adaptability and reveals the mechanism of how DC promotes GF through GIC. In practice, the government should provide tax incentives based on GIC, enterprises should build dedicated green finance strategy teams and leverage digital technologies like blockchain and AI to optimize GF project evaluations, thereby enhancing the long-term stability of the GF market. Investors should include GIC indicators in ESG ratings to further promote the adoption of green finance strategies. This study provides a theoretical basis for future empirical research.

Keywords: Green Financing, Technology-Organization-Environment Framework, Dynamic Capabilities Theory, Green Innovation Capability, Sustainable Finance

Introduction

GF enables companies to secure funds through instruments like green bonds, loans, and environmental impact financing for eco-friendly initiatives and sustainable development goals D’Orazio and Valente (2019). Since the Paris Agreement took effect, governments have stepped up backing for eco-conscious investments; this shift has elevated corporate green finance performance to a key benchmark for assessing sustainability commitments (Lee, 2020). Nevertheless, market growth masks persistent adoption barriers - from investor skepticism to cost-benefit uncertainties in GF implementation (Steuer & Tröger, 2022).

Current scholarship predominantly examines how technological innovations like blockchain reshape GF adoption through enhanced transparency in green financial instruments, particularly via decentralized verification mechanisms (Ezekiel Onyekachukwu et al., 2024). In addition, corporate social responsibility (CSR) now plays a pivotal role in sustainability-linked funding decisions, with firms demonstrating strong sustainability commitments garnering preferential access to green capital markets (Cai & Le, 2023). However, these studies mainly explore how external factors affect GF, and pay less attention to how companies can optimize GF strategies through internal capability building and dynamic adjustments. There is a triple disconnect in current research: firstly, excessive focus on external drivers such as policy incentives, while neglecting how enterprises can actively construct GF implementation paths through organizational capabilities; Secondly, the static analysis of the existing TOE framework is difficult to explain the rapid response of enterprises to frequent updates of green finance standards; Thirdly, the intermediate mechanism for the transformation of dynamic capabilities into GF achievements has not been clarified, especially how green innovation capital can transform strategic agility into quantifiable financing advantages. Therefore, exploring how companies can integrate internal resources to improve the adaptability and competitiveness of GF has become a topic that urgently needs in-depth research.

Based on this, this study focuses on the following core questions: (1) How can enterprises optimize GF through internal capability building? (2) How is the role of the TOE framework reflected in GF? (3) How does DC dynamically influence the GF implementation pathway through the mediating role of GIC?

To address these issues, this study combines the TOE framework with the DC theory. It introduces GIC as a mediating variable to construct a GF theoretical framework. The TOE framework provides a macro perspective on corporate GF decisions, emphasizing how technology, organization, and environmental factors affect GF (Cruz-Jesus et al., 2019). However, the TOE framework is relatively static and fails to explain how companies can dynamically adjust in a rapidly changing financial environment. Therefore, this study introduces the DC theory to explore how companies can improve their GIC through sensing, seizing, and reconfiguring capabilities, and ultimately promote successful implementation (Teece, 2014).

Theoretically, this study has three main contributions. First, it expands the scope of the TOE framework by integrating it with DC theory, offering insights into how enterprises can adapt to the rapidly changing green finance market and optimize their green finance strategies through dynamic capabilities. Second, it constructs a TOE-DC-GIC-GF integration model that highlights the pivotal mediating role of GIC in green finance adoption, deepening our understanding of how internal capabilities influence green finance outcomes. Third, the study systematically analyzes how enterprises can enhance their green finance adaptability and effectiveness by leveraging the three dynamic capabilities—sensing, seizing, and reconfiguring—thereby improving their capacity to adjust strategies in response to environmental changes.

At the practical level, this study provides a systematic decision-making basis for policymakers, corporate managers, and investors. Policymakers can use this to optimize green finance

policies and formulate more targeted incentives to improve the stability and sustainability of the GF market; corporate managers can enhance the adaptability of enterprises in the GF market by strengthening DC and GIC construction, thereby improving sustainable financing capabilities; investors can use this framework to more comprehensively evaluate the GIC of enterprises and their long-term potential in the GF field, to optimize investment decisions and promote the healthy development of the green financial system.

