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An Empirical Study On The Impact Of Supply Chain Finance On Enterprise Innovation Performance Based On The Mediating Effect Of Supply Chain Concentration

Huixing Huang[1*], Chonlavit Sutunyarak[2]

[1*]Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies, Rajamangala, University of Technology Tawan-Ok, Thailand. e-mail: huixing.hua@rmutto.ac.th
[2]Chakrabongse Bhuvanarth International Institute for Interdisciplinary Studies, Rajamangala, University of Technology Tawan-Ok, Thailand.e-mail: chonlavit_su@rmutto.ac.th

Abstract
Supply chain finance (SCF) is a crucial factor in driving supply chain development as it focuses on the flow of funds within the supply chain. In the realm of digital finance, companies engage in innovative research and development and participate in supply chain finance to secure stable and sufficient funds. This paper conducts a theoretical study on SCF, supply chain concentration(SCC), and enterprise innovation performance(EIP), and presents theoretical models and hypotheses. The empirical analysis in this article utilizes data from A-share listed companies in Shanghai and Shenzhen, China, spanning from 2011 to 2020, employing a fixed effects model. The results showed that: (1) SCF has a positive and significant impact on EIP; (2)SCC acts as a complete intermediary in the relationship between SCF and EIP. The results offers practical insights for enterprises to assess the value of supply chain cooperation relationships, enhance supply chain financial service capabilities, and improve the economic benefits of enterprise innovation. The results also provide guidance for organizational transaction relationship management between supply chain partners in practice.

Keywords: Supply chain finance; Enterprise innovation performance; Supply chain concentration; Enterprise innovation; Supply chain cooperation relationships

1. Introduction

As the world's second largest economy, China has achieved astonishing economic growth by relying on high household savings and investment activities. However, this growth has come at a cost, as it heavily relies on large amounts of factor inputs and energy consumption, which can lead to environmental degradation and energy shortages (Jalil and Feridun, 2011; Zhao et al., 2021). In order to achieve sustainable development, overcome the energy crisis, and become a global trade leader, China must focus on developing innovative production factors (Kantola et al., 2017). While China has made progress in becoming an 'innovative country', there is still a significant gap compared to developed nations in terms of the quality of innovation. Enterprises play a crucial role in the technological innovation system, and their level of research and development (R&D) investment and innovation directly impact a country's innovation capabilities. Enhancing the enterprises innovation capabilities has become a key focus for scholars and governments. Previous research on the factors influencing enterprises innovation has primarily focused on the endogenous growth theory, where enterprises attribute the growth of sales revenue and profits to the integration of their own asset investments and business capabilities. In other words, enterprise innovation(EI) can be achieved by adjusting their own production factors. Building on this foundation, many scholars have started exploring the factors that influence innovation within corporations. Previous research has identified several important factors that influence EI, including enterprise size (Andries and Faems, 2013), efficiency of own funds utilization (Zhang et al., 2020), nature of enterprise property rights (Yi et al., 2017), corporate governance (Jia et al., 2017), and corporate culture (Kraśnicka and Wronka-Pośpiech, 2018). While this study, based on endogenous growth theory, provides some understanding of innovation output in different types of enterprises under specific conditions, there are still certain differences that remain unexplained.

With the continuous deepening of research on factors affecting EI, the endogenous growth theory of enterprise independent innovation has gradually been replaced by the resource dependence theory of enterprise cooperative innovation. According to the resource dependence theory(RDT), an organization's reliance on external resources can influence its decision-making regarding resource selection. Since organizations do not possess all the necessary resources to carry out their activities, they must engage in cooperative relationships with other organizations to exchange resources and achieve their goals (Schiele et al., 2015). The implementation of organizational enterprise innovation requires financial support (Yuke and Xiaomin, 2015). Funds serve as an effective medium for resource exchange. In China, many small and middle enterprises (SMEs) struggle to obtain loans through traditional bank lending channels. The reasons behind this issue are multifaceted. It is commonly believed that SMEs lack stable and valuable assets, thus making it challenging for them to secure financing. Consequently, finding innovative financing methods to help SMEs overcome the difficulties and costs associated with financing has become a significant focus for both theoretical and practical circles. Information asymmetry has consistently been the

primary obstacle hindering effective access to financing for SMEs (Nizaeva and Coşkun, 2018). In recent years, there has been a growing trend among SMEs to reduce information asymmetry and overcome financial constraints through supply chain finance(SCF), which is an innovative financing method. Previous research on SCF for SMEs has primarily focused on financing theory (Randall and Theodore Farris, 2009; Xiang and Worthington, 2015; Ma et al., 2020), financing causes (Halldórsson et al., 2015), and financing countermeasures (Luo et al., 2018; Wang and Chen, 2023). Wandfluh et al. (2016), using the principal-agent theory, discovered that internal financial assistance within the enterprise and financial assistance between customers and suppliers have a significant positive impact on SCF performance. Song et al. (2016) combined information asymmetry theory and network theory to propose that strong links and bridge connections in supply chain networks can effectively enhance the financing quality of SMEs. Martin (2017), based on social exchange theory, analyzed the promoting effects of supplier dependence, buyer bargaining power, and buyer-supplier trust on SCF. Martin and Hofmann (2019), utilizing transaction cost theory, conducted an exploratory multi-case analysis and suggested that the effectiveness of SCF can be evaluated based on two dimensions: financing time and funding sources. Liang et al. (2018) developed a model for evaluating the SCF performance in SMEs. The model takes into account economic growth factors, social responsibility factors, and environmental governance factors, based on the triple bottom line theory. The study also investigated how internal and external capabilities of companies affect SCF performance, uncovering the underlying mechanism of influence.

Among various factors, the relationship formed by enterprises, customers, and suppliers in the supply chain plays a significant role in influencing EI (Roy et al., 2004). With the increasing technical complexity of high-tech products and the accelerating speed of product updates and iterations, corporate innovation is increasingly recognized as a multidisciplinary activity that spans across multiple organizations, environments, elements, and technologies (Teece, 2010). Scholars have attempted to explore the impact of external factors on enterprise innovation performance(EIP), such as economic policies (Fagerberg, 2017; Xu, 2020) and industry factors (Rothwell, 1992; Barbosa et al., 2014), based on resource dependence theory. Whittington et al. (2009) argue that different enterprises possess diverse and scarce resources that are difficult to imitate. Knowledge and information serve as the core elements of EI, and the exchange of knowledge and information between enterprises and supply chain partners emerges as a crucial pathway for successful EI (Hobday et al., 2000). Acquiring all the necessary elements for innovation is a challenging task for any enterprise. In order to obtain these elements, enterprises must engage in knowledge and resource exchange with external entities. Among these external entities, suppliers and customers within the supply chain possess the potential to provide complementary resources to enterprises, making them the primary targets for seeking external innovation resources. They also serve as a significant source of innovation resources for enterprises. However, it is important to note that not all companies can procure the required resources for innovation from their supply chain partners. This is influenced by factors such as supplier concentration(SC) and customer concentration(CC).

