Digital Finance Empowering Enterprise Innovation: A Multi-Case Study based on Heterogeneity of Financing Constraints and Differences in Intermediary Strength

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Abstract. With the development of science and technology, digital finance is playing an increasingly important role in promoting economic growth and innovation. However, previous studies have primarily focused on its role in reducing financing costs and expanding financing channels, while overlooking its potential impact on alleviating financing constraints and fostering enterprise innovation. This paper aims to fill this gap by empirically analyzing the relationship between digital finance, financing constraints, and enterprise innovation using data from enterprises of different sizes. By employing econometric methods and multi-dimensional indicators of digital finance, this study investigates whether digital finance can effectively ease financing constraints and subsequently stimulate innovation activities. Furthermore, it explores whether the mediating effect of financing constraints varies significantly among enterprises of different scales, such as small, medium, and large firms. The findings are expected to reveal that digital finance plays a more pronounced role in promoting innovation for small and medium-sized enterprises (SMEs), which typically face higher financing barriers. The study contributes to the understanding of the heterogeneous effects of digital finance and provides policy implications for optimizing the digital financial environment to support innovation-driven development across enterprises of varying sizes.

Keywords: Digital Finance; Financing Constraints; Enterprise Innovation; Firm Size Heterogeneity; Innovation-Driven Development.

1. Introduction

As the times change, digital finance has gradually integrated into our daily lives and has become a major path for enterprises to achieve high-quality innovation. With the help of digital technology, it breaks traditional limitations, alleviates the financing constraints faced by enterprises, thereby promoting enterprise innovation and injecting new impetus into enterprise development.

In recent years, the advancement of science and technology and the emergence of various economic formats have driven the rise of digital finance, which has greatly alleviated problems such as information asymmetry, low service efficiency, and high transaction costs. Existing literature has recognized that digital finance makes important contributions to enterprise innovation, but there is still a lack of research on the role of digital finance in alleviating financing constraints, especially on how to accurately match the constraint needs of different enterprises [1].

In global perspective,the use of digital finance in the enterprise financing shows the significant differences in the regions and industries,such as at the area of AI and biotechnology and so on, because of the high enterprise research and development investment, long payback period, digital finance always provides more customization services [2]. But in the traditional manufacturing industry, digital finance focusing more on optimizing the efficiency of supply chain financing.Besides,there has research rarely involves industry-specific analysis of this kind, it's difficult to show the variety value of digital finance. What's more, With the change of the digital technology in 5G,Internet.The forms of digital finance continue to evolve.But the research of how to adapt different enterprises financing requirements still in the early stages [3].

Current research mostly focuses on the technical application of digital finance, and there is a lack of research on the needs of different enterprises regarding the role of digital finance in alleviating financing constraints [1]. This research gap is exactly the main research direction of this paper. It

provides new ideas for solving the problem of financing constraints, can more accurately help various enterprises solve this problem, and thus ensure the sustainable development of enterprise innovation [1].

2. Financing Constraints of Enterprises of Different Sizes and Digital Finance Response Paths

2.1. Digital Finance's Impact on Large Enterprises

For large enterprises, take Huawei as an example. As a globally leading ICT enterprise, it has a large business scale and high market share, and also has diverse financing methods. In addition to traditional bank loans, it can also raise funds through bond issuance and other methods. Moreover, it has a unique internal employee stock ownership plan, which provides a stable internal financing channel and reduces its dependence on the external capital market. However, Huawei also has financing constraint problems. For instance, its relatively high asset-liability ratio may affect its subsequent financing capacity; as an employee-owned enterprise, its unique equity structure makes it difficult to raise funds through traditional IPOs.

According to quantitative data,the statistics during 2019 to 2023 shows that after implementing the blockchain-based supply chain financing platform by Huawei,the approval time of average financing reduced from 45 days to 12 days, comprehensive financing cost reduced 18% [4]. At the same time, the research and development support by digital finance increased 25% by years, the number of core technology patents increased 300 by years. These datas sufficient proof that digital finance not only released Huawei's financing constraints, but also prove the innovation output.