Literature Review

GF has received widespread attention worldwide in recent years. The rise of green financial instruments such as green bonds, green credit, and green investment has provided new financing paths for the sustainable development of enterprises and promoted the formation of environmentally friendly business models. Studies have shown that GF can not only improve the financial performance of enterprises, but also improve their environmental performance, and to a certain extent, encourage high-polluting enterprises to internalize external pollution costs (Zhang et al., 2022). While policy support and market incentives are critical drivers of GF current theoretical models inadequately explain how firms dynamically optimize GF adoption mechanisms amidst financial volatility. Existing studies predominantly examine linear relationships between policy interventions, market forces, and corporate outcomes, yet neglect the synergistic integration of technological adaptation, organizational resource allocation, and environmental contingencies in shaping GF strategies (Wu et al., 2021). This limitation parallels early-stage supply chain collaboration research, where scholars over-relied on formal contractual mechanisms until Wang et al. (2025) uncovered the mediating role of *guanxi* (relationships) in enhancing collaboration through trust-building and resource synergy—a breakthrough this study adapts by positioning GIC as the informal dynamic mediator that operationalizes TOE synergies into optimized GF strategies.

The TOE framework has emerged as a pivotal lens for analyzing GF adoption in corporate contexts. Grounded in the interdependence of technological capabilities (T), organizational readiness (O), and external pressures (E), this model rejects single-factor determinism, instead emphasizing how their synergistic interaction drives strategic GF implementation (Awa et al., 2016).

From a technological standpoint, using financial tools like blockchain can significantly boost the transparency and credibility of GF. It allows for real-time tracking of fund flows and carbon emissions, which in turn helps build investor trust (Wang et al., 2020). But just having technological innovation isn't enough to ensure the successful adoption of GF. Its success also relies on a company's ability to integrate resources, manage innovation, and make strategic adjustments. For instance, in a financial environment that's both complex and unpredictable, the decision-making style, risk tolerance, and leadership skills of corporate leaders are key to successfully implementing strategies (Beh et al., 2023). In addition, corporate culture, particularly one centered around sustainability, has a significant impact on the adoption and implementation of green finance strategies (Zhao & Ngoi, 2024).

Furthermore, environmental factors also play a vital role in the GF adoption process. For example, government supervision, market norms, and social responsibility pressures will directly affect the financing decisions of enterprises (Binti Ahmad et al., 2023). However, Kwan (2024) pointed out that most companies focus on the financial impact of CSR while

overlooking the intrinsic motivation behind CSR investments—whether such investments are made to build resilience against external shocks or as a strategic approach for future corporate activities. In the context of carbon neutrality policies, companies that proactively fulfill their CSR commitments can not only gain policy incentives (such as tax exemptions and green financial subsidies) but also enhance investor confidence and optimize their GF structure, ultimately strengthening their financial sustainability (Wang et al., 2022). Although the TOE framework provides a systematic perspective for GF adoption, its static analysis characteristics limit its explanatory power for the dynamic adjustment capabilities of enterprises. Given this, researchers began to explore how to combine DC theory to enhance the applicability of the TOE framework in GF research.

The DC theory was first proposed by Teece, Pisano, and Shuen to explain how companies gain and maintain competitive advantages in highly uncertain environments by sensing, seizing, and reconfiguring key resources and capabilities. Unlike the traditional resource-based view, the DC theory focuses more on how companies adapt to a changing environment (Teece, 2007). In GF research, the three core processes of DC play a key role in shaping a company's financing strategy. First, sensing capabilities help companies spot shifts in ESG regulations, market demand for green projects, and sustainable investment trends, allowing them to adjust their strategies accordingly (Ferrell et al., 2016). Second, seizing capabilities helps companies turn identified market opportunities into practical financing models, like optimizing capital through green bonds and sustainable credit (Mudalige, 2023). Finally, reconfiguring capabilities allows companies to adjust their resource structure within technological, organizational, and market limits, like improving green supply chain management and boosting financing efficiency (Li & Shen, 2022). DC Theory provides a structured framework for analysing how firms adapt their GF adoption strategies in complex markets. However, while Zhou et al. (2025) applied DC theory to design a financing strategy framework for risk-averse SMEs in low-carbon supply chains, their study narrowly focused on static capability constructs and overlooked the mechanisms through which dynamic capabilities (e.g., technology absorption, resource reconfiguration) drive GF implementation via innovation. To address this gap, scholars have recently turned to GIC theory, which emphasizes how firms can synergize internal capabilities to operationalize GF adoption. DC theory offers a structured approach to how companies adapt their GF adoption strategies in a complex market.

