The effect shipper, carrier, and supervisory management data mining of online freight platforms on the innovation of financing model for Chinese financial institutions

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Abstract.

The application of e-commerce and digitization in the logistics industry has given rise to the emergence of online freight forwarding platforms that connect shippers and carriers for the efficient transportation of goods. Online transactions on the platforms generate a large amount of data, creating opportunities to gain valuable insights through data mining techniques. However, against the backdrop of the Chinese government's accelerated efforts to create a new three-dimensional dynamic logistics landscape of "Internet + Logistics," the traditional financial service models of Chinese financial institutions are struggling to meet the evolving needs of these platforms. This research and innovation project explores the impact of data mining on the operation of online freight transportation platforms and the development of innovative financing models by Chinese financial institutions. A mixed research methodology was used to collect primary data, combining quantitative analysis, qualitative questionnaire analysis, and relevant interviews to collect and analyze the data. By analyzing financial data such as transaction volumes, creditworthiness indicators, and risk factors on these platforms, various data mining algorithms are utilized to mine and predict models. Further evidence is presented to analyze the relationship between shippers, actual carriers, freight platform managers, and financial service innovations that transact through online freight platforms and to propose new types of financing service solutions that can support the growth and sustainability of the logistics industry. These financing models have the potential to increase financial inclusion, reduce credit risk, and facilitate capital flows in the freight industry.

Keywords: data mining, logistics industry, online freight platform, financing model, financial innovation.

1. Introduction

1.1 Background Introduction

The logistics industry plays a pivotal role in the global economy by facilitating the movement of goods and ensuring smooth supply chain operations (Smith, 2020). Traditional logistics processes heavily relied on manual coordination and communication between shippers and carriers, leading to inefficiencies and challenges in securing financing for logistics operations. However, with the advent of online freight platforms, a paradigm shift has occurred in the logistics landscape (Johnson, 2018).

Online freight platforms, also known as digital freight marketplaces, have emerged as innovative solutions that connect shippers and carriers through digital platforms, streamlining the process of matching cargo with available transport capacity (Liu et al., 2019). These platforms leverage advanced technologies, such as cloud computing, big data analytics, and artificial intelligence, to enhance operational efficiency, reduce costs, and improve transparency in the logistics ecosystem (Zhang & Wu, 2020).

In the context of China, which boasts a massive logistics market, the proliferation of online freight platforms has been particularly noteworthy. These platforms have revolutionized freight transactions, enabling shippers to access a vast pool of carriers and negotiate competitive prices, while carriers gain access to a larger customer base (Li & Liang, 2021). As a result, the logistics industry in China has experienced significant transformation, leading to increased competition, operational optimization, and enhanced service quality.
The logistics industry plays a crucial role in facilitating global trade and economic growth. In recent years, the emergence of online freight platforms has transformed the traditional logistics landscape, offering new opportunities for shippers, carriers, and regulators to interact in a digital ecosystem (Dekker et al., 2013). These platforms leverage technology, data analytics, and connectivity to streamline logistics processes, optimize resource utilization, and enhance supply chain visibility.

Simultaneously, Chinese financial institutions have been at the forefront of financial innovation, constantly seeking new models to support the evolving needs of businesses and industries. As the logistics sector undergoes digital transformation, there is a growing need to explore how data mining from online freight platforms can impact the financing models of Chinese financial institutions.

1.2 Statement Problem

The integration of financial services and network freight transportation platforms has brought about significant changes and opportunities for the logistics industry. Network freight platform using Internet means and organizational model innovation, in promoting the transformation and upgrading of the logistics industry, quality and efficiency plays an important role. The annual loan financing demand of China's logistics enterprises exceeds 3 trillion yuan, while the current demand satisfied by financial institutions is less than 10%. In the Internet era, how to implant the financial innovation service model into the online freight this new logistics operation mode, to solve the freight platform upstream and downstream enterprises of the financial needs of the problem, and at the same time for the platform to create a new value of the growth point, has become the direction of the logistics industry and financial institutions concerned about the current.

This study demonstrates the impact on the effectiveness of China's financial institutions through an in-depth analysis of shippers', carriers' and regulators' innovative practices of operations management and data mining on online freight platforms.

1.3 Research Question

1. What are the data elements that influence financial institutions to provide innovative financial services for the online freight platform?

2. How can financial institutions provide innovative financing services for the platform based in the data analysis of the online freight platform?

3. What is the path for financial institutions to explore innovative service solutions for online freight platforms?

1.4 Research Objective

1. To analyse the sources of platform operation-related behavioural data elements needed to influence the effectiveness of innovative financing services for online freight platforms by financial institutions in China.

2. To uncover the value of data elements affecting the effectiveness of the innovative financing services provided by China's financial institutions for online freight transport platforms.

3. To explore the data value credit-enhancing innovation ability enhancement path that affects the effectiveness of China's financial institutions in providing innovative financing services for online freight transport platforms.

1.5 Research Scope

This study aims to explore the impact of online freight transportation platforms on the innovation of financing models at Chinese financial institutions. The research will focus on the role of online freight transportation platform data, data mining, and subsequent innovation by financial institutions. The target population of this study includes Chinese financial institutions that are actively involved in innovating their financing models using online freight platform data. Geographically, this study is limited to China. Given the uniqueness of China's digital and financial landscape, the findings may not be directly applicable to other regions without considering local contextual factors.

1.6 Research Hypothesis

H 1: Online freight platform operation has a positive influence on financial institution effectiveness.

H 2: Online freight platform operation has a positive influence on data mining.

H 3: Online freight platform operation has a positive influence on innovation capacity.

H 4: Data mining has a positive influence on financial institution effectiveness.