Based on this, this study aims to investigate the internal mechanism of enterprise participation in SCF on innovation performance. This study utilizes De Rassenfosse et al. (2013) who proposed patent output as an alternative indicator of EIP. The data used in the study is from the CSMAR database, which provides information on A-share listed companies in Shanghai and Shenzhen, China, from 2011 to 2020. This study empirically tests the impact of SCF on EIP from the perspective of supply chain concentration(SCC). The results support the conclusion that SCF can enhance EIP. It is worth noting that further analysis reveals that the impact of SCC on EIP has two different directions. This article contributes in three aspects. Firstly, it expands the research perspective on EIP. Secondly, it validates the relationship between SCF and EIP using the latest data. Lastly, it offers a valuable exploration of SCF from different perspectives. Secondly, this study focuses on A-share listed companies in Shanghai and Shenzhen, China, and aims to enhance the understanding of SCF and EIP. Previous research has examined EIP in relation to financing constraints (Chen et al., 2020) and digital finance (Yao & Yang, 2022). Our study contributes to the existing research by exploring the impact of SCF on EI. Moreover, we investigate the influence of SCC on EI, distinguishing between SC and CC. This study provides valuable insights into the research content and expands the exploratory scope of the topic. Thirdly, this study provides suggestions for policy-making departments to effectively utilize SCF policies in order to enhance the quality and efficiency of enterprises. The article argues that when enterprises engage in SCF activities, they should prioritize supply chain relationship management to ensure a reasonable concentration of suppliers and customers. For companies lacking innovation capabilities and funds, a high SC can be mitigated by seeking suppliers through multiple channels. However, it is important to note that a lower SC does not necessarily equate to better outcomes. While it can enhance EIP, it may have negative effects in other areas. Therefore, business managers must carefully consider the overall conditions of the business and strive to find an optimal balance point.

2. Literature Review and Hypotheses

2.1. Supply chain finance

Since the global financial crisis erupted in 2008, businesses and their supply chain partners have long been grappling with cash flow shortages, which have become a critical factor constraining their robust development (Jia et al., 2020). Following the financial storm, banks have become increasingly stringent in their qualification reviews for loan applicants, significantly increasing the difficulty for businesses to obtain funds from banks. As a core element of procurement and supply chain management, the importance of cash flow has become increasingly prominent in operational management (Mentzer, 2001). Consequently, short-term financing within the supply chain has gradually become a commonly used financing method for businesses.To effectively address cash flow liquidity issues, various participants in the supply chain actively explore diversified financing avenues, such as utilizing factoring facilities (Kuen-Chor, 1988), trade financing (Al-Najjar and Abed, 2014), and inventory financing (Hofmann, 2009). However, as pointed out by Templar et al. (2012) and Gelsomino et al.

(2016), there is a theoretical gap in current SCF research, resulting in a divide between theory and practice that hinders the progress of SCF research. Given this research gap, an increasing number of scholars in the fields of supply chain and finance have begun to delve deeper into the intrinsic relationship between supply chains and financial services (Liu et al., 2015; Gelsomino et al., 2016; Xu et al., 2018; Caniat et al., 2019; Jia et al., 2020).Caniato et al. (201) emphasize that SCF aims to optimize inter-organizational cash flows through innovative solutions implemented by financial institutions (Camerinelli, 2009) or technology providers (Lamoureux and Evans, 2011). The ultimate goal is to synchronize cash flows with product and information flows within the supply chain, thereby enhancing the efficiency of cash flow management from a holistic supply chain perspective. SCF provides a combination of financial, technological, and management tools aimed at optimizing working capital management and unlocking potential liquidity in supply chain processes and transactions (Caniato et al., 2016).A review of existing literature reveals that various theoretical frameworks have been applied to SCF research, including principal-agent theory (Lin and Peng, 2021), bargaining power theory (Chen et al., 2019), resource dependency theory (Dekkers et al., 2020), system theory (Wetzel and Hofmann, 2019), transaction cost theory (Schmidt and Wagner, 2019), pecking order theory of financing (Kouvelis and Zhao, 2018), innovation process theory (Du et al., 2020), and task interdependence theory (Wuttke et al., 2013). Among these theories, resource dependency theory and principal-agent theory are particularly widely used (Jia et al., 2020).A review of SCF definitions reveals that inter-organizational collaboration plays a crucial role in mitigating SCF risks. It facilitates effective information exchange and enhances connections among various entities, thereby contributing to risk reduction (Fischer and Himme, 2017). Furthermore, inter-organizational collaboration facilitates customers' access to SCF services, addresses operational capital constraints, and enables more resilient supply chain operations (Sugirin, 2009).

2.2. Enterprise innovation performance

From the available literature, it can be observed that two commonly used terms in describing EIP are innovative technological performance and innovative outcomes. The former mainly focuses on measuring the efficiency and effectiveness of enterprise innovation, as emphasized by scholars such as Irwin (1998), Choi and Valikangas (2001), and Hagedoorn and Cloodt (2003). On the other hand, the latter places more emphasis on the generation and transformation of innovative outcomes, as discussed by Gemunden et al. (1996) and Ritter et al. (2003). Undoubtedly, innovation is the core of innovation performance, and innovation performance is the fruit borne by innovative activities. Naturally, when delving into the study of EIP, one should start from the enterprise's innovative activities.According to the resource-based theory, both tangible and intangible assets owned by enterprises in the fierce market competition, such as knowledge and technology, play a pivotal role. These heterogeneous resources are particularly valuable due to their technical complexity, high acquisition costs, and difficulty in substitution and imitation (Yu et al., 2016). For enterprises, innovation is undoubtedly a crucial path to acquiring these valuable heterogeneous resources. However, innovative activities themselves are characterized by high investment and long cycles, which often lead to resource constraints during the innovation process, resulting in innovation path dependencies and constraints on innovation outputs.In recent years, the innovation environment has undergone tremendous changes, profoundly affecting enterprises' innovation strategic decisions and implementation. Heyden, Sidhu, and Volberda (2018) pointed out that the formulation and implementation of enterprise innovation strategies are closely related to the external environment faced by top management. Furthermore, the research by Hemmert et al. (2022) revealed a close relationship between top management and innovation performance, emphasizing the impact of heterogeneity within the top management team on EIP.As the formulators and promoters of innovation strategies, the top management of enterprises plays an irreplaceable role in driving innovation efforts and enhancing innovation outputs. The Upper Echelons Theory also indicates that the individual characteristics of top management team members profoundly influence strategic decisions. These characteristics, such as age, gender, experience, and tenure, are closely linked to their cognition and capabilities, further significantly impacting EIP (Zhang et al., 2023).The resource dependency theory further suggests that the survival of enterprises is closely intertwined with the external environment. In this process, the individual backgrounds of top management team members serve as crucial bridges for information communication, external resource acquisition, and support between the enterprise and the external environment (Stam and Elfring, 2008).Research on innovation management further reveals that the interaction between top management (an internal core factor) and external institutional pressures (an external environment) has a profound impact on EIP (Nureen et al., 2023). In existing research, the external environment is often defined from the perspective of industry characteristics, encompassing various aspects such as social, economic, technological, competitive, cultural, and political systems (Wu et al., 2022). When formulating innovation strategies, enterprises inevitably face various external environmental pressures, such as imitation pressure from competitors, coercion pressure from customers and suppliers, and normative pressure from industry associations (Hambrick and Mason, 1984). The complexity of the external environment, shaped by the varying levels of these institutional pressures, poses new challenges and requirements for enterprise innovation (Zhang et al., 2023).Meanwhile, digital technology is profoundly transforming the techno-economic paradigm and the organizational forms of enterprises, injecting new momentum into enterprise innovation. With the widespread application of digital technology, digital transformation has become a new path for enterprise innovation. Peng and Tao (2022) argue that digital transformation has a significant positive impact on enterprise innovation, with mechanisms including promoting supply chain collaboration, activating knowledge fields, driving binary learning, strengthening R&D collaboration, reducing innovation costs, enabling human capital, and generating learning and competitive effects. As an important technological innovation, digital technology is constantly enriching its connotation. Through deep integration with modern industries and inter-industry integration supported by digital technology, it is triggering digital transformations in product forms, innovation subjects, innovation processes, and innovation organizations. Wu et al. (2020) found in their classified study of enterprise innovation practices that data analysis and