Recently, GIC has become a key driver of GF adoption, drawing continued attention from scholars (García-Granero et al., 2018). GIC is proposed to be measured in four areas: product, process, organizational, and market innovation. It helps companies enhance their adaptability in the green financial market. Additionally, GIC allows businesses to use GF tools more effectively and boost financing success through technology integration, management optimization, and market adaptation (Kraus et al., 2020). However, most research focuses on the direct impact of GIC on corporate performance, with little attention given to its role as a mediator between the TOE framework and GF adoption.

While existing research has made progress in GF, there are still several gaps. First, it mainly examines the impact of policies, market incentives, and individual factors, without a systematic framework to explain how technology, organization, and environmental factors work together. Second, although the TOE framework has been applied to GF research, its

static characteristics limit the explanatory power of strategic adjustments of enterprises in a dynamic market environment. In addition, the application of DCT in GF research is still in the exploratory stage, and there is a lack of systematic research on how enterprises can improve the effectiveness of GF adoption through dynamic capabilities. Third, the mechanism of GIC as a mediating variable has not been fully explored, especially in the context of the combination of TOE and DC, its impact on the GF adoption path still needs further verification. Based on this, this study integrates TOE and DC theories and introduces GIC as a mediating variable to construct a new GF adoption mechanism analysis framework to make up for the shortcomings of existing research and provide a theoretical basis for enterprises to optimize GF adoption strategies.

Conceptual Framework

GF has become an important driving force for the global sustainable economic transformation. However, enterprises still face many challenges in the process of GF, such as insufficient market trust, high financing costs, and policy adaptability (Steuer & Tröger, 2022). Existing research mainly focuses on how technological innovation and policy factors drive the adoption of GF, but there is less discussion on how enterprises can optimize GF strategies through internal capability building (Ezekiel Onyekachukwu et al., 2024). Although the TOE framework has been widely used to explain the technology adoption behavior of enterprises, its static characteristics make it difficult to adapt to the dynamically changing financial environment (Abdurrahman et al., 2024). This study draws on the views of Teece (2014) and introduces DC theory to make up for the limitations of the TOE framework. It also uses GIC as a mediating variable to construct a more adaptive GF conceptual framework. In this framework, the TOE dimension not only directly affects GF, but also acts on GIC through DC, ultimately enhancing the GF capabilities of enterprises. As a key capability for enterprises to adapt to market changes and optimize resource allocation, DC plays a core role in GF's strategic adjustments, enabling enterprises to effectively coordinate technology, organization, and environmental factors to improve financing feasibility and market competitiveness.

In terms of the technology dimension, the application of digital technology and green technology, such as blockchain, AI, and IoT, can improve the transparency and traceability of GF and reduce financial fraud and information asymmetry (Cheng et al., 2023). However, technological innovation itself is not enough to ensure the effective implementation of GF. Enterprises also need to have DC to promote the efficient adoption and application of these technologies. DC enables green financial instruments to be more effectively embedded in corporate development strategies through sensing (sensing market demand and policy trends), seizing (identifying the optimal technology application scenario), and reconfiguring (reconstructing corporate operating models) (Teece, 2007). For example, enterprises can use blockchain to improve the transparency of ESG data disclosure or adopt AI-driven carbon credit assessment models to improve the feasibility of green loans (Liu & He, 2024). Ultimately, the role of DC enhances the GIC of enterprises, enabling them to use GF tools more efficiently and optimize sustainable financial strategies.

In the organizational dimension, an enterprise's resource allocation, innovation culture, and management system directly impact its ability to adopt GF. Rapid changes in the market and policy environment make it hard for static capabilities to sustain GF in the long run. Therefore, companies must leverage DC to adapt their strategies and improve management models. DC

helps companies spot ESG regulatory changes and sustainable investment trends, seize new opportunities in the green finance market, like sustainable bonds and green investment funds, and reorganize internal resources, such as adjusting capital structure and setting up cross-departmental collaboration to improve GF execution (Teece, 2014). Companies with strong DC can quickly adapt to changes in the carbon trading market, lower GF costs, and boost market recognition by adjusting financing tools and improving ESG ratings.

In terms of the environmental dimension, government regulation, CSR, and market norms constitute the key external factors affecting GF's adoption (D'Orazio & Valente, 2019). The government has directly influenced corporate GF through policies like carbon taxes, green credit incentives, and ESG oversight. Additionally, stronger CSR requirements have pushed companies to focus more on environmental sustainability during the financing process (Wu et al., 2021). DC helps companies adapt more easily to policy changes, seize regulatory incentives, and adjust business models to reduce policy risks and improve GF success (Teece, 2014). The role of DC in the environmental dimension not only helps companies cope with external pressures but also enhances their GIC, making GF part of the company's long-term competitive advantage.