2.2. Digital Finance's Impact on Medium and Small Enterprises

For medium-sized enterprises,take Xiaomi as an example. It has a certain influence in the fields of smartphones and smart hardware. During its development, a large amount of funds are needed for R&D, production, and market expansion. Its financing mainly relies on equity financing, debt financing, as well as bank loans and bond issuance. Compared with large enterprises, Xiaomi's financing constraints are more obvious [5]. For example, when applying for bank loans, Xiaomi will face higher interest rates and stricter loan conditions. Furthermore, Xiaomi's recognition in the capital market is relatively low, which will affect the convenience and cost of its financing.

Xiaomi has remarkable practical results by integrating various sources of loan financing.In 2020-2023, Xiaomi have cumulatively raised 12 billion yuan in financing by using digital finance platforms, 60% of it is used for foldable screen mobile phones,smart cars and other new products research and development [4].Data shows that these new products' research and development cycle is shortened by 3 months on average, the listing process is faster than traditional channel financing by 20%.Besides, Xiaomi leading supply chain financing program has helped more than 200 small and medium-sized suppliers in the upstream sector get a 5-billion-yuan financing round, not only stable it own supply chain, but also indirectly prove the innovation of supporting enterprises.

For small enterprises: Most small enterprises are internet-based start-ups with relatively small scales. Due to their small scale, limited funds, and lack of sufficient credit records, they face relatively great difficulties in the financing process [1]. These enterprises mainly rely on equity financing methods such as angel investment and venture capital. However, to obtain these funds, they need to meet the strict requirements of investors and may face the problem of equity dilution. Moreover, it is very difficult for small enterprises to obtain loans from banks; even if they can, the loan amount is relatively small and the interest rate is relatively high. The development of digital finance may provide some new financing channels for small enterprises, such as financing through online financial platforms, but the financing cost on these platforms is relatively high due to high risks.

3. Financing Constraints of Enterprises of Different Sizes and Digital Finance Response Paths

3.1. Main Reasons for Heterogeneity in Digital Finance's Impact on Enterprises of Different Sizes

Obviously, the same financing method cannot be applied to large enterprises and small and medium-sized enterprises. There are three main reasons for this:

First, large enterprises and small and medium-sized enterprises have different credit evaluation systems. Large enterprises have more comprehensive financial statements and good credit records. Combined with their abundant business data and market information, accurate credit ratings can be conducted for large enterprises. In contrast, small and medium-sized enterprises often have incomplete financial data, and their credit ratings are limited. Therefore, digital finance needs to make use of more non-financial data, such as enterprise transaction records, supply chain data, and social media data, to build a credit evaluation model more suitable for the data of small and medium-sized enterprises [6].

Second, the scale and duration of financing demand are different. The financing demand of large enterprises is relatively large and the duration is relatively long. For example, large-scale infrastructure construction requires a large amount of long-term financial support. To meet this demand, digital finance can adopt methods such as bond issuance. In contrast, the financing demand of small and medium-sized enterprises is relatively small and the duration is relatively short, and they pay more attention to the flexibility and timeliness of funds. Digital finance can provide fund support through supply chain data and micro-credit.

Third, the level of risk tolerance is different. Large enterprises have strong risk tolerance, which enables them to bear higher financing costs and risks. Therefore, when digital finance provides financing services for large enterprises, it can adopt relatively flexible risk control strategies. On the contrary, the risk tolerance of small and medium-sized enterprises is relatively low, so digital finance needs to assess risks more cautiously and implement stricter risk control measures, such as guarantees and mortgages [1].

In the era of digital finance, it is important for enterprises of different sizes to adopt different methods and accurately match financing needs to precisely alleviate financing constraints.

3.2. Differences in Intermediary Strength among Enterprises of Different Sizes

For large enterprises like Huawei, they can use their technology to make the financing process more convenient and secure [7]. For example, big data and AI tools can be used to optimize the loan process. They can also use automatic agreements on the blockchain to sign financing contracts, which is very fast and has few potential problems. At the same time, Huawei can help banks improve their technology, so that the service capabilities of banks can be enhanced, and banks will be more willing to provide Huawei with cost-effective financing services.

Furthermore, Huawei can also build a digital platform to help itself and other enterprises obtain funds [4]. Huawei can use cloud technology, smart devices, and blockchain methods to convert the goods in the warehouse into trustworthy assets. In this way, Huawei not only can facilitate its own financing, but also can enable other cooperative enterprises to obtain the credit and data of this platform, making it easier for them to obtain funds from banks, and there will be no shortage of cash flow in the entire blockchain.