H 5: Innovation capacity has a positive influence on financial institution effectiveness.
2 Literature Review

2.1 History of The Online Freight Platform

From the mid-21st century to the present, freight platforms have leveraged emerging technologies such as artificial intelligence, blockchain, and the Internet of Things to provide unprecedented efficiency, transparency, and customer experience. The data mining of shippers, carriers, and regulatory management by these online freight platforms has had a significant impact on the innovation of financing models for financial institutions in China. Understanding the evolution of freight transportation platforms highlights the interdependence between technological advances, industry needs, and financial models. As freight platforms continue to evolve, the strategic role of data mining in shaping financing models within the financial industry will become increasingly important. These developments highlight the importance of continued innovation and adaptation within the industry and the role of financial institutions in facilitating and supporting these changes.

2.2 Theory

2.2.1 Theory of Technological Innovation Systems (TIS)

Technology Innovation Systems (TIS) theory is a framework that explains how innovation systems work. It is derived from the broader systems of innovation (SI) approach, which emphasizes that innovation and technological change are complex systemic processes involving a variety of actors and institutions (Edquist, 1997). In our study, online freight platforms, data mining and innovation can be considered as components of a technological innovation system. Online freight platforms represent technological products, while data mining and innovation represent different functions of the system. Data mining can be regarded as the knowledge development and dissemination function of the technology innovation system. It involves extracting useful insights from the large amounts of data generated by online freight platforms to facilitate the learning and knowledge creation process within the system. Knowledge and insights gained from data mining can influence the direction of search and the formation of new markets (e.g., in transportation information service systems).

2.2.2 Theory of Resource-Based View (RBV)

The resource-based view (RBV) has been widely used in strategic management research. Proposed by Wernerfelt and further developed by Barney, it argues that firms can gain a sustainable competitive advantage and improve performance by utilizing their unique resources and capabilities. Sustainable competitive advantage and improve performance. An online freight transportation platform can be seen as a valuable technological resource. It facilitates interaction between shippers, carriers, and government entities, providing a wealth of data that can be mined and analyzed. This, in turn, enables financial institutions to make better decisions and improve operational efficiency (Bharadwaj, 2000).

Data mining can be viewed as a dynamic capability that enables financial institutions to extract meaningful insights from the vast amount of data generated by online freight platforms. This capability enhances the decision-making process, leading to more accurate risk assessment, efficient resource allocation, and improved financial products and services. According to RBV, these capabilities, if developed and deployed effectively, can provide a competitive advantage to financial institutions and organizations.

2.3 Online Freight Platform

2.3.1 Research Literature of Online Freight Platforms

The convergence of information technology and logistics has given rise to a new field of research that focuses on the impact and application of online freight transportation platforms. In the past few years, several important studies have been conducted in this area, laying the foundation for this research.

Liu et al. (2019) investigated the impact of online freight transportation platforms on the efficiency of the logistics industry in China, providing important insights. The researchers emphasized the transformative role these digital platforms play in improving logistics efficiency. Online platforms primarily act as digital interfaces, creating vital links between shippers, carriers, and government agencies. They facilitate smooth coordination and real-time information sharing, both of which are critical to improving overall logistics performance. By digitizing all relevant parties in the logistics chain, these platforms enable more efficient allocation of freight resources and a faster response to changing market demands. In addition, these platforms can streamline government oversight, increase transparency, and ensure compliance with industry regulations. This study highlights the growing role of digital innovation in shaping the future of logistics and freight management in China.
Wu and Li (2021) promote the wider use of platforms with innovative capabilities in data mining technologies in the financial sector, with a particular emphasis on their potential to improve the performance of financial institutions. At the core of their argument is the unique conceptual model they propose. The model advocates the use of data collected from online freight platforms, which they argue are key to improving the accuracy of credit assessment and risk prediction in the financial sector. They argue that freight data, including transaction history, business relationships, and shipment volumes, has considerable predictive power. If this rich source of information is effectively mined and analyzed, it can greatly facilitate financial decision-making. By incorporating this data into the credit assessment process, financial institutions can gain a more nuanced understanding of a debtor’s reliability, leading to more informed and less risky lending decisions.

In conclusion, online freight platforms are transforming not only logistics and freight management but also have the potential to impact other industries such as finance. They have benefits in terms of efficiency, environmental sustainability, economic growth, and potentially credit risk assessment.

2.3.2 Dimensions of Online Freight Platform

The dimensions of online freight platforms can be conceptualized from different perspectives, each reflecting particular aspects of technology, innovation, financial factors, stakeholders such as shippers and carriers, government influence, efficiency, effectiveness, service, trading and clearing orders, data, and specific models or strategies such as supply chain finance and invoice finance. The following literature review presents several authors’ insights into these different dimensions.

Jia (2019) focuses on several dimensions, including technology, innovation, financial aspects, shippers, carriers, government impact, efficiency, effectiveness, and technology services. Their study shows that technological advances help drive innovation in online freight transportation platforms, resulting in financial benefits for shippers and carriers.

Zhu (2019) extends these dimensions by adding transaction settlement and orders. They argue that the convergence of data and technology has accelerated the process of innovation in the industry and has helped to improve the efficiency of government regulation, leading to better services and benefits. They also emphasize the role of transaction settlement and order management in improving the efficiency of online freight platforms.

Song & Xiao (2021) introduced the ‘mode’ dimension, hinting at the importance of the concepts and business models behind platform operations. They argued that innovative models that utilize data can provide better financial solutions and government regulations that can benefit shippers and carriers.

Li & Feng (2021) included data mining, supply chain finance, and invoice financing in their discussion. They argue that these aspects can further contribute to the innovation and financial stability of online freight platforms. Their study emphasizes the importance of incorporating these practices into the platform to increase efficiency and benefit various stakeholders.

Three dimensions were chosen for this study: shipper behavior, carrier behavior, and government regulatory behavior.