In general, GIC plays a key intermediary role in the relationship between TOE, DC, and GF. GIC improves GF performance through product innovation, process innovation, and market innovation (García-Granero et al., 2018). In a policy-driven market, GIC mainly enhances the compliance capabilities of enterprises and helps them better meet ESG regulatory requirements; while in a market-oriented environment, GIC promotes the development of green financial products and improves investment attractiveness (Kraus et al., 2020). Therefore, GIC not only affects the success rate of GF adoption but also determines whether enterprises can maintain their competitive advantage in the green financial market in the long term.

Based on the above theoretical analysis, this study constructs a GF conceptual framework that integrates TOE, DC, and GIC to systematically explain how enterprises can optimize the implementation path of GF through the synergy of multidimensional factors (see Figure 1).

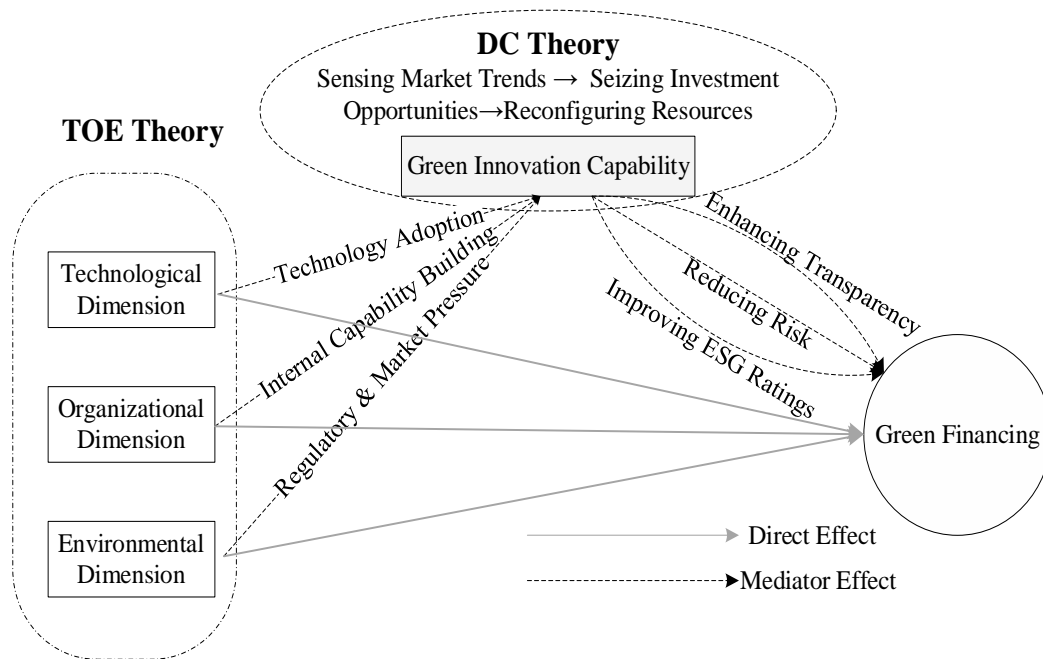


Figure 1: Conceptual Framework

As shown in Table 1, this study integrates the Technology, Organization, and Environment dimensions with the DC theory, constructing a simplified green finance implementation framework that emphasizes how DC directly impacts GIC, driving the interaction of these dimensions and promoting GF. This framework highlights that while the TOE dimensions directly affect GF, DC influences GIC, helping enterprises optimize green finance strategies and enhance market competitiveness. Additionally, GIC, as a core mediating variable, bridges the dynamic capabilities of enterprises with green financial performance, addressing the gap in existing studies that primarily focus on external market drivers.

Table 1

Integration Model of TOE and DC Theories

Dimension	Main Factors	DC on GIC	Impact on GF
Technology (T)	Digital tech, Blockchain, AI, IoT	Sensing: Monitor trends & changes, enhance transparency & efficiency of green finance tools	Improve financing transparency, boost investor confidence
		Seizing: Choose optimal tech applications, improve the effectiveness of green finance projects	Increase the attractiveness of green investments, improve financing feasibility
		Reconfiguring: Adapt to new tech, enhance project execution	Promote sustainable green finance growth, enhance market competitiveness
Organization (O)	Resource allocation, management system, cross-department collaboration	Sensing: Identify green investment opportunities, enhance GIC	Lower financing costs, increase the feasibility of green finance
		Seizing: Adopt new models, drive sustainable finance transformation	Increase capital inflows, improve acceptance of green finance products
		Reconfiguring: Optimize structure & cross-departmental collaboration	Enhance market competitiveness and strategic execution
Environment (E)	Government regulations, carbon tax, CSR pressures	Sensing: Monitor policy changes, enhance compliance capabilities	Improve ESG ratings, obtain policy support
		Seizing: Capture policy incentives, enhance financing feasibility	Enhance policy adaptability, reduce financing costs
		Reconfiguring: Optimize supply chain management, and reduce policy risks	Improve financing success rate, enhance market share in green finance

