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Impact of Supply Chain Resilience on High-Quality Development of Enterprises—Based on the Perspective of Digital Economic Development

Haoxin Liu[1,a,*], Xiuqiong Xia[1,b]

[1]*School of Business, Guangxi University, Nanning, 530004, Guangxi Zhuang Autonomous Region, China*
[a]*18700591225@163.com*, [b]*1930226761@qq.com*
[*]*Corresponding author*

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Abstract: From the perspective of the evolution of the internet-based economy, the function of the manufacturing chain in the superior development of businesses under the background of globalization is becoming increasingly important. However, with the intricate and dynamic market landscape that businesses currently face, the instability and weak resilience of the supply chain have become key factors restricting the high-quality development of enterprises. Increasing the supply chain's capacity to handle unforeseen issues has become an urgent concern for enterprises, especially in the era of digital economy. Thus, the article's objective is to examine how robustness of the manufacturing process chain affects the high-quality growth of businesses, with a particular focus on the regulatory role that the digital economy plays in this process. By constructing an empirical analysis model, this paper explores the four core dimensions of supply chain resilience - risk resistance, adaptability, chain recovery and creativity, and how to help enterprises enhance risk resistance, improve market response speed, promote innovation, and ultimately enhance these dimensions' capacities to encourage superior development. The regression test results show that the relationship between each dimension of supply chain resilience and the superior development of businesses shows a significant positive impact. In particular, the standard error is 0.07 and the regression coefficient of risk resistance (SCR1) is 0.28, suggesting that it significantly contributes to the high-caliber growth of businesses. The high-quality development of businesses is positively impacted by adaptability, as evidenced by the regression coefficient of adaptability (SCR2) of 0.25 and the normative error of 0.08.

1. Introduction

The expansion of the internet-based economy in recent years has given businesses new chances to strengthen their supply infrastructures' durability .Innovative technologies like big data analytics (BDA), blockchain, computer science (AI), and the Internet of Things (IoT) are significantly

changing how corporations maintain their supply chains. These technologies allow businesses to better forecast market demand, allocate resources, increase operational efficiency, and improve the supply chain's visibility and intelligence. Thus, investigating how supply chain resilience affects the high-quality growth of businesses against the backdrop of the digital economy has significant theoretical value as well as practical guiding significance for business management and policy formation.

The growth of the digital economy serves as the foundation for this study's analysis of the relationship between supply chain resilience and the superior development of businesses. It also delves into the regulatory function of the digital economy. By constructing an empirical analysis model, this paper focuses on the four core dimensions of supply chain resilience - risk resistance, adaptability, chain recovery and creativity, and explores how they work together on the innovation ability, market response speed, resource allocation efficiency and sustainable development ability of enterprises, thereby promoting enterprises to move towards a high-quality development stage. It is intended that the study's findings would give businesses both theoretical backing and real-world examples to improve resilience tactics and managing the entire supply chains in the age of digital currency.

In addition to outlining the study's history and goals, this article highlights how crucial supply chain resilience is to the successful growth of businesses in the age of the digital economy. Then, it reviews the relevant literature, explores the relationship between supply chain resilience and high-quality development of enterprises, and proposes corresponding research hypotheses. Then, it introduces the research methods, focusing on the theoretical analysis framework, hypothesis construction and regression analysis model. Next, through empirical research, it examines how resilient supply chains affect businesses' high-quality growth and confirms the digital economy's regulatory role. Finally, it summarizes the main findings of the study, puts forward practical significance, and looks forward to the direction of future research.

2. Related Work

As supply chain resilience becomes increasingly important in addressing global challenges and uncertainties, scholars have conducted extensive research on this topic in recent years, exploring its multiple dimensions and the application of related technologies. Shishodia et al. found that research topics on supply chain resilience include concept development, resilient supply chain design, risk drivers, evaluation and measurement methods, and capacity building to improve supply chain performance [1]. Zamani et al.'s research results had promoted the understanding of AI and BDA in the field of supply chain resilience, assessed the current status of AI and BDA, and determined their impact on each stage of supply chain resilience (preparation, response, recovery, and adaptability) [2]. Rashid et al. analyzed data from 251 manufacturing supply chain professionals and found that information processing capabilities (especially disruption orientation and advanced visibility) and digital supply chains significantly improved flexibility and handling hazards in the supply chain [3]. Ivanov investigated how supply chain stability was impacted by the COVID-19 pandemic in this setting [4]. Digital technology has a certain regulatory impact on supply chain robustness and resilience, according to Alvarenga et al. [5]. The significance of artificial intelligence in enhancing supply chain resilience was demonstrated by Attah et al., who used the supply chain as an example and investigated its role in rapid fluctuations, interruptions in supply chains, inventory optimization, effectiveness of transport, and relationship management with suppliers [6].

