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Research on Manufacturing Supply Chain Insurance Demand and Product Supply Innovation

-- Based on a Survey in Foshan, Guangdong

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Abstract

Under the superposition of multiple factors such as epidemic and global economic slowdown as well as trade segmentation, the supply chain risk of manufacturing enterprises, especially small and medium-sized enterprises (SMEs), has been rising, and how to protect supply chain security with insurance as an important means of risk management is gradually becoming a research hotspot. This paper analyzes the main supply chain risks faced by manufacturing SMEs and the demand for insurance services through a questionnaire survey of 425 manufacturing enterprises in Foshan, Guangdong Province, and the results show that raw material prices, raw material quality, raw material shortages, breach of contract risk, and the risk of capital chain breakage have the most significant impact on the demand for insurance services. At present, although the insurance market is constantly innovating in the supply of insurance products, the degree of matching with the needs of enterprises is low, the product design and rate pricing lack of actuarial basis, and the participation rate of enterprises needs to be improved, and it is necessary to further safeguard the manufacturing supply chain risk from the supply side.

Keywords

Manufacturing Industry; Supply Chain Risk; Insurance Demand; Insurance Supply; Matching.

1. Introduction

Manufacturing is the foundation of a nation, the foundation of a strong nation. However, in recent years, "black swan" events occur frequently, enterprises continue to face the supply of raw material suppliers according to rationing, cost increases, pulling the gate to limit the power supply, production line shutdowns, order cancellation, logistics disruption and other risks, enterprises, especially small and medium-sized enterprises, the uncertainty of earnings increased significantly, therefore, the willingness of enterprises to reinvest in the declining, and become an important factor restricting the stable development of the manufacturing industry. Important factors that constrain the stable development of the manufacturing industry. How to protect the manufacturing industry to realize safe development? Insurance, as one of the means of risk management, has gradually expanded its functions from a single after-the-fact risk compensation to multiple functions such as ex ante risk prevention, investment and financing, social governance, etc. As early as in the first Sino-German Seminar in 2015, Mr. Liang Tao, Vice Chairman of the CIRC, pointed out that the insurance industry has to comprehensively promote "Made in China 2025", and requested the insurance industry to In recent years, the insurance industry has become a hot topic of discussion among various circles by continuously developing and providing products suitable for industrial development and providing high-quality insurance services.