Discussion

This study integrates the TOE framework with the DC theory to construct a dynamic adaptability conceptual framework of GF and introduces GIC as a key intermediary to explain how enterprises optimize GF adoption under the joint action of technology, organization, and environmental factors. Different from previous studies that only focus on single factors such as policy, technology, or organization, this study provides a more comprehensive analytical path, revealing how DC affects GIC through sensing, seizing, and reconfiguring capabilities, and ultimately enhances GF adaptability. Existing GF research mostly relies on the TOE framework, but its static analysis characteristics limit its explanatory power for dynamic market adjustments. This study introduces the DC theory to make the TOE framework more

dynamically adaptable, thereby expanding its scope of application. This responds to the emerging call in strategic management for dynamic structuralism—balancing stable frameworks (TOE) with agile capabilities (DC) to address sustainability paradoxes. In addition, this study deepens the application of DC theory in the field of GF and proposes that DC can not only directly optimize the allocation of enterprise resources, but also indirectly improve the success rate of GF by enhancing GIC.

In practice, this study provides decision-making guidance for enterprises, policymakers, and investors. Enterprises should strengthen GIC construction, set up dedicated green finance strategy teams, and use blockchain and AI to optimize GF project evaluation to improve the success rate of financing. Policymakers can introduce "GIC-based tax incentives" and "government-guaranteed green bonds" to reduce the cost of corporate GF adoption and optimize ESG disclosure standards to improve market transparency. When evaluating GF projects, investors should not rely solely on traditional ESG ratings but should combine machine learning prediction models to measure the company's dynamic adjustment capabilities and green innovation levels, thereby optimizing the investment portfolio.

Although this study has constructed a new GF theoretical framework, it still has certain limitations. First, this study has not yet passed the empirical test. In the future, the structural equation model (SEM) can be used to analyze the path effects of TOE, DC, and GIC on GF, especially to verify whether GIC has different effects on GF at different stages of enterprise development. Secondly, this study mainly focuses on the enterprise level, and in the future, the moderating role of the policy environment can be further explored, such as the impact of carbon tax policies in different countries on GF strategies. In addition, the specific role of emerging technologies (such as AI, blockchain, and big data) in GF adoption still needs to be further studied, such as how AI optimizes the risk assessment of green loans, or how blockchain improves the transparency of the green bond market. Future research can further explore the applicability of GF in different industries (such as manufacturing, finance, and technology companies), and analyze the differences in its adoption paths in carbon-intensive industries to improve the theoretical system of green finance.

Conclusion

This study constructs a GF conceptual framework that integrates the TOE framework and DC theory and introduces GIC as a key intermediary to explain how enterprises optimize GF adoption under the joint action of technological, organizational, and environmental factors. The study finds that TOE factors not only directly affect GF, but also play an indirect role through GIC. At the same time, DC enhances GIC through three capabilities: Sensing, Seizing, and Reconfiguring, forming an organizational learning cycle where sensing triggers environmental scanning, seizing enables strategic resource allocation, and reconfiguring implements structural ambidexterity, thereby improving the adaptability of enterprises to GF. This framework expands the static analysis perspective of TOE, making it more dynamically adaptable, as technological factors drive knowledge codification systems, organizational factors establish cross-functional synergy mechanisms, and environmental factors shape dynamic strategic fit, and deepens the application of DC theory in GF, providing a new research perspective for understanding the dynamic adoption of green finance at the enterprise level. In practice, enterprises should enhance GIC construction, optimize green technology adoption capabilities, and enhance organizational flexibility to better adapt to

policy and market changes. Policymakers should promote market incentive mechanisms based on GIC to improve the stability of the green finance market, while investors should incorporate the DC and GIC capabilities of enterprises into ESG evaluation indicators to optimize investment decisions. Future research can use structural equation modeling or case analysis to empirically test this research framework and further explore how different industries, market environments, and policy systems affect the GF adoption path, to improve the theoretical system of green finance.

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Conflict of Interest Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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