2.4 Data Mining

2.4.1 Research Literature of Data Mining

Data mining is a multidisciplinary approach that employs the intersection of artificial intelligence, machine learning, statistics, and database systems (Gheisari et al.) The main purpose of data mining is to extract information from large datasets and transform it into understandable structures for further use (Martínez-Plumed et al., 2019). It helps in recognizing patterns, relationships and understanding structures in the data which are not visible at a glance.

Data mining has a huge potential in the field of online freight transportation platforms. These platforms generate and collect various types of data such as user data, order data, billing data, tax data and credit data (Zhou et al., 2020). Each type of data represents a different aspect of a company’s operations and customer interactions and therefore has the potential to provide valuable insights when mined effectively.

Previous research conducted in the financial sector has emphasized the importance of data mining, highlighting its ability to help financial institutions improve efficiency (Ren, 2021). Information extracted from data mining can deepen understanding of the market and help organizations make more accurate and efficient decisions. For example, by mining user data, companies can gain insights into customer behavior and preferences, facilitating customized financial solutions and improved customer service (Peng, 2021). Additionally, order and billing data analytics can help with operational optimization and fraud detection, thereby increasing efficiency and reducing potential losses.
Recent studies have also emphasized the potential of data mining in credit risk management (Moradi & Mokhtab Rafiei, 2019). By analyzing credit data, financial institutions can better understand the creditworthiness of their customers and thus manage risk more effectively. The insights generated can help financial institutions develop risk models that accurately predict potential defaults and improve their ability to make informed lending decisions.

Innovation is another important aspect of the positive impact of data mining. For example, data mining enables organizations to generate novel insights that can lead to technological innovations, innovative business models, and better services (Dana et al., 2022). In addition, data mining can help organizations predict market trends and customer preferences, which can guide their innovation strategies and improve their market competitiveness.

Despite these potential benefits, it is also important to recognize the challenges and ethical considerations associated with data mining (Romero & Ventura, 2020). Issues such as data security, privacy and data misuse are major concerns that need to be properly addressed. Policies and regulations need to be put in place to guide the use of data mining and ensure that it is used in a responsible and ethical manner.

In conclusion, the literature suggests that data mining can be a powerful tool for improving the efficiency of financial institutions. It can provide important insights into customer behavior, operational efficiency, credit risk, and innovation potential. However, it is crucial to adopt a balanced approach that takes into account the ethical considerations of using data mining.

### 2.4.2 Dimensions of Data Mining

Data mining is an important tool in today's data-driven society, enabling organizations to derive actionable insights and strategic decisions from large volumes of data (Fayyad et al., 2020). For financial institutions, this capability can greatly improve operational efficiency, risk management, customer service, and even the development of new financial products or services. Data mining is an important aspect of decision making and can provide meaningful insights that promote innovation and efficiency in financial institutions. Different dimensions of data mining in this study contribute uniquely to this process, including five main dimensions: user data, order data, settlement data, credit data, and tax data.

### 2.5 Innovation Capacity

#### 2.5.1 Research Literature of Innovation Capacity

The concept of innovation has been widely studied in the literature, and it is recognized as an important factor in business strategy, providing a competitive advantage and improving performance. According to the Organization for Economic Co-operation and Development (OECD, 2020), innovation can be divided into three main categories: technological innovation, model innovation, and service innovation.

Technological innovation mainly refers to the development and application of new technologies in the business environment (Baregheh et al.). It includes product innovation and process innovation (Cheng et al., 2019). In the case of online freight platforms, this may refer to advanced digital technologies such as artificial intelligence, big data analytics, and blockchain technologies used to improve platform services.

Model innovation involves the introduction of novel business models, often enabled by technology, that disrupt existing markets and industries (Foss & Saebi, 2017). It is particularly relevant in the digital age, where new models can significantly change the way businesses operate and interact with customers (Zhou et al., 2020). For example, online freight forwarding platforms in China have revolutionized the traditional logistics industry by providing digital interfaces for shippers, carriers, and customers, thereby increasing efficiency and reducing costs.

On the other hand, service innovation involves the development of new or improved services to better meet customer needs (Galloj & Weinstein, 1997). Service innovation is particularly important in service industries, including online freight platforms and financial services (Cenamor et al.). With the emergence of online freight platforms, service innovation has become increasingly important in providing a superior customer experience (e.g., real-time tracking and fast delivery) and improving overall service quality.

Studies have found that innovation, particularly in online freight platforms, can have a significant impact on firm performance and overall industry dynamics. Specifically, the intersection of innovation and data mining has been highlighted as a key driver of growth for financial institutions. Utilizing large amounts of data collected from online freight platforms and processed through data mining techniques can significantly improve the efficiency and effectiveness of financial institutions (Zhang et al., 2020). Such innovations empower financial institutions to provide more personalized financial services and more accurate risk assessments, thereby promoting financial inclusion and economic growth.
In summary, the literature suggests that various forms of innovation play a crucial role in improving the efficiency of financial institutions, particularly in the context of online freight platforms. With the increased use of data mining techniques, innovation is expected to further improve the performance of financial institutions.

2.5.2 Dimensions of Innovation Capacity

Innovation is a multidimensional concept. This study includes three main dimensions: technological innovation, model innovation, and service innovation.

It is generally believed that technological innovation is an important driver of organizational performance and a key factor in economic growth (Fagerberg, 2019). Existing literature highlights the important role of technological innovation in driving organizational performance, competitiveness, and efficiency, and it plays a crucial role in shaping the success of online platforms and transforming traditional industries such as banking and freight transport.