Based on this, more research was done on the mechanism of supply chain resilience and how it affects supply chain performance in various settings. Hamidu et al. studied Ghanaian manufacturing companies and examined the relationship between enterprise efficiency and supply department

durability. The results showed that supply chain resilience can actively promote supply chain performance, and non-catastrophic emergencies have a beneficial mediation effect on the connection between performance and resilience [7]. Ghobakhloo summarized 16 functions of using Industry 4.0 to improve supply chain resilience through a literature review, and pointed out that manufacturers need to adjust their digital strategies according to the functions and delivery sequence of Industry 4.0 [8]. Belhadi studied how artificial intelligence technologies directly and indirectly impact supply chain resilience, and investigated how these technologies can enhance supply chain toughness, ultimately increasing the supply network's efficiency over the long run[9].

Belhadi et al. investigated how, during the Russian invasion of Ukraine, African agricultural food supply networks employed digital technologies to create resilience plans to deal with the unpredictability of the outside world. They found that downstream companies widely employed cutting-edge technology like additive manufacturing and blockchain. to take proactive measures, while upstream small companies relied on technologies such as mobile applications and cloud data analysis and mainly adopted a "wait-and-see" strategy for passive response [10]. Chowdhury et al. explored alternative structures of resilience strategies under severe disturbances. The results showed that a single resilience capability does not work, and only by combining it with the removal of risk factors can supply chain performance be improved [11]. The bottleneck of existing research is that it has not yet explored the complex interactions of supply chain resilience in different industries, environments, and technological applications, and lacks a unified evaluation framework [12].

3. Method

3.1 Theoretical Analysis and Research Hypotheses

3.1.1 The primary influence of robustness of manufacturing process chain on the superior growth of businesses

This section thoroughly examines the ways in which the fundamental variable of supply chain resilience significantly affects businesses' high-quality development process. Considering the current theoretical framework and reviewing the literature, the analysis that follows is suggested: Supply chain resilience, as the core capability of enterprises to cope with supply chain disruption risks, can not only ensure that enterprises maintain stable operations in the face of external shocks but also create continuous value for enterprises by increasing the adaptability and rapid response capabilities of the supply chain. This capacity is essential for encouraging the superior growth of businesses. Specifically, a highly resilient supply chain can ensure that businesses preserve their competitive advantages in a dynamic and complex marketplace, and by optimizing resource allocation, enhancing innovation capabilities and improving market response speed, it can effectively promote enterprises to steadily move towards a higher quality development stage.

3.1.2 Moderating effect: the way in which the digital economy moderates the connection between robust supply chains and the superior growth of businesses

Given the growing complexity and unpredictability of the global economic landscape, an organization's endurance of the manufacturing process chain has emerged as a critical component of its superior growth. Supply chain resilience can effectively respond to changes in the market, emergencies and other external shocks, and ensure the continuity and stability of enterprise production and operation. But supply chain resilience's effect on businesses' high-quality development is not constant; rather, it is influenced by a number of external environmental factors, one of which is the digital economy's explosive growth.

In addition, the importance of the internet economy in facilitating may vary depending on the digital maturity of the enterprise, industry characteristics, and market environment. For example, in highly digitalized industries, it is easier for enterprises to use digital technology to optimize supply chain management and achieve high-quality development; while in traditional industries, the digital economy may have a comparatively small regulatory role. Therefore, exploring the regulatory effect of the digital economy on the connection between outstanding growth in business and logistics chain sustainability not only help deepen theoretical understanding but also provide important reference for enterprises to formulate digital transformation strategies.

3.2 Research Design

3.2.1 Model construction

This section elaborates on the construction strategy of the research model. An adequate regression model is built for analysis in order to further investigate the relationship between supply chain resilience and the high-quality development of businesses, as well as the moderating influence of the digital economy in this relationship. The model considers multiple dimensions of supply chain resilience and their potential relationship with the superior development of businesses. At the same time, relevant variables of the digital economy are introduced to explore its moderating role between supply chain resilience and the superior development of businesses.

3.2.2 Variable selection

This paper intends to comprehensively measure the resilience of enterprise supply chains from three dimensions: risk resistance, chain recovery and enterprise creativity. The specific variable definitions are as follows:

Supply Chain Resilience (SCR):

SCR1: It indicates "the company is able to cope with changes caused by supply chain shocks", which is used to measure the company's risk resistance.