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Academics have carried out more in-depth exploration of supply chain risk, specifically from the following aspects: first, from the perspective of the division of labor in the industrial chain to carry out research. From the perspective of the manufacturing industry chain, with the deepening of the vertical specialty division of labor, enterprise strategy selection is increasingly constrained by the vertical structure of the industry chain (Ling Chao and Zhang Zan, 2014). Upstream monopolies mainly extract efficiency rents by raising the prices of intermediate goods or raw materials, while firms in the downstream close to the competitive market usually do not have strong bargaining power and find it difficult to transfer the rising costs of intermediate goods to consumers by raising the prices of final products (Guo Shulong, Ge Jian et al., 2019). Midstream industries produce intermediate products (primary products and industrial reproductions) to provide downstream industries with components or intermediate raw materials for the assembly of end products, such as engines, integrated circuit boards, and carbon monochemicals (Cai, Wuciu, and Xu, Fengru, 2021). Downstream industries provide end products for consumers, typical products such as home appliances and automobiles. The degree of development of downstream industries is an important symbol of a country's degree of production equipment and the level of people's material living standards (Wang Zhiping, Liu Huanlong et al., 2021). The development of downstream industries depends on the development of upstream and midstream industries, but this dependence will be weakened with the increase of industrialization level. Second, the research is conducted from the perspective of industrial chain length and supply chain network. Supply chain network is an ecosystem with complex internal levels, affected by internal and external risks in the supply chain, supply chain activities will deviate from the normal expectations or plans, resulting in negative impacts on the upstream and downstream enterprises in the supply chain and increasing the vulnerability of the supply chain network (Svensson, 2000), and the longer the industrial chain and the more complex the supply chain, the more affected by the epidemic (Hong Wei, 2020). As supply chain risk is transmissible, from the procurement of raw materials, to the manufacturing of intermediate products, to the transportation of final products, enterprises have close links with each other, once a certain enterprise in the supply chain suffers from uncertainty, the risk will be transmitted to other enterprises along a specific path (Zhang Zhongyin, 2012). In supply chain disruption risk propagation, the stability of core node enterprises plays an important role in maintaining the stability of the supply chain network system (Liu Chunxia et al., 2015). The impact of the epidemic led to rising raw material prices affecting the manufacturing industry upstream enterprises, according to the business community price monitoring, 2021, the national chemical, non-ferrous metals, textiles and other nearly 80% of raw material prices rose ring, the main price of raw materials concentrated in the chemical, non-ferrous metals, textile and other sectors, of which non-ferrous metals as a whole rose by the highest rate of 62.60%, the chemical plate monolithic rose by the highest rate of 432.00%, the textile plate has the highest range of increase, the whole category of 18 kinds of raw material prices are showing an upward trend. Rising raw material prices show a wide range, many varieties and high rate of increase, while raw materials with a high degree of foreign dependence and raw materials related to the new energy industry have the most obvious rate of increase (Wu Changrong and Tao Tingting, 2022). Transportation and logistics control directly affects the circulation efficiency of raw materials, intermediate products and finished products, and enterprises face severe challenges in inventory management, the on-time delivery of orders is affected, and the risk of default by midstream and downstream enterprises increases (Hong Wei, 2020). Downstream exporters face a series of problems such as buyers' delayed payment and request for delayed shipment, at which time buyers' credit and the comprehensive strength of buyers' resistance to the adverse effects of the epidemic are crucial for exporters (Eddie Jiang, 2021). In addition, the impact of the epidemic also makes the cash flow of small and medium-sized manufacturing enterprises nervous. When facing the risk

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of capital chain, some small and medium-sized manufacturing enterprises have financing conditions just above the standard line due to the low comprehensive strength, little accumulation of enterprise credit, and long operation and investment cycle, etc., plus the urgent short-term demand and a single financing channel make it difficult for enterprises to obtain the required funds on schedule (Zhang Qunling, 2019).

Overall, scholars generally agree that small and medium-sized manufacturing enterprises will face more risks in the supply chain in the post-epidemic era, and at the same time, due to the transmissibility of supply chain risks, small and medium-sized manufacturing enterprises will be affected at the upstream, midstream and downstream ends, which are mainly manifested in the sudden increase in the price of raw materials, the quality of raw materials and raw material shortage risk, the risk of breach of contract, the risk of capital chain breakage, etc., and the small and medium-sized enterprises are difficult to prevent the risk through the means of internal control of the enterprise. Risks. However, the industry lacks in-depth systematic discussion on how to use insurance to transfer the supply chain risks faced by the industry.

Foshan is a nationally recognized manufacturing city, with private economy as the main body, with large scale, complete industrial categories, perfect industrial support, brand fame and many other advantages. This paper analyzes the main supply chain risks and insurance service demands faced by manufacturing SMEs through a questionnaire survey of 425 manufacturing enterprises in Foshan, Guangdong Province, and discusses how innovative insurance products and services can help SMEs cope with supply chain risks in light of the research on the supply situation of Foshan City's insurance market, which will provide important policy insights for Foshan City and even Guangdong-Hong Kong-Macao Greater Bay Area's insurance industry to cope with the supply chain risks of small and medium-sized manufacturing enterprises. The conclusion will be an important policy inspiration for the insurance industry in Foshan and the Guangdong, Hong Kong and Macao Greater Bay Area to cope with supply chain risks of small and medium-sized manufacturing enterprises.