application are particularly beneficial for process innovation and innovation achieved through diversified reorganization, indirectly confirming the complementary role of digital technology with other types of innovation.

2.3. Supply chain concentration

There is a consensus in the academic community on the understanding of SCC, which refers to the number of upstream suppliers that a enterprise relies on in the supply chain and the number of customers that it targets for selling goods or services (Chae et al., 2017; Jääskeläinen, 2021; Gu et al., 2022). In simple terms, a high level of SCC implies a relatively small number of suppliers (customers) with whom the enterprise establishes transactional partnerships, and the procurement of raw materials and sales of goods are primarily concentrated among a few suppliers and customers. Notably, Jääskeläinen (2021) further divides SCC into two dimensions: supplier concentration and customer concentration, providing a more nuanced perspective for observation. According to the resource dependency theory, different enterprises possess unique and heterogeneous resources that are often scarce and difficult to imitate. No enterprise can independently possess all the innovative elements, thus knowledge exchange and resource interchange with external parties become necessary avenues for enterprises to acquire innovative elements. In this process, suppliers and customers in the supply chain, who possess resources complementary to the enterprise, naturally become the main targets for the enterprise to seek innovative resources. Open innovation has become a critical pathway for enterprises to access diverse innovative resources and compensate for their knowledge gaps. Searching for and integrating knowledge from partners in the innovation chain, as well as seeking R&D collaborations, have become effective means to enhance a enterprises' innovative capabilities (Teece, 2013; Hannigan et al., 2015).R&D collaborations not only facilitate knowledge transfer, especially the integration of tacit knowledge, among supply chain partners but also effectively promote innovative development within enterprises (Husted and Michailova, 2010). Suppliers, as an indispensable part of the supply chain, provide enterprises with raw materials and other inputs, helping them optimize production processes, enhance production efficiency, and improve product quality (Un and Asakawa, 2015). Through the establishment of long-term and mutually dependent relationships, the personnel cooperation and interaction between suppliers and enterprises become increasingly close, facilitating knowledge transfer across organizational boundaries and thus driving the innovation process (Squire et al., 2009).Furthermore, customers are also significant sources of innovation for enterprises. They can not only bring new product or service ideas that meet their needs (Mahr et al., 2014) but also their ideas are often unconstrained by corporate culture, helping enterprises break conventions and achieve innovation (Poetz and Schreier, 2012). Customers are often willing to share their ideas with enterprises and expect them to invest resources and technology to produce new products or services that meet their needs (Franke and Schreier, 2010).In summary, SCC profoundly affects the willingness of supply chain partners to share knowledge and information, thereby influencing a enterprises' innovative capabilities and market competitiveness. Therefore, enterprises should attach great importance to managing SCC, optimizing the structure of their supply chain, and enhancing the level of knowledge sharing and information exchange among supply chain partners to drive continuous innovation and development.

2.4. Supply chain finance and Enterprise innovation performance

Innovation is a long-term, high-risk investment that often faces financing constraints (Hall, 2002). Zhu and Yang(2019) conducted a study using data from GEM listed companies between 2013 and 2015. They found that SCF can help alleviate the financing constraints encountered by GEM listed companies. Enterprises are embedded in the supply chain network, creating an industrial ecosystem where they engage in close and stable long-term economic cooperation. Through transactions and SCF, these enterprises establish alliances of interests, forming strong connections and trust relationships among supply chain enterprises. Transaction relationship and trust relationship embedding actively promotes EI (Tigre, 2009). Houessou et al.(2023) found that micro proximity between enterprises has a positive impact on external tacit knowledge acquisition and incremental innovation capacity. The closer the geographical location of enterprises, the stronger the transaction relationship between enterprises. Strong ties within the supply chain are often associated with incremental innovation(Nguye et al. (2022). The stability of supply chain relationships provides a platform for frequent interactions and sophisticated knowledge sharing among supply chain participants, thereby promoting incremental innovation by enterprises. SCF is a financial service that relies on supply chain relationships to accelerate the flow of funds and information between business partners in the supply chain (Fathollah and Zargar, 2019). Additionally, SCF enables timely tracking of customer needs, which compels enterprises to promptly address problems encountered in the innovation process. This helps alleviate information asymmetry, enhance supply chain innovation output, and ultimately achieve innovation synergy. As a result, the innovation capabilities and motivation of enterprises are enhanced. When the supply chain relationship formed by 'supplier-seller-customer' is stable, enterprises do not need to invest excessive time and money in developing new customers or suppliers. The stability of supply chain relationships allows companies to establish a flexible response mechanism, reducing the costs associated with external changes (Hsu et al., 2018). This enables enterprises to allocate more resources towards innovation.

Based on the aforementioned analysis, we propose the following hypothesis:

Hypothesis 1 (H1). Supply chain finance has a positive impact on enterprise innovation performance.

2.5. Supply chain finance and Supply chain concentration

The sharing of knowledge and information between enterprises and suppliers is crucial for successful innovation (Jaca et al., 2016). Low SC means that the enterprise deals with a large number of upstream suppliers, reducing the impact of a single supplier on the enterprise. This also lowers the cost for enterprises to switch suppliers. By working with numerous suppliers, enterprises can access a wider range of new knowledge and information, facilitating innovative activities and improving

innovation performance. On the other hand, higher SC strengthens the bargaining power of suppliers on raw materials. Suppliers will first consider their own profits and then increase the price of raw materials, which will lead to higher procurement costs for enterprises. Additionally, the increased bargaining power may require companies to provide more commercial credit, leading to insufficient corporate funds and hindering the role of SCF in promoting EI.

Downstream customers play a crucial role in connecting enterprises with end consumers, holding a significant position in the strategic innovation framework. Pan et al. (2020) discovered that excessive customer concentration can hinder corporate technological advancement. Conversely, Krolikowski et al. (2017) found that a strong bond between enterprises and customers can lead to high switching costs, ultimately incentivizing enterprises to boost their innovation investments. However, their study also reveals that a close relationship between enterprises and customers leads to higher switching costs, which in turn encourages enterprises to invest more in innovation. A higher level of customer concentration leads to a stronger relationship between the enterprise and its customers, resulting in lower costs for maintaining customer relationships. This allows customers to consistently purchase goods directly from the enterprise, leading to an increased inventory turnover rate and higher profit margins for the enterprise to invest in innovation. Technological innovation is primarily driven by customer demands (Edler, 2010), and enterprises gather innovative ideas through information transmission from downstream customers. By designing new products that align with customer needs, enterprises can better satisfy their customers. When downstream customers are highly concentrated, the transmission of customers demand information becomes more timely and accurate, enabling companies to have a better understanding of new innovative ideas and a stronger motivation for innovation (Hou et al., 2021).