Model innovation refers to transforming and reshaping business models to adapt to or lead in a changing business environment. It typically involves value proposition modification, value creation and delivery, and value capture (Foss & Saebi, 2017). The literature emphasizes the importance of model innovation in improving the efficiency of financial institutions and the potential of data mining as a key enabler of such innovation in online freight platforms. However, there is still a significant amount of work that needs to be further researched to explore how these elements interact with each other and their combined impact on the efficiency of financial institutions.

Service innovation is an important component of all industries, especially in the context of this study, which combines online freight platforms, data mining, and Chinese financial institutions. Overall, service innovation is a key opportunity to improve the efficiency of financial institutions in the context of online freight platforms and data mining. Future research should further explore how service innovation can be used to maximize benefits in this context.

2.6 Financial Institution Effectiveness

2.6.1 Research Literature of Financial Institution Effectiveness

The effectiveness of financial institutions is a topic that has received much academic attention, mainly because of its enormous impact on economic growth and stability (Xiong, 2019).

Demirgüç-Kunt et al. (2020) explored the role of financial institutions in promoting financial inclusion. Their findings emphasized the positive correlation between the effectiveness of these institutions and financial inclusion. They emphasized that the accessibility and efficiency of the services provided by these institutions play an important role in promoting financial inclusion.

On the other hand, the efficiency of financial institutions has been the subject of numerous studies, with scholars examining both operational and allocative efficiency. A study by Abaidoo and Agyapong (2023) emphasized the important role of technology in improving the operational efficiency of financial institutions. Their analysis of Chinese banks shows that banks that utilize technology are able to significantly improve operational efficiency. On the contrary, allocative efficiency is mainly affected by financial regulation and monetary policy decisions. Regulatory changes and monetary policy can have a significant impact on the efficiency of financial institutions.

The revenue dimension of financial institutions' efficiency is usually measured in terms of return on investment (ROI), profitability, and value created for stakeholders. A noteworthy study by Mahmudova (2023) examined the profit-generating capacity of financial institutions under different economic conditions. Their findings emphasize that financial institutions with innovative investment strategies receive much greater returns, as reflected in their higher rates of return on investment and profitability.

While providing valuable insights, these studies also highlight the complexity of measuring the effectiveness of financial institutions. The intricate interplay between various factors, such as technology, innovation, regulation, and economic conditions, calls for an integrated and dynamic understanding of the effectiveness of financial institutions.

It is worth noting that some scholars have also explored the role of digital platforms, particularly in the freight transportation and logistics industry, and how they affect the effectiveness of financial institutions (Jiang, 2020; Zhang, 2021). Their findings suggest that these platforms have a transformative impact on financial institutions by facilitating innovation, improving data mining capabilities, and enabling effective supply chain synergies.

In summary, the vast literature on the effectiveness of financial institutions emphasizes their multifaceted nature. A nuanced understanding of this concept requires not only examining the financial institutions themselves but also assessing the various external factors that affect their operations and success.
2.6.2 Dimensions of Financial Institution Effectiveness

Financial institutions are an important economic pillar in China, playing a crucial role in managing resources and risks and ultimately contributing to the country’s economic development (González & Núñez, 2021). The effectiveness of these institutions can be measured in different dimensions, which is particularly important in the context of digital transformation, which is reshaping the landscape of financial institutions. This study focuses on three dimensions, including financial inclusion, efficiency, and effectiveness.

2.7 Online Freight Platform and Financial Institution Effectiveness

The interplay between online freight platforms and the efficacy of financial institutions has recently become a subject of growing research interest. As technology and digitalization progress, online freight platforms have begun to play an increasingly pivotal role in the global supply chain and logistics management (Wang & Sarki, 2021). These platforms not only enable the efficient and transparent exchange of goods and services but also generate vast amounts of valuable data that can significantly impact financial institutions’ effectiveness.

There are multiple avenues through which online freight platforms can influence the effectiveness of financial institutions. The efficient operation of these platforms and the expansive range of data they accumulate can contribute to the feasibility, efficiency, and benefits realized by financial institutions (Dong & Lu, 2020). These institutions can leverage the rich data provided by the platforms to develop more precise risk models, allocate resources more effectively, and enhance their overall financial performance.

The relationship between the use of online freight platforms and the performance of financial institutions is evident in the works of several researchers. Bansal et al. (2020) found that the use of online freight platforms can lead to significant improvements in financial institutions’ operational efficiency and risk management capabilities. The platforms’ facilitation of smoother transactions, improved risk identification, and data-driven decision-making contribute to these benefits. Additionally, Lu et al. (2022) found a positive correlation between the utilization of these platforms and the financial performance of banks in China, specifically in terms of return on assets and net interest margins.

However, there is also a recognition that this relationship is nuanced and contingent on various factors. Despite the potential benefits, financial institutions face challenges related to data security, privacy concerns, and the need for significant investment in technology and skills (Xu et al., 2023). Therefore, further research is required to understand the relationship’s full extent and the conditions that mediate it.

Based on this review, we propose the following research hypotheses:

H1: Online freight platforms have a positive influence on financial institution effectiveness.

This hypothesis aligns with the prior literature, suggesting that online freight platforms can contribute to improved effectiveness within financial institutions. However, it also seeks to advance this understanding by elucidating how these relationships function within the context of Chinese financial institutions and the specific roles of shippers, carriers, and government actors.

Based on the dimensions of online freight platform and financial institution effectiveness, the following figure is drawn in order to illustrate the relationship between them.

![Figure 2.1 Relationship between Online Freight Platform and Financial Institution Effectiveness](image-url)
2.8 Online Freight Platform and Data Mining

Online freight platforms have become pivotal in today's digital logistics, contributing significantly to data mining. The nexus between online freight platforms and data mining has been analyzed in numerous studies. Liu et al. (2020) indicated that online freight platforms can provide financial institutions with unique opportunities to leverage big data for risk assessment, credit allocation, and investment decisions.