2. Analysis of Influencing Factors of Enterprise Supply Chain Insurance Demand

2.1. Model Construction and Variable Selection

2.1.1. Model Building

Since the Logit model does not require the variables to satisfy normal distribution or equal variance, and the explanatory variable "the degree of enterprise demand for insurance products" has multiple options and is ordered, the multivariate ordered logistic regression model is used. The basic form of the model is as follows.

$$\ln\left(\frac{p(y \le j|x)}{1-p(y \le j|x)}\right) = u_j - \left(\alpha + \sum_{i=1}^{k} \beta_i x_i\right) \quad (1)$$

$p(y \le j|x)$Denote the cumulative probability of classification j and the following categories.

$$p(y \le j|x) = \frac{e^{u_j-(\alpha+\sum_{i=1}^{k}\beta_i x_i)}}{1+e^{u_j-(\alpha+\sum_{i=1}^{k}\beta_i x_i)}} \quad (2)$$

In equations (1) and (2), j denotes the five levels of firms' demand for insurance products, j = 1, 2, 3, 4, 5. y is the explanatory variable. x_i denotes the ith factor affecting firms' demand for

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insurance products, i = 1, 2.....k. α is the intercept term; β_i is the partial regression coefficient. $u_1, u_2, \ldots\ldots, u_j$ are the cut-off points.

2.1.2. Variable Selection

This paper takes the degree of enterprises' demand for insurance products as an explanatory variable. On the basis of relevant research results, combined with the actual research situation, this paper selects raw material price risk, raw material quality risk, raw material shortage risk, default risk, capital break risk, annual income of the enterprise, the number of employees of the enterprise as the factors affecting the degree of enterprise's demand for insurance products, and the assignments of the various types of variables are shown in Table 1.

Table 1. Description of model variables

Variable name	Variable code	Variable Definition
Insurance for Businesses Demand for insurance products	*Y*	Very low demand = 1, low demand = 2, average demand = 3. High demand = 4, very high demand = 5
Raw material price risk	X_1	Very low impact = 1, low impact = 2, average impact = 3, high impact = 4, very high impact = 5
Raw material quality risk	X_2	Very low impact = 1, low impact = 2, average impact = 3, high impact = 4, very high impact = 5
Risk of shortage of raw materials	X_3	Very low impact = 1, low impact = 2, average impact = 3, high impact = 4, very high impact = 5
default risk	X_4	Very low impact = 1, low impact = 2, average impact = 3, high impact = 4, very high impact = 5
risk of financial breakdown	X_5	Very low impact = 1, low impact = 2, average impact = 3, high impact = 4, very high impact = 5
Annual income from enterprises	X_6	$500,000 and below = 0, $500,000 - $1,000,000 = 1, $1,000,000 - $3,000,000 = 2, $3,000,000 - $10,000,000 = 3, $10,000,000 - $20,000,000 = 4, $20,000,000 and above = 5
Number of employees in the enterprise	X_7	Up to 50 = 1, 50-100 = 2, 100-200 = 3, 200-300 = 4, 300 and over = 5

2.1.3. Estimated Results

According to the constructed model, SPSS26.00 statistical software is used to carry out multivariate ordered logistic regression estimation to analyze the influencing factors of the enterprise's demand for insurance products. The specific operation is carried out in two steps: the first step is to introduce all the explanatory variables into the multivariate ordered logistic regression equation to obtain model Ⅰ; the second step is to screen the explanatory variables and eliminate the variables that are not significant on the regression, until all the variables entering the model are more significant, to obtain the model Ⅱ (see Table 2). Model Ⅱ shows that five explanatory variables, including raw material price risk, raw material quality risk, raw material shortage risk, default risk, and capital break risk, are included in the model and have a significant effect on the explanatory variables, while two explanatory variables, namely, annual income of the enterprise and the number of employees of the enterprise, are eliminated and have a non-significant effect on the explanatory variables.

The parallel line test is the basis for judging whether the multivariate ordered Logistic regression model is applicable. The parallel line test was conducted for Model I and Model II respectively, and the results showed that the P-values of the two models were 0.141 and 0.713 respectively, which were greater than 0.05, indicating that the data met the conditions of using the multivariate ordered Logistic regression model.