Based on the aforementioned analysis, we propose the following hypothesis:

Hypothesis 2 a(H2a). Supply chain finance has a negative impact on supplier concentration.

Hypothesis 2 b(H2b). Supply chain finance has a positive impact on customer concentration.

2.6. Supply chain concentration and Enterprise innovation performance

The higher the SC , the stronger the ability for suppliers to transfer risk to the enterprise, resulting in higher risks faced by the enterprise. Additionally, the decrease in accounts payable from suppliers and the obstruction of external financing can hinder the positive impact of SCF on EI. Nakasumi(2017)suggests that an increase in SC has a ripple effect. Switching suppliers can lead to higher transaction costs and the potential leakage of valuable technical knowledge and trade secrets, resulting in greater economic losses. Furthermore, a higher SC reduces the number of knowledge and technology sources available to enterprises, putting pressure on their technological innovation and development capabilities. Therefore, the high SC will cause enterprises to expose more cash, thus putting pressure on EI.

Downstream customers play a crucial role in providing corporate product ideas, market information, and valuable resources. When CC is high, both parties involved in the transaction allocate their resources in a concentrated manner, resulting in more specific assets. This means that enterprises need to make significant 'specific investments' to maintain contractual relationships with each other. However, if these investments are repurposed, their value greatly diminishes. Consequently, enterprises may find themselves trapped by their large customers(Titman,1984; Williamson,1979). Moreover, high CC increases customer bargaining power. Customers, driven by their own interests, tend to monopolize the benefits derived from these special investments. Due to imperfect contracts, it becomes challenging to effectively constrain customers' actions(Choi et al.,2024). In addition, customers may leverage their power to pressure enterprises into making concessions on sales prices, extending payment collection time, and providing more commercial credit. These actions undoubtedly strain EI funds and intensify enterprise financing constraints(Huang et al. ,2016). Customers will demand lower prices for the enterprise's products in their own interests, leading companies to lower product prices and reduce enterprise profits. In the global competitive landscape, enterprises must innovate and develop continuously, strategically leveraging existing resources to build core capabilities and competitive advantages (Fitriatia et al. ,2020). By examining the enterprise's profits and product structure from an internal perspective, it is evident that reduced enterprise profits can hinder EI capabilities.

Based on the aforementioned analysis, we propose the following hypothesis:

Hypothesis 3 a(H3a). supplier concentration has a negative impact on enterprise innovation performance.

Hypothesis 3 b(H3b). customer concentration has a negative impact on enterprise innovation performance.

2.7.Mediating Role of Supply chain concentration

The supply chain is an organized network that gathers raw materials and oversees the entire product manufacturing process (Crook and Combs, 2007). Supply chain management plays a crucial role in reducing costs, improving quality, and fostering innovation by effectively integrating the business processes of its members (Mabert and Venkataramanan, 2003). Within the supply chain, there are numerous suppliers, and a higher supplier diversity leads to a greater variety of resources available to the enterprise. Supplier diversity resources contribute to enhancing product quality, reducing product development cycles, acquiring new knowledge, and generating innovative solutions for product or process development. However, suppliers, driven by their own interests and the desire to maintain stability, may not support high-risk innovation projects. Consequently, suppliers can impede the ongoing innovation and growth of businesses to some extent. Particularly for firms with a high concentration of suppliers, to uphold a strong collaborative bond with key suppliers, these firms often voluntarily promise the largest suppliers to decrease investment in innovation funds to guarantee stable supply chains and partnerships. Nevertheless, these commitments and actions will inevitably result in a decline in the company's innovation investments, subsequently having an adverse effect on the company's innovation performance and constraining its long-term development drive and competitiveness.

Customers not only drive enterprise product demand but also hold valuable market information. The increasing customer concentration in the supply chain ecosystem has become a crucial factor in corporate development. Supply chain integration enhances information exchange between enterprises and customers, ensuring a stable customer base and expanding revenue sources. This, in turn, provides a consistent cash flow for enterprises. Moreover, innovation activities often require significant capital, leading to financial challenges. SCF offers capital support for innovation investments, aiding enterprises in overcoming financial hurdles. Customer satisfaction and profits are key funding sources for enterprises. High customer concentration allows banks to assess corporate operations comprehensively, reducing information asymmetry and facilitating access to innovative lending. This advantage boosts enterprises' innovation capabilities, market competitiveness, and overall growth.

Hypothesis 4 Supplier concentration mediates between supply chain finance and enterprise innovation performance.

Hypothesis 5 Customer concentration mediates between supply chain finance and enterprise innovation performance.

Based on the above assumptions, the following conceptual model (Figure 1) has been established.

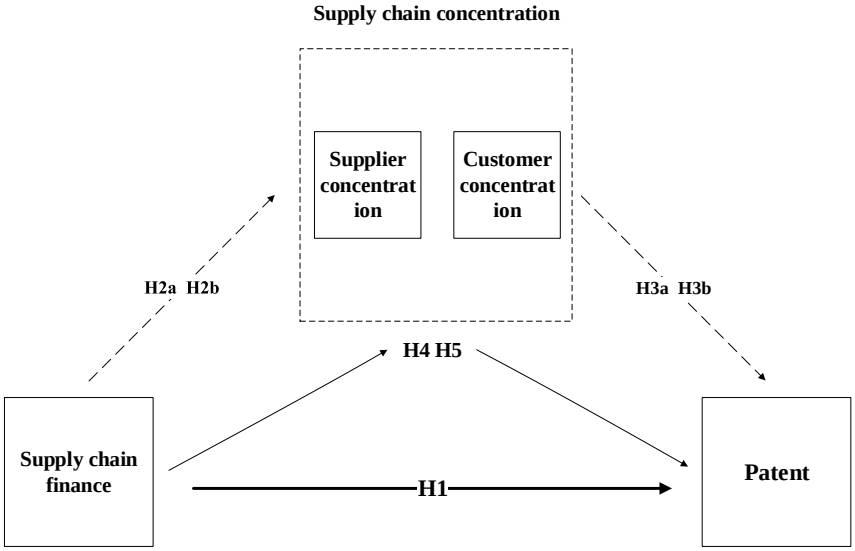

Figure 1. Conceptual model.