SCR2: It indicates "the company is able to adapt to supply chain shocks", which also reflects the company's risk resistance and adaptability.

SCR3: It indicates "the company can respond quickly to supply chain shocks", which is used to evaluate the company's chain recovery ability.

SCR4: It indicates "the company can maintain a high level of situational awareness of supply chain shocks at any time", this variable reflects the company's risk resistance, as well as its creativity and market sensitivity.

3.2.3 Data sources

The data for this study mainly comes from enterprise questionnaire surveys and publicly available secondary data. The questionnaire survey is conducted on representative enterprises to ensure the breadth and accuracy of the data. Meanwhile, we also obtain relevant secondary data from authoritative databases and public reports to supplement and improve the research data set. In terms of data processing, we use statistical software to clean, organize and analyze the data to ensure the accuracy and reliability of the research results.

3.3 Basic Situation Analysis

In the basic scenario analysis, the experiment first conducts descriptive statistical analysis on the collected sample data to understand the basic attributes of the sample and the probability of its

variables. This part shows the basic attributes of the companies in the sample, such as industry category, scale, business model, digital level, etc. To aid in the future analysis of the possible association between the variables, it is also required to summarize the fundamental statistical data, including the sample information standard deviation, average, highest number, and lowest possible value.

3.3.1 Main effect analysis

Based on the theoretical framework proposed in the previous article, the regression analysis method is used to verify the impact of supply chain resilience on various dimensions of excellent business development (such as innovation capability, market response speed, resource allocation efficiency, etc.).

3.3.2 Robustness analysis

Verifying generalization ability and reproducibility of research findings is the primary goal of robustness analysis. In order to be sure that the results are unaffected by biassed data or mistakes in the model definition, the model must be tested several times.

This part includes testing different assumptions of the model, such as using different data sets, changing the definition of variables, introducing additional control variables, etc., to check whether consistent results can still be obtained. Robustness analysis helps to confirm that the supply network resilience's effects on the excellent business development are generally applicable, rather than specific to a specific sample or model setting.

In addition, robustness analysis can also include regression analysis of different sub-samples, such as grouping samples according to enterprise size, industry category or region, to test whether there are significant differences in the impact of supply chain resilience on the excellent business development under different conditions.

3.3.3 Moderating effect analysis

The goal of the moderating effect analysis is to investigate how the digital economy affects resilience within supply chains and the superior growth of businesses. By testing the interaction terms in the regression analysis, it examines whether the level of digital economic development (such as digital technology application, data analysis capabilities, etc.) can enhance or weaken the role of supply chain resilience in the high-quality development of enterprises.

This section first analyzes the interaction between digital economy variables (such as enterprise digitalization level, data-driven decision-making ability, etc.) and supply chain resilience through variable construction and regression model design. If the digital economy shows a significant moderating effect in this relationship, it means that digital transformation helps further enhance the role of resilient supply chains in cultivating high-quality development of enterprises.

4. Results and Discussion

4.1 Experimental Objectives

The main objective is to look into how supply chain resilience—which includes risk resistance, chain recovery, corporate inventiveness, etc.—affects the superior growth of businesses.

Moderating effect objective: To explore how the digital economy affects the relationship between a robust supply chain and high-quality business development.

4.2 Experimental Sample

Target Sample: Companies in multiple industries (such as manufacturing, retail, information technology, etc.) are selected to ensure that the sample is representative.

Sample Size: It is recommended to select at least 200 enterprises to ensure that there is sufficient sample size to enhance the testing outcomes' statistical value and dependability.

Enterprise Type: It includes large, medium and small enterprises, and is grouped according to the different degrees of their digital transformation (such as low, medium and high).

4.3 Experimental Methods

Quantitative Analysis:

The impact of various characteristics of supply chain resilience on the high-quality growth of firms is examined using multiple regression analysis or the structural equation model (SEM).

Regression analysis is conducted on the moderating effect of the digital economy, and an interactive model is used to test whether digital transformation plays a significant moderating role between supply chain resilience and business excellence.

Regression model:

$$Y_i = \beta_0 + \beta_1 SCR_i + \beta_2 DE + \beta_3 (SCR_i \times DE) + \varepsilon_i \tag{1}$$

Among them, Y_i is the indication of high-quality development for businesses, SCR_i is the various aspects of supply chain robustness, DE is the level of digital economy, β_1, β_2, β_3 are the regression coefficient, and ε_i is the error term.

4.4 Experimental Process

Preliminary preparation stage:

Samples of enterprises are collected to obtain basic information and contacts of enterprises.