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Table 2. Estimated results of multivariate ordered logistic regression model

Variable name		Model Ⅰ			Model Ⅱ	
Insurance for Businesses Demand for insurance products	B	sig	EXP(B)	B	sig	EXP(B)
Raw material price risk	0.835	0.048	2.305	0.836	0.045	2.307
Raw material quality risk	0.164	0.017	1.178	0.159	0.015	1.172
Risk of shortage of raw materials	0.520	0.041	1.682	0.722	0.032	2.059
default risk	0.711	0.008	2.036	0.680	0.011	1.974
risk of financial breakdown	0.902	0.000	2.465	0.887	0.000	2.428
Annual income from enterprises	0.637	0.145	1.890	——	——	——
Number of employees in the enterprise	0.201	0.499	1.223	——	——	——

2.1.4. Analysis of Results

1) Impact of raw material prices

In Model II, the biased regression coefficient of the raw material price risk variable is 0.836, which shows a significant positive influence on the degree of demand for insurance products by enterprises at the 5% statistical level, i.e., the greater the degree of influence of raw material prices, the greater the degree of demand for insurance products by enterprises. The dominance ratio of this variable is 2.307, which indicates that all other things being equal, the possibility of increasing the degree of demand for insurance by one level will increase by 130.7% for every one level increase in the degree of influence . The main reason for this is that the substantial increase in the price of raw materials has led to an increase in the cost of enterprises, which has made the liquidity of enterprises worse, and the degree of demand for insurance products has greatly increased.

2) Influence of raw material quality

In Model II, the partial regression coefficient of the raw material quality risk variable is 0.159, which shows a significant positive influence on the degree of demand for insurance products by enterprises at the 5% statistical level, i.e., the greater the degree of influence of raw material quality, the greater the degree of demand for insurance products by enterprises. The dominance ratio of this variable is 1.172, which indicates that, all other things being equal, for every increase in the degree of influence by one level, the likelihood of increasing the degree of demand for insurance by one level will increase by 17.2%. The main reason for this is that the applicability of the selected raw materials can not meet the quality requirements stipulated in the design and relevant specifications, resulting in unqualified products, on the one hand, can not be circulated into the market, the product to increase the cost of the enterprise, on the other hand, into the market to cause adverse consequences, the loss caused by the enterprise will be greater. The greater the quality risk of raw materials, the greater the demand for insurance products.

3) Impact of raw material shortages

In Model II, the biased regression coefficient of the raw material shortage risk variable is 0.722, which shows a significant positive influence on the degree of demand for insurance products by enterprises at the 5% statistical level, i.e., the greater the degree of influence of raw material shortage, the greater the degree of demand for insurance products by enterprises. The dominance ratio of this variable is 2.059, which indicates that, all other things being equal, for every increase in the degree of influence by one grade, the likelihood of increasing the degree of demand for insurance by one grade will increase by 105.9% . The main reason for this is that the degree of demand is higher due to the impact of the New Crown Epidemic, which affects the normal operation of enterprises by blocking logistics and express delivery, and affects enterprises in the production chain.

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4) Impact of default risk

In Model II, the partial regression coefficient of the default risk variable is 0.680, which shows a significant positive influence on the degree of demand for insurance products by enterprises at the 5% statistical level, i.e., the greater the degree of influence of default risk, the greater the degree of demand for insurance products by enterprises. The dominance ratio of this variable is 1.974, which indicates that, all else being equal, for every one level increase in the degree of impact, the likelihood that the degree of demand for insurance will increase by one level will increase by 97.4%. The main reason for this is that the shortage of raw material prices leads to the inability to produce products on schedule, the inability to deliver as promised, and the risk of defaulting on the contract and paying a large amount of liquidated damages; the higher the risk of contractual default, the higher the degree of demand for insurance products.

5) Impact of the financial interruption

In Model II, the partial regression coefficient of the capital break risk variable is 0.887, which shows a significant positive influence on the degree of demand for insurance products by enterprises at the 5% statistical level, i.e., the greater the degree of influence of capital break risk, the greater the degree of demand for insurance products by enterprises. The dominance ratio of this variable is 2.428, which indicates that, all other things being equal, the likelihood of increasing the degree of demand for insurance by one level will increase by 142.8% for every one level increase in the degree of impact . The reason for this is that supply chain revenues are reduced, there are fewer sources of financing, maintaining the minimum level of cash flow increases, and insurance products play an effective role in alleviating financial pressures.