3. Methods

3.1. Sample Source and Data Selection

This study meticulously selected A-share listed companies in Shanghai and Shenzhen, China, from 2011 to 2020 as the initial research sample. The choice of 2011 as the starting point of the sample period was informed by multiple considerations. Firstly, in December 2007, the China Securities Regulatory Commission issued the "Content and Format Guidelines for Information Disclosure of Publicly Issued Securities Companies - No. 2 Annual Report Content and Format", explicitly requiring listed companies to disclose information on their major suppliers and customers, including the proportion of procurement amounts from the top five suppliers to the annual total procurement amount and the proportion of sales amounts from the top five customers to the company's total sales. This regulation prompted listed companies to gradually disclose information on suppliers and customers, providing ample data sources for this study. Secondly, in 2005, Shenzhen Development Bank, as the first bank in China, introduced the country's first SCF solution. This solution replaced traditional real estate assets with receivables and payables as collateral for loan issuance (Li and Hu, 2017). Subsequently, more and more banks began to launch different types of SCF businesses, and listed companies gradually joined this financial system. Considering that the development of SCF business required a certain amount of time, this study assumes that the number of listed companies engaging in SCF business had significantly increased by 2011, five years later. Lastly, in December 2020, China experienced the outbreak of the COVID-19 pandemic. Subsequently, in 2021, the Chinese government implemented strict lockdown measures to contain the spread of the virus. These consecutive pandemic and policy measures had profound impacts on the operations of Chinese enterprises in 2021, with many companies experiencing severe operational disruptions. Therefore, to ensure the accuracy and reliability of the study, we chose 2020 data as the endpoint of our research. In summary, based on data from 2011 to 2020, this study delves into the situation of EIP among A-share listed companies in Shanghai and Shenzhen against the backdrop of SCF. It aims to provide valuable references for research and practice in the fields of SCF and EIP.This study excluded certain companies from the initial sample based on the following criteria: (1) Enterprises facing financial difficulties, special transfer (PT), or those classified as special treatment (ST or *ST) by the China Securities Regulatory Commission, with no signs of financial improvement in the year following ST classification; (2) Financial, insurance, securities, public utilities, and social service enterprises due to variations in accounting systems; (3) AB-share or AH-share cross-listed companies; (4) Samples with missing financial data; (5) Samples with missing or discontinuous disclosures of customer and supplier information. (6) To account for potential outliers, all continuous variables were winsorized at the top and bottom 1% levels. The final sample used in this study consisted of 23,077 firm-year observations from 4,021 enterprises.

3.2. Measurement of variables

SCF is the study's independent variable, while EIP which is determined by how many new patents are invented by enterprises is the dependent variable. Firm Size, profitability, firm nature and so on are the control variable . Table 1 provides details on the measurement of these variables.

Table 1: Variables and definition.

Variable Types	Variable name	Variable symbol	Definition
Dependent variable	Enterprises innovation performance	Patent	Enterprises innovation performance mainly refers to the input and output results of enterprises in terms of new technology R&D investment Following Ren et al.(2015)that measures EIP, we use the value of In(design patents+ utility model patents+ invention patents+1).
Independent variable	Supply chain finance	SCF	SCF is a collaborative and innovative business model that provides credit and services to businesses. It converts non-current assets into cash without incurring additional liabilities. Following Wu et al. (2022) that measures SCF, we use the value of In(account payables + notes payables + mortgage loan) .
Intervening Variable	Supplier concentration	SS	Supplier concentration refers to the concentration of supplier s' supplying shares on the side of the enterprise. Following Yang (2017) that measures SC，we use the ratio of top five suppliers purchase amount to total purchase amount.
	Customer concentration	CC	Customer concentration refers to the concentration of customers' purchasing shares on the side of the enterprise. Following Yang (2017) that measures CC，we use the ratio of top five customers payment amount to total payment amount.
Control variables	Firm Size	Size	Total assets' natural logarithm at the conclusion of the time period.
	Firm nature	Soe	Firm nature represents who holds more enterprise shares. If the enterprise is state-owned enterprises, the value is 1, otherwise it is 0 (Ruiqi et al., 2017).
	Return on total assets	Roa	Ratio of earnings before interest and tax to average total assets.
	Whether the chairman and the general manager are the same person	Dual	Dual indicates whether the chairman and the general manager are the same person. If the CEO concurrently serves in that year, the value is 1; otherwise, it is 0.
	Asset-liability ratio	Dta	Asset-liability ratio is used to measure the proportion between the assets and liabilities of a business or individual. Ratio of total debt to total assets.
	Stock market listing time	Age	the number of years since the firm went public's natural logarithm.
	TobinQ	TobinQ	Tobin's Q defined as the ratio of the market value of a firm to the replacement cost of its assets, is a good measure of a firm's longterm performance (Jose et al. 1996).
	Ownership concentration	Topl	Ratio of the number of first stockholder strands to total number of strands.
	Sales growth rate	Growth	Sales growth rate is the rate of increase in operating income this year over the previous year. Ratio of the current year's sales revenue to the total sales revenue of the previous year.
	Industry	Industry	It was used to control the effects of time.
	Year	Year	It was based on the 2012 China Securities Regulatory Commission (CSRC) industry classification codes (first digit).

Source: Author's Own.

3.3. Model specification

To explore the effect of SCC on SCF and EIP , we constructed models 1 to 7, of which models 2 to models 3 test Hypothesis 2a to Hypothesis 2b,and models 4 to models 5 test Hypothesis 3a to Hypothesis 3b.

$$Patent = \alpha_0 + \alpha_1 Scf_{i,\ t} + \alpha_2 Controls_{i,t} + Industry\ + Year\ + \varepsilon_{i,t} \quad (1)$$

$$SC = \beta_0 + \beta_1 Scf_{i,\ t} + \beta_2 Controls_{i,t} + Industry + Year\ + \varepsilon_{i,t} \quad (2)$$

$$CC = \beta_0 + \beta_1 Scf_{i,\ t} + \beta_2 Controls_{i,t} + Industry\ + Year\ + \varepsilon_{i,t} \quad (3)$$

$$Patent = c_0 + c_1 SC_{i,\ t} + c_2 Controls_{i,t} + Industry\ + Year\ + \varepsilon_{i,t} \quad (4)$$

$$Patent = c_0 + c_1 CC_{i,\ t} + c_2 Controls_{i,t} + Industry\ + Year + \varepsilon_{i,t} \quad (5)$$

$$Patent = \eta_0 + \eta_1 Scf_{i,\ t} + \eta_2 Sc_{i,t} + \eta_3 Controls_{i,t} + Industry\ + Year\ + \varepsilon_{i,t} \quad (6)$$

$$Patent = \eta_0 + \eta_1 Scf_{i,\ t} + \eta_2 Cc_{i,t} + \eta_3 Controls_{i,t} + Industry\ + Year\ + \varepsilon_{i,t} \quad (7)$$

All variables are described in Section 3.2, Controls represents control variables, Year and Industry are year fixed effects and industry fixed effects, $\alpha_0, \beta_0, c_0, \eta_0$ are constant terms, and $\varepsilon_{i,t}$ represents Errors.

3.4. Data Analysis Method

This study utilized Stata16.0 software to analyze the collected data. The data analysis involved descriptive statistical analysis, correlation analysis, regression equation path analysis, mediation effect test, and robustness test to verify the proposed hypotheses. Following the data analysis, the results are discussed.

4. Results

4.1.Descriptive Statistics

Table 2 shows the number, mean, standard error, minimum and maximum of the variables in our models. The maximum VIF is 1.310, lower than the critical value of 10, indicating that the problem of multicollinearity has been ruled out.

Table 2: Descriptive statistics.