Questionnaires are designed and distributed to ensure its reliability and validity (a pre-experiment is conducted to check whether the questionnaire is clear and could effectively measure the target variables).

Secondary data are collected to ensure completeness and accuracy of the data.

Data collection phase:

The questionnaires are distributed and collected, and the data are cleaned and processed.

The digital economy level, supply chain resilience and high-quality development indicators of enterprises are quantified.

Data analysis phase:

Methods such as regression analysis are used to verify the influence of the supply chain on the superior growth of businesses and to test the regulatory role of the digital economy.

Combined with the specific numerical analysis in Table 1, it can be seen that there is an obvious correlation between supply chain resilience and the high-quality development score of enterprises. Taking enterprise ID 1 as an example, this large enterprise has outstanding performance in various supply chain resilience indicators, with SCR1 (risk resistance) of 4.5, SCR2 (adaptability) of 4.2, SCR3 (chain recovery ability) of 4.7, and SCR4 (creativity) of 4.6, indicating that it has strong advantages in coping with risks, adapting to market changes, restoring supply chain functions and innovation capabilities.

Table 1. The impact of supply chain resilience on the high-quality development of enterprises

Enterprise ID	1	2	3	4	5	...
Enterprise Size	Large	Medium	Small	Large	Small	...
Industry Category	Manufacturing	Retail	Information Technology	Manufacturing	Services	...
SCR1	4.5	3.8	3.5	4.8	3.2	...
SCR2	4.2	4	3.6	4.5	3.4	...
SCR3	4.7	4.2	3.9	4.6	3.3	...
SCR4	4.6	3.9	3.8	4.7	3.1	...
Digital Economy Level (DE)	4.8	4.3	3.9	5	3.5	...
Innovation Capability	4.5	3.9	3.6	4.7	3.4	...
Market Response Speed	4.6	4	3.7	4.8	3.3	...
Resource Allocation Efficiency	4.4	4.1	3.8	4.9	3.5	...
Social Responsibility and Sustainable Development Capability	4.7	4	3.6	4.8	3.4	...
Enterprise High-Quality Development Score	4.55	4.05	3.73	4.83	3.43	...

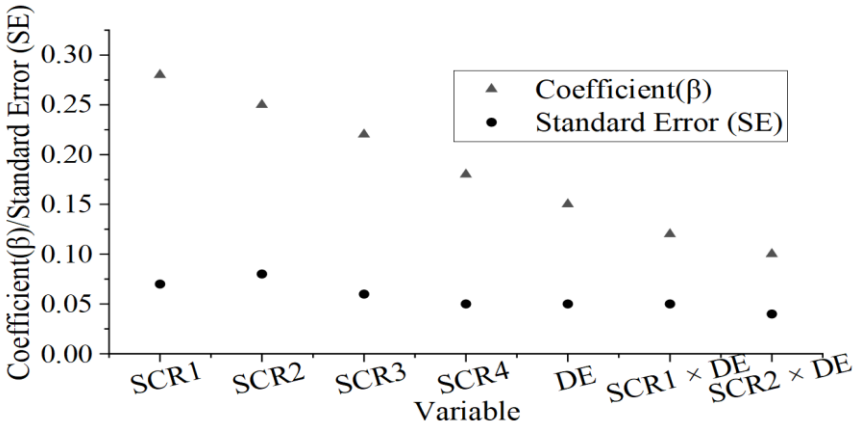

Figure 1. Regression coefficients and standard deviations

There is a substantial positive correlation between each facet of supply chain robustness and organizations' superior expansion. In particular, the standard error is 0.07 and the regression coefficient of risk resistance (SCR1) is 0.28, suggesting that it has a significant beneficial impact on the high-quality development of businesses. The digital economy (DE) has a favorable effect on the high-quality development of businesses, as evidenced by its regression coefficient of 0.15 and standard error of 0.05. According to the interaction conditions of sale, the online economy modifies the relationship between resilience to supply chains and high-quality business development, as illustrated in Figure 1. The regression coefficient of SCR1 × DE is 0.12, with an expected value of 0.05, and the corresponding regression coefficient of SCR2 × DE is 0.1, with a standard a mistake of 0.04.

According to the regression analysis results in Figure 2, the t-value and p-value of each variable show significant statistical significance. The digital economy (DE) has a t-value of 3 and a p-value of 0.003, which suggests that it also significantly improves the high-quality development of businesses. Regarding interaction terms, the digital economy significantly moderates the relationship between supply chain resilience and high-quality enterprise development, as evidenced by the t-value of SCR1 × DE of 2.4 and the p-value of 0.018 and the t-value of SCR2 × DE of 2.5 and the p-value of 0.013.