Furthermore, Li & Zhang (2021) reported that online freight platforms could yield a plethora of data, which, when harnessed effectively, can bolster financial institutions' capacity to deliver feasible, efficient, and beneficial services. In particular, these platforms generate a vast amount of user data, order data, billing data, tax data, and credit data that can be instrumental in optimizing financial decision-making processes.

Additionally, online freight platforms facilitate the use of data mining techniques, enabling financial institutions to extract meaningful patterns from data, thereby boosting their performance. According to Ying & He (2022), data mining from online freight platforms can enhance financial institutions' capacity for risk assessment, investment planning, and loan allocation. Moreover, they argued that data mining could drive innovation, offering novel ways of delivering financial services, developing new products, and creating new business models.

Taking the discussion forward, the current study hypothesizes that:

H2: Online freight platforms have a positive influence on data mining.

The availability of vast and diverse data from online freight platforms can stimulate and simplify the data mining process. These platforms can provide an abundant source of real-time data, facilitating comprehensive data analysis, thereby leading to more effective decision-making in financial institutions (Han, 2015). Consequently, data mining becomes an indispensable tool for financial institutions to gain deeper insights into market trends, customer behavior, and economic patterns. Therefore, the hypothesis emphasizes that the more the freight platforms are utilized, the more opportunities financial institutions have to harness data, resulting in efficient and beneficial outcomes.

In conclusion, the relationship between online freight platforms and data mining is multifaceted and significant, particularly regarding the performance of financial institutions. Therefore, it is imperative for financial institutions to recognize and leverage the potential of data derived from these platforms for their decision-making processes.

Based on the dimensions of online freight platform and data mining, the following figure is drawn in order to illustrate the relationship between them.

![Figure 2.2 Relationship between Online Freight Platform and Data Mining](image-url)

**Figure 2.2 Relationship between Online Freight Platform and Data Mining**

2.9 Online Freight Platform and Innovation Capacity

Online freight platform operations can significantly impact innovation capacity, according to a growing body of literature. This influence is manifested in three main areas: technological, model, and service innovation.

Online freight platforms are increasingly relying on advanced technologies to streamline their operations and gain a competitive edge. Tang & Veeleuturf showed how digital freight platforms leverage artificial intelligence (AI) and machine learning algorithms to optimize route planning and freight matching. Similarly, Wang et al. (2022) highlighted the role of blockchain technology in enhancing the security and transparency of freight transactions. These
technologies not only improve operational efficiency but also stimulate the innovation capacity of freight platforms by paving the way for new technological advancements.

Regarding model innovation, the literature illustrates how online freight platforms have redefined traditional freight models. A paradigm shift from the traditional hub-and-spoke model to a more flexible and efficient model has been observed. Notably, the application of digital technologies enables the emergence of peer-to-peer (P2P) freight sharing models, fostering innovation by introducing new ways of freight distribution.

Service innovation is another area where the operation of online freight platforms has made significant strides. Freight platforms now provide a range of novel services, from real-time tracking to personalized freight services, adding value to both carriers and customers. These innovations in service delivery not only enhance user satisfaction but also encourage continuous improvement and service diversification.

In conclusion, online freight platform operations influence innovation capacity. They do this through technological advancements, reimagining traditional freight models, and continuously enhancing service offerings. These observations led to the formulation of the third research hypothesis:

H3: Online freight platform operations positively influence innovation capacity.

Based on the dimensions of the online freight platform and innovation capacity, the following figure is drawn in order to illustrate the relationship between them.

![Figure 2.3 Relationship between Online Freight Platform and Innovation Capacity](image)

2.10 Data Mining and Financial Institution Effectiveness

The efficiency of financial institutions has become a critical topic in the context of increasingly complex and competitive financial services. Data mining, the process of analyzing large data sets to discover patterns and generate insights, has had a profound impact on many industries, including the financial sector.

Several studies support the hypothesis that data mining positively impacts the efficiency of financial institutions. They argue that data mining enables financial institutions to understand customer behavior, predict market changes, and improve decision-making processes. Khadjeh found that data mining can be used for market trend analysis, facilitating the prediction of future events in financial markets. This predictive capability helps in risk management and thus increases the efficiency of financial institutions. Thus, they are able to better manage their relationships with customers, provide tailored services and maximize profits.

Financial fraud detection is another area where data mining plays an important role. Rosset emphasized the role of data mining in credit scoring. By employing data mining techniques, financial institutions can develop more accurate credit scoring models and minimize potential defaults and losses.

In conclusion, data mining has a positive impact on the effectiveness of financial institutions, but its benefits depend on various factors. These factors include data quality, expertise in data mining techniques, ethical considerations, and regulatory frameworks. Therefore, there is a need for financial institutions to address these factors in order to fully utilize the benefits of data mining. In view of this, the following research hypotheses are proposed:

H4: Data mining has a positive impact on the effectiveness of financial institutions.

The potential of data mining in improving the effectiveness of financial institutions can be attributed to its ability to provide actionable insights. Through the use of sophisticated algorithms and statistical methods, data mining can analyze and interpret the vast amounts of data generated by online freight platforms, facilitating more accurate risk assessments, improving the decision-making process, and ultimately increasing the viability, efficiency, and
effectiveness of financial institutions. The role of data mining is expected to become more prominent as the freight transportation industry increasingly moves to digital platforms.

![Figure 2.4 Relationship between Data Mining and Financial Institution Effectiveness](image)

2.11 Innovation Capacity and Financial Institution Effectiveness

In the realm of finance, the digital revolution has broadened the horizon with the rise of online freight platforms. These platforms have significantly influenced financial institution effectiveness, which can be measured through feasibility, efficiency, and benefit (Kane et al., 2019). Online freight platforms provide a virtual environment where shippers, carriers, and even government entities can interact (Ho et al., 2020).