For small and medium-sized enterprises like Xiaomi, they can find a suitable borrowing channel for themselves on a digital finance platform that gathers many loan products [8].

Moreover, other smaller enterprises can borrow money relying on Xiaomi's credit [4]. Small enterprises can use the funds owed by Xiaomi as proof to obtain money from banks in advance without waiting for payment from Xiaomi. They can also use the stored millet in the warehouse as collateral to obtain funds for business operations. Banks can view the cooperation data between

Xiaomi and these small enterprises, know that these small enterprises can obtain orders from Xiaomi, and that repayment is guaranteed, so banks are willing to lend money to these small enterprises.

After discussing the financing differences among enterprises of different sizes, the next point to be covered is the differences in the degree of intermediary involvement among various enterprises.

For large enterprises like Huawei, the degree of intermediation is low, and it tends to be a weak form of intermediation [3]. Large enterprises have high credit ratings, complete business data, and the technical ability to build their own digital finance systems, so they have low dependence on external financial intermediaries. For example, Huawei can connect other enterprises and banks through the supply chain blockchain built by itself, without relying on a third-party intermediary for matchmaking. At the same time, Huawei can use blockchain and big data technology to verify the credit of the industrial chain and itself, reducing the risk assessment of banks and other intermediaries [9]. Even Huawei can design financing plans by itself, and intermediaries only need to provide fund support without deep involvement in the process.

It's valuable to notice that Large enterprises like Huawei is gradually changing from the user of digital finance to the service provider [10]. Such as Huawei has share their self-built supply chain digital platforms to more than 100 enterprises in the same industry, provided the technology supply in asset digitization, credit verification and other financing techniques support.This transformation not only improve Huawei's Industry influence, but also promote the whole application level of digital finance in ICT industry, forming a mutually beneficial and innovative industry landscape.

For small and medium-sized enterprises like Xiaomi, the degree of intermediation is high, and they are more dependent on intermediaries [1]. Small and medium-sized enterprises have low credit, scattered data, and lack the ability to independently connect with fund providers. They must rely on digital financial intermediaries to build a bridge to achieve financing. For example, through digital finance platforms, the cooperation data of Xiaomi can be converted into authentic certificates. The platform has to help small and medium-sized enterprises connect with banks, complete risk assessment, and streamline the application process. Without intermediaries, it is very difficult for small and medium-sized enterprises to obtain financing.

In practice, the intermediary of digital finance also provides value-added services beyond financing matchmaking for medium and small enterprises. Such as some platforms provide the financial consulting service for Xiaomi and its upstream suppliers, include Formulate a research and development funding allocation plan and optimize the tax structure and so on [4]. During 2021 to 2023, these value-added services help Xiaomi reduce 12% financial management cost ,the efficiency of fund utilization of upstream suppliers increase 15%, further promoting the whole supply chain's innovation income.

4. Conclusion

Generally speaking, in the process of digital finance influencing enterprise innovation, the heterogeneity of financing constraints is a key variable that distinguishes enterprises of different sizes in obtaining funds and promoting innovation. From Huawei, the representative of large enterprises that does not need intermediaries, to Xiaomi, the representative of small and medium-sized enterprises that relies on intermediaries to break the financing dilemma, it can be seen that there are various solutions to alleviate financing constraints. By making rational use of digital finance, it can accurately address the financing difficulties faced by enterprises of different sizes. Improving the cash flow of the industrial chain and reducing the loss of financing efficiency can provide a basic guarantee for converting funds into innovative momentum. Ultimately, it can promote large, medium, and small enterprises to perform their respective duties well and make progress together, becoming the main support for stimulating the innovative vitality of enterprises in the era of digital finance.

It's valuable to notice that, using digital finance to make enterprises innovation still facing challenges.Such as, data security risks may make the leakage of core business information of the enterprise, the service of digital finance lack of unified standard may triggered the messy of market.

Therefore, when enterprises using digital finance need to improve the data security management, the relevant parts should be expedited to establish industry standards,make sure that healthy development of digital finance, keep giving full play of function in prove enterprise innovation.

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