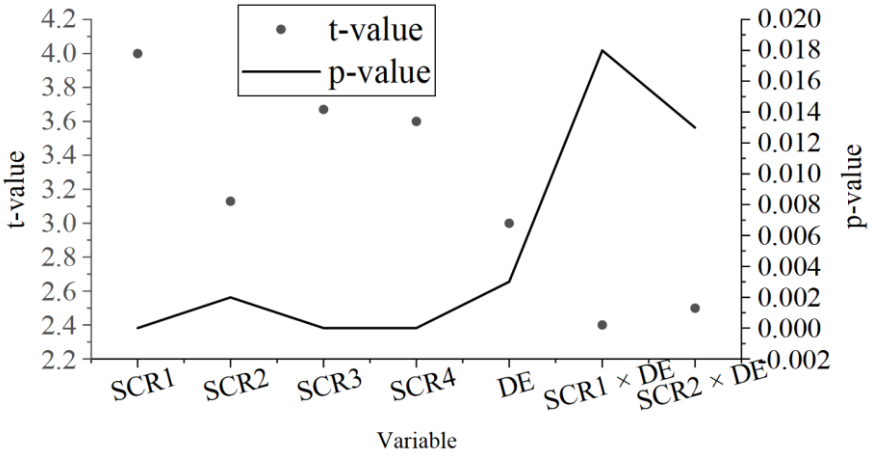

Figure 2. t value and p value

Note: When p<0.00001, it is too small and is directly displayed as 0 in the figure.

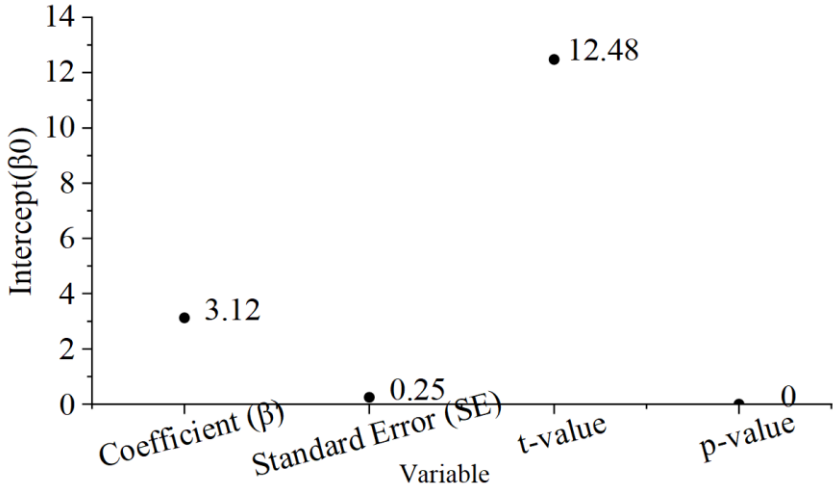

Figure 3. Intercept term

The intercept term is extremely important in the model, as shown by the regression analysis results in Figure 3, which show that its coefficient is 3.12, its standard error is 0.25, its t value is 12.48, and its p value is less than 0.00001. This indicates that the fundamental level of high-quality enterprise development is roughly 3.12 when all independent variables are zero, and this outcome is statistically significant.

5. Conclusion

This study deeply explores adaptability of the production chain's effects on the superior development of businesses, especially the regulatory role of the impact of the digital revolution on resilient supply chains in the electronic the economies surroundings. The results show that adaptability of the supply chain has a noteworthy favorable influence on the superior growth of businesses, especially in improving the innovation ability, market response speed and resilience of enterprises. Through the analysis of multiple dimensions of the supply chain (including risk resistance, resilience, chain recovery and creativity), this study reveals the specific impact of each dimension on the superior development of businesses, and further emphasizes the importance of improving supply chain resilience for the long-term stable and efficient operation of enterprises. In addition, the study also reveals that technological economy plays an important regulatory role in

this process. By increasing information sharing, maximizing resource allocation, and encouraging innovation, using digital technology not only makes the supply chain more adaptable and responsive but also advances the organization's high-quality development process. In enterprises with higher information technology and data analysis capabilities, the role of digital economy in promoting the relationship between supply chain resilience and high-quality development is more significant. In conclusion, this study offers theoretical justification and useful recommendations for how businesses can strengthen their supply chain system's resilience and improve their capacity to manage external risks in the age of the digital economy. Future research can further expand the connection between supply chain robustness and high-quality development in different industries, enterprise scales, and national contexts, and further verify the research findings' applicability and universality.

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