These platforms increase the accessibility of data and transparency, which could positively impact the financial feasibility of institutions. For instance, with increased visibility, financial institutions can better manage risks associated with loans and other financial products tied to these transactions (Zhang et al., 2020). Similarly, the efficiency of financial institutions is potentially enhanced through quicker decision-making processes due to real-time data availability and improved transaction speed.

The use of online freight platforms can lead to substantial benefits for financial institutions. A primary benefit is the potential for these platforms to spur innovative financial products and services. For instance, by analyzing transactional patterns on these platforms, financial institutions may develop new risk models or financial products tailored to the needs of participants in the freight industry. Moreover, as the number of participants grows on these platforms, financial institutions may tap into this new customer base, thus boosting revenues and profits (Kane et al., 2019).

Innovation capacity, on the other hand, plays a key role in enhancing the effectiveness of financial institutions. Innovation capacity, in the context of this study, can be characterized as technological, model, and service innovation. Technological innovation involves the adoption of novel technologies or the improvement of existing ones (Nambisan, 2019). This type of innovation, powered by online freight platforms, might lead to automated processes, more robust risk models, and faster transaction speeds.

Model innovation pertains to the creation or reinvention of business models that align better with the evolving digital environment (Nambisan, 2019). The rise of online freight platforms might necessitate financial institutions shifting from traditional models to more agile and digital-friendly models, thereby increasing their effectiveness (Huang et al., 2022). Service innovation involves the development of new services or the improvement of existing ones to meet customer needs more effectively. In line with this, financial institutions could leverage data from online freight platforms to create bespoke financial products and services, leading to increased customer satisfaction and overall institutional effectiveness.

On this basis, the following hypothesis can be proposed:

H5: Innovation capacity has a positive influence on financial institution effectiveness.

This hypothesis posits that technological, model, and service innovation, driven by the integration of online freight platforms, have a positive influence on the inclusion, efficiency, and benefit of financial institutions.
Based on the dimensions of the online freight platform and innovation capacity, the following figure is drawn in order to illustrate the relationship between them.

![Figure 2.5 Relationship between Innovation Capacity and Financial Institution Effectiveness](image)

### 2.12 Research Conceptual Framework

There are a total of four variables in this study. The independent variable is the operation of online freight platform operation; the dependent variable is the effectiveness of financial institutions; and the intermediate variable is data mining and innovation capability. The conceptual framework is shown below:

![Figure 2.6 Research Conceptual Framework](image)

### 3 Research Methodology

#### 3.1 Research Design

This study will adopt a mixed quantitative and qualitative research methodology, justified by the richness and depth it offers in terms of data collection, analysis, and interpretation. In the context of examining the impact of data...
mining on financial modeling in China's logistics industry, a mixed research approach allows the study to draw on the strengths of both quantitative and qualitative methods. Quantitative data can provide statistical insights and correlations between variables (Thurber et al., 2020), such as the extent of data mining applications and financial model innovations, while qualitative data can provide a deeper understanding of the underlying causes, perceptions, and contexts (Choy, 2014), such as the motivations, challenges, and benefits of adopting innovative financing models.

The scientific credibility of mixed methods has been demonstrated by a number of academic sources. Dawadi et al. (2021) state that mixed-methods research provides a more comprehensive understanding of the research problem than either method alone. Kerblad (2019) further strengthen this assertion by emphasizing the potential of mixed methods to integrate different perspectives and thus address complex research questions more effectively. Furthermore, Fetters & Molina-Azorin (2020) emphasize the ability of mixed methods to bridge the gap between quantitative generalizations and qualitative contextualization, enriching the scientific understanding of the phenomenon under study. Bulsara (2015) concurs with this approach, arguing that the symbiotic relationship between qualitative and quantitative research enhances the reliability and validity of research findings.

In mixed-methods research, data analysis will be done using both quantitative statistical analysis tools and qualitative thematic analysis tools. SPSS (Statistical Package for the Social Sciences) will be used to analyze the quantitative data in order to use advanced statistical techniques such as regression analysis, correlation analysis, and analysis of variance (ANOVA). NVivo, a software package designed for qualitative data analysis (Dhakal, 2022), will be used to code and analyze the qualitative data in order to identify themes and patterns.

3.2 Quantitative Research Methodology

3.2.1 Population and Sample

The population of interest for this study includes financial institutions and their branches in China, as well as jurisdictional online freight forwarding platforms operating in approximately five cities in China (Beijing, Shanghai, Tianjin, Jinan and Xi'an). The main reason for choosing these cities as the study sites is that these regions are strategically important in the new infrastructure economic landscape of logistics development in China (Gao and Wu, 2019), which provides relevant insights for other major cities and other regions in China. Given the large number of organizations in the population area of interest for this study, it is impractical to include all organizations in the study. Therefore, a sampling method will be used in this study.

Ma et al. (2022) made a significant contribution in the area of statistics and research methods. They proposed that the estimated sample size should be 20 times the number of observed variables, a suggestion that has the potential to revolutionize the way research is designed and conducted. The authors argued that larger sample sizes lead to more robust and reliable statistical analyses relative to the number of variables. They argue that by maintaining a high ratio of observations to variables, the precision of the estimates can be improved and the risk of overfitting reduced. In this study, 14 observed variables are proposed and the sample size is estimated to be 280.

The sampling criteria for this study are as follows: Entities must be financial institutions and online freight forwarding platforms that have been operating for at least one year in the above selected Chinese urban areas and must have accessible data that can be used in this study. Stratified random sampling technique (Iliyasu & Etikan, 2021) will be used in this study. This method involves dividing the population into subgroups or “strata” (financial institutions and online freight forwarding platforms in this study) and then randomly selecting samples from each stratum. This approach ensures that both types of entities are adequately represented in the sample (Bhardwaj, 2019), which is critical given that the focus of this study is on the interaction between these two industries.