Variables	N	Mean	SD	Min	Max
Patent	23077	2.02	2.237	0.000	11.212
Scf	23077	0.2527	0.172	0.000	1.215
SC	23077	0.3493	0.200	0.003	1.000
CC	23077	0.318	0.225	0.000	1.579
Size	23077	22.15	1.293	17.641	28.636
Soe	23077	0.3085	0.462	0.000	1.000
Roa	23077	0.03309	0.105	-4.946	0.786
Cash	23077	0.0466	0.077	-1.938	0.664
Dual	23077	0.3019	0.459	0.000	1.000
Top1	23077	0.3402	0.148	0.029	0.900
Lev	23077	0.4133	0.210	0.008	3.919
FirmAge	23077	8.754	0.349	6.996	10.696
Growth	23077	6.112	886.097	-1.116	1.35e+05
TobinQ	23077	2.118	2.263	0.674	122.189

Source:Results on Stata 16 software.

4.2.Correlations analysis

The correlation analysis of the sample used in this study is presented in Table 3. It is observed that SCF shows a positive correlation with EIP, while SC exhibits a negative relationship with EIP. This suggests that companies with higher innovative performance tend to have a larger number of suppliers. Additionally, it is worth noting that CC demonstrates a positive relationship with EIP, which can be attributed to the fact that firms with innovative performance have a more concentrated customer base.

Table 3. Correlations Analysis.

Variables	**Patent**	**Scf**	**SC**	**CC**	**Size**	**Soe**	**Roa**
Patent	1						
Scf	0.130***	1					
SC	-0.149***	-0.086***	1				
CC	0.033***	0.070***	0.277***	1			
Size	0.00700	0.00600	-0.209***	-0.169***	1		
Soe	-0.122***	-0.069***	-0.037***	-0.00800	0.360***	1	
Roa	0.071***	-0.178***	-0.033***	-0.048***	0.021***	-0.037***	1
Cash	0.047***	-0.241***	-0.040***	-0.068***	0.054***	-0.00900	0.319***
Dual	0.057***	0.022***	0.028***	0.017**	-0.186***	-0.294***	0.028***
Top1	-0.035***	-0.097***	-0.026***	0.00300	0.170***	0.205***	0.121***
Lev	-0.072***	0.448***	-0.114***	-0.062***	0.499***	0.270***	-0.341***
FirmAge	-0.090***	-0.038***	0.00200	-0.036***	0.180***	0.210***	-0.071***
Growth	-0.00600	-0.00400	-0.00800	0.00100	-0.00400	0.0100	0.00100
TobinQ	-0.024***	-0.074***	0.125***	0.082***	-0.304***	-0.088***	-0.028***
Varname	Cash	Dual	Top1	Lev	FirmAge	Growth	TobinQ
Cash	1						
Dual	0	1					
Top1	0.094***	-0.040***	1				
Lev	-0.170***	-0.129***	0.037***	1			
FirmAge	0.00900	-0.110***	-0.080***	0.175***	1		
Growth	0	-0.00400	0.00800	0.00600	0.00300	1	
TobinQ	-0.00200	0.050***	-0.086***	-0.114***	0.00600	-0.00200	1

Note:∗ Statistical significance at the 0.05 level. ∗∗ Statistical significance at the 0.01 level. ∗∗∗ Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

4.3.Structural Model Regression

Since our dependent variable is a continuous variable, we used ordinary least squares(OLS) regression to analyze the impact of SCF on EIP and the mediating effects of SC and CC. Table 4 presents the regression results for hypotheses 1-5. In column (1), the coefficient of the first independent variable SCF is positive and significant (0.782, t-value=0.106), indicating that enterprises' SCF has a substantial positive impact on enterprise innovation performance, thus supporting Hypothesis 1. In column (2), the coefficient of the independent variable SCF is negative and significant (-0.029, t-value= 0.010), suggesting that SCF decreases a company's customer concentration, providing support for Hypothesis 2a. In column (3), the coefficient of SCF is positive and significant (0.065, t-value = 0.01), indicating that SCF has a positive impact on customer concentration, hence supporting Hypothesis 2b. In column (4), the coefficient of SC is negative and significant (-0.882, t-value = 0.073), demonstrating that supplier concentration has an adverse effect on EIP, supporting Hypothesis 3a. In column (5), the coefficient of CC is negative and significant (-0.190, t-value=0.067), revealing that customer concentration also has a negative impact on EIP. Therefore, Hypothesis 3b was also supported.

Table 4: Results of hypotheses 1–5.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Model 1	Model 2	Model 3	Model 4	Model 5
	Patent	SC	CC	Patent	Patent
Scf	0.782***	-0.029***	0.065***		
	(0.106)	(0.010)	(0.010)		
SC				-0.882***	

				(0.073)	
CC					-0.190***
					(0.067)
Size	0.258***	-0.043***	-0.041***	0.201***	0.230***
	(0.014)	(0.001)	(0.001)	(0.014)	(0.014)
Soe	-0.076**	-0.008**	0.014***	-0.102***	-0.093***
	(0.034)	(0.003)	(0.003)	(0.034)	(0.034)
Roa	0.488***	-0.026**	-0.014	0.576***	0.602***
	(0.144)	(0.013)	(0.014)	(0.143)	(0.144)
Cash	1.050***	-0.120***	-0.157***	0.689***	0.752***
	(0.189)	(0.017)	(0.019)	(0.186)	(0.186)
Dual	0.050*	0.005*	-0.001	0.054*	0.050*
	(0.030)	(0.003)	(0.003)	(0.030)	(0.030)
Top1	-0.048	-0.012	0.051***	-0.078	-0.059
	(0.095)	(0.009)	(0.009)	(0.094)	(0.095)
Lev	-0.871***	-0.044***	-0.033***	-0.506***	-0.453***
	(0.101)	(0.009)	(0.010)	(0.083)	(0.083)
Firm Age	-0.490***	-0.003	-0.014***	-0.503***	-0.504***
	(0.043)	(0.004)	(0.004)	(0.043)	(0.043)
Growth	0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TobinQ	-0.004	0.006***	0.004***	-0.004	-0.009
	(0.006)	(0.001)	(0.001)	(0.006)	(0.006)
_cons	-0.521	1.281***	1.217***	1.100**	0.227
	(0.511)	(0.046)	(0.050)	(0.514)	(0.514)
N	23077.000	23077.000	23077.000	23077.000	23077.000
r2	0.235	0.219	0.271	0.238	0.234
r2_a	0.232	0.216	0.268	0.235	0.230
industry	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes

Note:* Statistical significance at the 0.05 level. ** Statistical significance at the 0.01 level. *** Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

We introduced SC and CC into Model 1, resulting in Model 6 and Model 7. Our objective was to investigate the impact of SCF on EIP in supply chain relationships. The regression results for Hypothesis 6 and Hypothesis 7 are presented in Table 5. In Column (1), we analyze the regression results for both SCF and SC on EIP. The coefficient for the independent variable SCF is positive and significant (0.757, t-value=0.105). Moreover, when compared to Model 1 without considering SC, the coefficient for SCF (0.782) has decreased. This suggests the presence of an indirect transmission channel, whereby SCF influences EIP. Specifically, a portion of the effect of SCF is transmitted through SC, while another portion affects EIP. Moving on to Column (2), we examine the regression results when considering the impact of SCF and CC on EIP simultaneously. Once again, the coefficient for the independent variable SCF is positive and significant (0.796, t-value=0.106), matching the coefficient for SCF in Model 1 without considering CC (0.782). This indicates the existence of an indirect transmission channel through which SCF affects EIP via CC. Similar to the previous case, a portion of the effect of SCF is transmitted through CC, while another portion influences EIP.