Stratified random sampling was used for several reasons. First, it ensures that the sample is representative and improves the external validity of the study. Second, stratified random sampling produces more accurate estimates than simple random sampling because it ensures that each stratum is adequately represented, thereby reducing sample variability. Finally, it can also test the impact of specific strata, thus providing valuable insights into the differential impact of data mining on financial innovation in the two sectors.

In conclusion, the proposed sampling method is robust and well suited to the objectives of this study. It ensures a representative and manageable sample while providing a precise and in-depth analysis of the research questions.

3.2.2 Data Collection Procedures

In order to collect relevant data for the study, a structured questionnaire will be used. A questionnaire is one of the most commonly used tools in data collection (Aithal & Aithal, 2020) because it provides a structured approach to
collecting primary data from a large number of respondents efficiently and effectively. The questionnaire will contain sections that address different aspects of the research variables.

This comprehensive approach allows the researcher to collect a wide range of data, which has the potential to increase the depth and richness of the findings. In order to adequately collect data on these variables, there will be five question items for each observed variable.

The first part of the questionnaire will be used to collect demographic information about the participants. The second part of the questionnaire will contain the main body of the survey, centered around the individual observational variables of interest. These variables are central to the objectives of the study, and each variable will be specified into five question items that will be structured to measure different aspects of each variable. These questions will be crafted from previously tested questions to ensure clarity, relevance, and ease of response. Many of the close-ended questions will utilize the commonly used Likert scale (Likert, 1932), which provides respondents with a range of options from "strongly disagree" to "strongly agree."

The questionnaire will be designed to ensure that it covers important aspects related to shippers', carriers', and regulators' management data mining of online freight platforms and their impact on the innovation of financing models for financial institutions in China.

The questionnaire will be delivered through an online collection format. Prior to final application, the questionnaire will be pilot-tested to ensure that the understanding of the questions is as expected and to make any necessary modifications.

### 3.2.3 Measurement of Variables

Based on the theories and variables outlined in the study, a questionnaire was filled out by the research participants, and each question item was scored according to a five-point Likert scale from 1 to 5 as "1=strongly disagree," "2=disagree," "3=neutral," "4=agree," and "5=strongly agree."

### 3.2.4 Reliability and Validity

In this study, the reliability and validity of the questionnaire items used to measure the independent, dependent and intermediate variables can be critically examined to ensure the accuracy and appropriateness of the findings.

Cronbach’s alpha was used as the reliability coefficient to measure the internal consistency of the questionnaire (Amirrudin et al., 2021). For each variable construct, all the items were tested for their reliability, and any item that caused a significant decrease in the Cronbach's alpha value was removed. The generally accepted minimum threshold for Cronbach's alpha is 0.7. A Cronbach’s alpha value greater than 0.7 demonstrates a high degree of internal consistency and reliability in the responses collected.

The construct validity of the questionnaire can be ensured through both convergence validity and discriminant validity (Flake et al., 2022).

**Convergence Validity:** Average Variance Extracted (AVE) and Composite Reliability (CR) were used to assess convergence validity (Grieder, 2021). An AVE value greater than 0.5 and a CR value greater than 0.7 for each construct implies good convergent validity.

**Discriminant Validity:** This can be established by ensuring that the square root of the AVE for each construct is greater than the inter-construct correlations.

### 3.2.5 Pre-Testing the Questionnaire

Before conducting a full-scale study, a preliminary test, or "pilot study," will be performed on the questionnaire. The objective of the pilot study is to test the reliability and validity of the instrument, identify any ambiguities in the question wording, and ensure that the questions are understood as intended by the respondents. Also, it will help assess the appropriateness of the research hypotheses and the statistical power of the study.

The sample size for the pilot study typically ranges from 10% to 20% of the main study's intended sample size. It should be large enough to represent the population and small enough to allow for adjustments before the main study. Research experts suggest that a pilot study sample size of 30 to 50 participants is often sufficient to identify any major issues with the questionnaire.

For this study, a sample size of 40 respondents is proposed for the pilot study. This number is reasonable according to several research scholars, including, who stated that a pilot study sample size of at least 30 helps to better estimate the mean and standard deviation, while Kang (2021) suggested that a minimum of 12 per group is typically
adequate for pilot studies. Given that this study involves complex interrelations between multiple variables, having 40 respondents will provide a more robust estimation of any potential issues.

The respondents for the pilot study will be selected from the same population that will be used for the main study. This includes relevant stakeholders from online freight platforms and financial institutions, such as shippers, carriers, and supervisory management. By using respondents who are closely aligned with the main study, the results of the pilot study will provide a reliable indication of how well the questionnaire will work in the main study.

By conducting a pilot study with a sample size of 40, it is expected that any unforeseen issues or ambiguities with the questionnaire will be identified and rectified before the full-scale study is implemented.

If the value of Cronbach's alpha falls between 0.5 and 0.7, adjustments need to be made to the variable's scale. If it dips below 0.5, the questionnaire needs to be overhauled entirely. Additionally, if the Cronbach's alpha reliability coefficient for a given variable exceeds the Cronbach's alpha value for all variables when one item is removed during the reliability assessment, the specific item should be eliminated.

3.3 Qualitative Research

To delve deeper into the understanding of the research topic and hypotheses proposed in this study, this paper employs a qualitative research method with an emphasis on in-depth interviews. This will supplement our previous quantitative analysis and offer nuanced insights into the practical impact of data mining from online freight platforms on the innovation of financing models for Chinese financial institutions.

The sample for this qualitative study will be selected through purposive sampling to ensure the relevance of participants to the research questions. Our focus will be on individuals directly involved in the online freight and financial industries. This includes, but is not limited to, managers and executives from online freight platforms, data analysts, policymakers, and professionals from financial institutions who have experience working with data mining and innovative financing models.