Table 5: Results of hypotheses 6–7.

Variables	**(1)**	**(2)**
	Model 6	Model 7
	Patent	Patent
Scf	0.757***	0.796***
	(0.105)	(0.106)
SC	-0.871***	
	(0.073)	
CC		-0.211***
		(0.067)
Size	0.221***	0.249***
	(0.014)	(0.014)
Soe	-0.083**	-0.073**
	(0.034)	(0.034)
Roa	0.465***	0.485***
	(0.144)	(0.144)
Cash	0.945***	1.017***
	(0.189)	(0.190)
Dual	0.054*	0.050*
	(0.030)	(0.030)
Top1	-0.058	-0.037
	(0.094)	(0.095)
Lev	-0.909***	-0.878***
	(0.100)	(0.101)
FirmAge	-0.493***	-0.493***
	(0.043)	(0.043)
Growth	0.000	0.000
	(0.000)	(0.000)
TobinQ	0.001	-0.003
	(0.006)	(0.006)
_cons	0.594	-0.264
	(0.518)	(0.518)
N	23077.000	23077.000
r2	0.240	0.235
r2_a	0.237	0.232
industry	Yes	Yes
year	Yes	Yes

Note:∗ Statistical significance at the 0.05 level. ∗∗ Statistical significance at the 0.01 level. ∗∗∗ Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

4.4.Intermediate effect test

The test analysis demonstrates that SCF enhances EIP by reducing SC and CC. To examine these mechanisms, two combinations were constructed based on previous research (Wen and Ye, 2014). The first combination includes model 1,

model 2, and model 6, while the second combination consists of model 1, model 3, and model 7. The regression results can be found in Table 6 and Table 7.

Table 6 demonstrates that SCF has a positive influence on EIP. Even with the inclusion of SC, SCF continues to have a positive impact on EIP regression. However, SC exhibits a negative effect (p<0.001, β=-0.871). Notably, there exists a noteworthy negative correlation between SC's mediating effect on SCF and EIP. This finding supports the hypothesis H4, indicating that SC indeed acts as a significant mediator between SCF and EIP.

Table 6: Mediation Effect Tests- supplier concentration.

Variables	**(1) Model1**	**(2) Model2**	**(3) Model6**
	Patent	SC	Patent
Scf	0.782***	-0.029***	0.757***
	(0.106)	(0.010)	(0.105)
SC			-0.871***
			(0.073)
Size	0.258***	-0.043***	0.221***
	(0.014)	(0.001)	(0.014)
Soe	-0.076**	-0.008**	-0.083**
	(0.034)	(0.003)	(0.034)
Roa	0.488***	-0.026**	0.465***
	(0.144)	(0.013)	(0.144)
Cash	1.050***	-0.120***	0.945***
	(0.189)	(0.017)	(0.189)
Dual	0.050*	0.005*	0.054*
	(0.030)	(0.003)	(0.030)
Top1	-0.048	-0.012	-0.058
	(0.095)	(0.009)	(0.094)
Lev	-0.871***	-0.044***	-0.909***
	(0.101)	(0.009)	(0.100)
FirmAge	-0.490***	-0.003	-0.493***
	(0.043)	(0.004)	(0.043)
Growth	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)
TobinQ	-0.004	0.006***	0.001
	(0.006)	(0.001)	(0.006)
_cons	-0.521	1.281***	0.594
	(0.511)	(0.046)	(0.518)
N	23077.000	23077.000	23077.000
r2	0.235	0.219	0.240
r2_a	0.232	0.216	0.237
industry	Yes	Yes	Yes
year	Yes	Yes	Yes

Note:* Statistical significance at the 0.05 level. ** Statistical significance at the 0.01 level. *** Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

Table 7 demonstrates that SCF has a positive influence on EIP. Even when CC is introduced, SCF continues to have a positive impact on EIP regression. However, CC exhibits a negative relationship ($p<0.001$, $\beta=-0.211$). Furthermore, SC displays a significant negative correlation in the mediating effect between SCF and EIP, indicating that the mediating effect of CC between SCF and EIP is indeed significant. Hence, H5 is supported.

Table 7: Mediation Effect Tests- customer concentration.

Variables	**(1) Model1**	**(2) Model3**	**(3) Model7**
Scf	0.782***	0.065***	0.796***
	(0.106)	(0.010)	(0.106)
CC			-0.211***
			(0.067)
Size	0.258***	-0.041***	0.249***
	(0.014)	(0.001)	(0.014)
Soe	-0.076**	0.014***	-0.073**
	(0.034)	(0.003)	(0.034)
Roa	0.488***	-0.014	0.485***
	(0.144)	(0.014)	(0.144)
Cash	1.050***	-0.157***	1.017***
	(0.189)	(0.019)	(0.190)
Dual	0.050*	-0.001	0.050*
	(0.030)	(0.003)	(0.030)
Top1	-0.048	0.051***	-0.037
	(0.095)	(0.009)	(0.095)
Lev	-0.871***	-0.033***	-0.878***
	(0.101)	(0.010)	(0.101)
FirmAge	-0.490***	-0.014***	-0.493***
	(0.043)	(0.004)	(0.043)
Growth	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
TobinQ	-0.004	0.004***	-0.003
	(0.006)	(0.001)	(0.006)
Size		0.000	
		(.)	
_cons	-0.521	1.217***	-0.264
	(0.511)	(0.050)	(0.518)
N	23077.000	23077.000	23077.000
r2	0.235	0.271	0.235
r2_a	0.232	0.268	0.232
industry	Yes	Yes	Yes
year	Yes	Yes	Yes

Note:∗ Statistical significance at the 0.05 level. ∗∗ Statistical significance at the 0.01 level. ∗∗∗ Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

After conducting 500 iterations using the Bootstrap method, the results in Table 5 indicate that both SC and CC have a statistically significant positive influence on EIP (P<0.001, β=2.708, β=2.835). This suggests that in the context of this study, both SC and CC have a substantial positive impact on SCF and EIP. Furthermore, the findings also reveal a significant mediating effect on the relationship between SC and EIP. Therefore, the hypotheses H4 and H5 are once again supported.

Table 8: Bootstrap mediating effect test results.

	Suppliers Concentration	**Customers Concentration**
	(1)	**(2)**
Indirect effect	0.167***	0.040***
	(0.017)	(0.008)
direct effect	2.708***	2.835***
	(0.100)	(0.098)
Gross effect	2.875	2.875
N	23077	23077

Note:∗ Statistical significance at the 0.05 level. ∗∗ Statistical significance at the 0.01 level. ∗∗∗ Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

4.5.Robustness tests

The impact of SCF on the EIP can vary depending on the duration of participation. To address potential endogeneity issues that may affect the regression results, we employ the Heckman two-stage regression method (Sdiri et al., 2010) to examine the consistency between SCF and EIP, as hypothesized in Hypothesis 1. The regression results are presented in Table 9, indicating a positive regression coefficient for SCF on EIP, thus supporting the findings of this paper.

Table 9: Heckman two-stage regression method test results.

Variables	**(1)** **The first Stage Probit regress**	**(2)** **The second Stage OLS regress**
	Patent1	Patent1
Scf		0.208***
		(0.024)
Mills		0.773***
		(0.092)
Size	-0.027***	-0.016***
	(0.010)	(0.004)
Soe	-0.035	-0.025***
	(0.024)	(0.008)
Roa	0.647***	0.522***
	(0.114)	(0.056)
Cash	0.289**	0.291***
	(0.136)	(0.046)
Dual	0.054***	0.041***
	(0.021)	(0.007)
Top1	-0.121*	-0.086***
	(0.066)	(0.023)
Lev	-0.458***	-0.478***
	(0.059)	(0.035)
FirmAge	-0.370***	-0.288***
	(0.030)	(0.022)

Growth	-0.003	-0.003***
	(0.003)	(0.001)
TobinQ	-0.047***	-0.036***
	(0.007)	(0.004)
_cons	3.910***	2.809***
N	22903.000	22902.000
r2		0.218
r2_a		0.215
industry	Yes	Yes
year	Yes	Yes

Note:∗ Statistical significance at the 0.05 level. ∗∗ Statistical significance at the 0.01 level. ∗∗∗ Statistical significance at the 0.001 level.Source:Results on Stata 16 software.

5.Discussion

This study demonstrates a positive relationship between SCF and EIP. The findings are consistent with the research (Najafi-Tavani et al.,2022; Lu et al.,2023;Bai et al.,2024). Lu et al. (2023) highlight that SCF plays a crucial role in corporate financing and is particularly relevant for enterprises with strong pioneering and innovative capabilities, such as service innovation, production innovation, and model innovation. These capabilities enable enterprises to identify external borrowers more efficiently and accurately during financing activities. The signaling theory suggests that enterprises, especially those with limited resources like SMEs, should focus on concentrated rather than exaggerated capability signals in their production and operation activities to access SCF services. These findings contribute to the existing body of research.

Second, this study found that SCF has a negative impact on SC, while it has a positive impact on CC. This result aligns with the research (Liu et al.,2021) and differs from the research (Kalwani and Narayandas,1995). The banking sector focuses more on the strategic development of customers and suppliers (Ma et al., 2020), as they are the primary entities responsible for SCF risks. When there is symmetric information, banks minimize their expected loss by increasing loans solely to suppliers. The bank's financing risk is primarily associated with the default rate of its customers (Yan and Sun, 2014). Choosing to provide financing to both suppliers and customers exposes banks to the highest potential loss.

Third, this study examined the impact of supply chain relationships on EIP by analyzing SC and CC separately. Interestingly, it was found that both SC and CC had a negative effect on EIP, indicating that SCC has a dual effect. This finding is consistent with previous research (Zhao et al. ,2008) which showed that trust and commitment between enterprises positively influence the stability of cooperative relationships and innovation performance. The study also suggests that promoting supply chain relationships can enhance innovation performance by reducing transaction costs and opportunistic behaviors, thereby enabling enterprises to acquire more innovative capital. Overall, this study contributes to the existing literature by highlighting the importance of fostering an innovative environment, improving supply chain relationship quality, and enhancing innovation capabilities of enterprises.

In addition, this study also discovered that, in comparison to the negative effects of CC on EIP, SC has a more pronounced direct negative impact on EIP. This study suggests that in the context of supply chain relationships, companies establish strong connections with their upstream suppliers. These connections enable companies to enhance communication and interaction opportunities with each other. Through such communication and interaction, enterprises and suppliers can foster mutual trust and commitment, which in turn significantly contribute to improving the enterprises' internal innovation awareness and capabilities.

Finally, this study confirms the positive influence of SCF on EIP by considering the mediating role of SCC. The study reveals that SC has a negative effect on the association between SCF and EIP, while CC positively moderates the relationship between SCF and EIP, addressing an unresolved aspect in previous EIP research.

6. Conclusion

6.1.Theoretical and practical implications

The findings of this study have significant implications for policy and practice. Firstly, this study contributes to the theoretical significance by confirming that SCF can enhance EIP and expands the existing research on the impact of SCF on corporate economic benefits. Additionally, this study introduces the concept of SCC as a mediating factor between SCF and EIP. While previous research on EIP has primarily focused on intermediary factors such as financing constraints (Fan and Zhou, 2023) and partner diversity (Van Beers and Zand, 2014), few studies have explored the negative impact of SCC from the perspective of supply chain relationships. Therefore, this research offers a unique perspective and enhances the theoretical framework's ability to address practical issues.

Second, this study discovered that SCC acts as an intermediary between the supply chain relationship and the impact of SCF on EIP. SC was found to have a negative moderating role, indicating that when SC is high, SCF inhibits EIP. This is because SCF integrates various resources in the supply chain, and high SC hinders innovation, leading to a disruption in the SCF and

its impact on EIP. On the other hand, CC also plays a negative role in the relationship between SCF and EIP. In the case of low CC, SCF has a significant positive relationship with EIP. This suggests that companies should aim to expand their customer base and reduce dependence on a few large customers. These findings contribute to the understanding of the impact of SCF on EIP within the context of supply chain relationships, addressing a gap in previous research.

Finally, the practical significance of this study lies in its potential for enterprises to develop innovative investments by leveraging their own supply chain resources and combining them with SCF financing services. This approach can lead to a continuous improvement in capital utilization efficiency for enterprises, tailored to the actual needs of users. By utilizing big data and other modern technologies, enterprises can expand their digital SCF business models, enabling all participants in the supply chain to efficiently and conveniently integrate into collective development. This integration helps prevent disruptions in corporate capital chains and enhances the efficiency of financial services provided by financial institutions, ultimately improving the overall efficiency and speed of supply chain operations in related industries. The continuous innovation of SCF services not only accelerates financing but also ensures the smooth operation of enterprises, empowering them to innovate and enhancing their competitiveness in the market.

6.2. Limitation and future research

This study has certain limitations. While SCC plays a partial mediating role in the relationship between SCF and EIP, it is important to note that SCC is not the sole mechanism through which SCF affects enterprise innovation. There are other factors at play. In future research, it would be interesting to explore different factors that could lead to more insightful and beneficial findings for EI. Additionally, this study focuses on enterprise innovation as a general concept, without specific divisions into different types of innovation. Further exploration of different innovation characteristics such as management innovation, ambidextrous innovation, and organizational innovation would be valuable in future research. It is also worth mentioning that this study only analyzed data from China's Shanghai and Shenzhen A-share listed companies , and did not include unlisted companies. While the overall R&D expenditure of listed companies accounts for a significant proportion of Chinese enterprises, it does not cover the full spectrum of company types in China. Future research could explore the impact of different company types, individual factors, and environmental factors such as government on EIP. In summary, this study provides new empirical evidence for the impact of SCC on the relationship between SCF and EIP, contributing to the development of SCF and EI theory.

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