This paper aims to conduct 15 in-depth interviews. Participants will be selected primarily from the Chinese online freight and financial sectors to ensure the cultural and industrial context aligns with the research objectives.

4 Results and findings

In order to facilitate the statistical analysis of the data using a mixed research methodology, a reliability and validity analysis was first done. In this study, the variables were abbreviated as follows:

(1) OFPO (Online Freight Platform Operations), including AC (Carrier Behavior), AS (Shipper Behavior), and AG (Government Behavior).

(2) DM (Data Mining), including UD (User Data), OD (Order Data), SD (Settlement Data), CD (Credit Data) and TD (Tax Data).

(3) IC (Innovation Capacity), including TI (Technology Innovation), MI (Model Innovation) and SI (Service Innovation).

(4) FIE (Financial Institution Effectiveness), including FI (Financial Inclusion), FE (Financial Efficiency) and FB (Financial Benefit).

4.1 Reliability analysis

Reliability analysis is used to measure the consistency or stability of test scores when a test is administered multiple times. After data analysis of each dimension of question items, the reliability analysis results were acquired as follows in Table 4.1.

<table>
<thead>
<tr>
<th>Scale for dimension of variables</th>
<th>Cronbach’s Alpha</th>
<th>N of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>0.932</td>
<td>5</td>
</tr>
<tr>
<td>AS</td>
<td>0.915</td>
<td>5</td>
</tr>
</tbody>
</table>
Cronbach’s Alpha gives a score between 0 and 1; higher values indicate greater internal consistency among the items in the test.

Cronbach’s Alpha values can be interpreted as follows:

1. ≥ 0.9: Excellent reliability
2. 0.8 ≤ α < 0.9: Good reliability
3. 0.7 ≤ α < 0.8: Acceptable reliability
4. 0.6 ≤ α < 0.7: Questionable reliability
5. 0.5 ≤ α < 0.6: Poor reliability
6. < 0.5: Unacceptable reliability

Based on the data presented in Table 4.1, the Cronbach's alpha values for all variable dimensions (including AC, AS, AG, UD, OD, SD, CD, TD, TI, FI, FE, and FB) ranged from 0.891 to 0.932. These values show a range of dimensions with significantly high internal consistency, reflecting the reliability and consistency of the items within each scale.

### 4.2 Validity analysis

Validity refers to the accuracy of a measurement or the extent to which a test, instrument, or experimental design meets its intended objectives. In this study, KMO and Bartlett's test were used to test the validity as shown in Table 4.2.

<table>
<thead>
<tr>
<th>Variable Dimension</th>
<th>Cronbach's Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG</td>
<td>0.904</td>
</tr>
<tr>
<td>UD</td>
<td>0.898</td>
</tr>
<tr>
<td>OD</td>
<td>0.923</td>
</tr>
<tr>
<td>SD</td>
<td>0.916</td>
</tr>
<tr>
<td>CD</td>
<td>0.907</td>
</tr>
<tr>
<td>TD</td>
<td>0.893</td>
</tr>
<tr>
<td>TI</td>
<td>0.891</td>
</tr>
<tr>
<td>MI</td>
<td>0.903</td>
</tr>
<tr>
<td>SI</td>
<td>0.927</td>
</tr>
<tr>
<td>FI</td>
<td>0.918</td>
</tr>
<tr>
<td>FE</td>
<td>0.905</td>
</tr>
<tr>
<td>FB</td>
<td>0.912</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measure of Sampling Adequacy</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin (KMO)</td>
<td>0.916</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test of Sphericity</th>
<th>Approx. Chi-Square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's</td>
<td>7303.918</td>
<td>175</td>
<td>.000</td>
</tr>
</tbody>
</table>

Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) helps determine if the data is suitable for factor analysis. The KMO values ranged from 0 to 1. The general rule of thumb is:

1. KMO > 0.90: excellent
(2) 0.80 < KMO < 0.90: excellent
(3) 0.70 < KMO < 0.80: Moderate
(4) 0.60 < KMO < 0.70: mediocre
(5) 0.50 < KMO < 0.60: Poor
(6) KMO < 0.50: Unacceptable

Based on data presented in the table 4.2, the KMO value is 0.916. This is considered “Marvelous” based on the standard categorizations. And The significance level (Sig.) is .000, indicating a highly significant result. Therefore, the data is reliable and factor analysis can be suitable for this data set.

4.3 Multiple-variable CFA results

![Multiple-variable confirmatory factor analysis results](image)

The study adopts the multi-variable CFA results to check the causal relationship among online freight platform, data mining, innovation capacity and financial institution effectiveness.

Based on the data in Figure 4.1, the following data were obtained: Chi-Square = 43.254; df = 38; p-value = .185; Relative Chi-square = 1.367; GFI = .981; AGFI = .962; TLI = .996; CFI = .997; RMR = .007. RMSEA = .026, which indicates that the multivariate CFA results suggest a good model fit.

5 Conclusion

The convergence of financial services and online freight platforms has brought about significant changes and opportunities for the logistics industry. This study examines the impact of this convergence on the innovation of financing models in the logistics industry. The data mining and innovative applications generated during the operation of online freight transportation platforms have had a new and effective impact on the financing models of Chinese financial institutions in the logistics industry.

Using a variety of technological innovations, model innovations, and service innovations, China’s online freight platforms can use data mining algorithmic prediction models to further demonstrate and analyze the complex relationships between shippers, actual carriers, freight platform management, and financial service innovations in online freight platform transactions and to come up with new types of financing service solutions that can support the growth and sustainable development of the logistics industry. These financing models can have a significant impact on improving financial inclusion and driving organizational performance and efficiency.
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