3. Problems in Foshan's Insurance Service Manufacturing Industry

3.1. Capital Risks for Small and Medium-sized Manufacturing Enterprises Still Exist

For small and medium-sized manufacturing enterprises, the risk of capital chain exists for a long time. Failure to collect accounts receivable in a timely manner can lead to a tight financial chain, preventing enterprises from better investing capital in their products, which in turn leads to failure to produce and deliver in a timely manner and creates the risk of default. Among the 425 SMEs participating in the survey, most of them have indicated that they have financial risks, especially difficulties in credit. At present, the city of Foshan for small and medium-sized manufacturing industry financing difficulties has launched a small loan guarantee insurance, after several years of development, the development of the insurance results are remarkable, in 2020 the city of Foshan policy small loan guarantee insurance program services for small and medium-sized micro-enterprises 770, for the enterprise to issue a low-interest loan of 790 loans, a total of 1.646 billion yuan, to help solve the micro-enterprises micro-financing needs. However, Foshan City has a large number of small and medium-sized manufacturing industries, and over the past five years, the number of market players in Foshan has increased from 536,000 to 1.115 million. Therefore, overall, in terms of microfinance guarantee insurance, the participation rate of enterprises is still relatively low.

3.2. Strong Demand for Insurance from Upstream Manufacturing Companies, Fewer Insurance Products Related to Raw Materials

Rising commodity prices affect the upstream industries of small and medium-sized manufacturing industries in Foshan. From the point of view of insurance demand, according to the National Input-Output Table 2017 released by the National Bureau of Statistics, the main equipment manufacturing industry is the equipment manufacturing industry that consumes more metal products completely. The electrical machinery and equipment manufacturing industry, as a pillar industry in Foshan, is greatly affected by the upstream metal raw material

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price increases, and the results of the questionnaire survey show that nearly 75% of the enterprises are facing the risk of sudden increases in raw material prices. From the point of view of the insurance supply, Foshan City, for raw material price increases in insurance only "corn price insurance", the service object for the feed production enterprises, the insurance company does not provide and equipment manufacturing industry raw material price increases related to insurance products.

3.3. Insurance Products are at a Blank Stage as Purchasing Risks Increase in Manufacturing Midstream Companies

The increase in oil and natural gas prices will be transmitted to the middle and lower reaches of the rubber, textile, textile and garment, and leather footwear industries through the upstream enterprises. According to the 2021 Foshan Statistical Yearbook, the rubber and plastic products industry and the textile industry in Foshan City ranked fourth and tenth respectively in terms of total industrial output value of the manufacturing industry in Foshan City. In terms of insurance demand, it was found that sudden price increases in the raw material market, delays in supplier deliveries, lower raw material quantities from suppliers, the inability to find alternative sources of supply and the risk of refusal to supply from key suppliers have increased the procurement risk for most midstream enterprises. In terms of insurance supply, the current insurance products designed for supplier default risk include procurement contract performance guarantee insurance, which was first proposed nationwide in 2020 and is currently in a blank stage in the Foshan City area.

3.4. Business Interruption Risk Rises for Downstream Manufacturing Companies, Insurance Products Fail to Meet Business Needs

From the aspect of insurance demand, in the supply chain operation system, the middle and upper reaches of the enterprise there are delivery delays, insufficient inventory, unable to deliver and other problems will not only cause the enterprise itself to bear the compensation for breach of contract, but also may lead to its downstream enterprises due to the supply of raw materials or intermediary products is not timely to affect the production and processing, and thus lead to the downstream enterprise business interruption, and even cause the whole supply chain production stagnation. Foshan City, automobile manufacturing industry, for example, tires are one of the necessary parts of automobile production, the main raw material is rubber, if the rubber industry suppliers have delivery problems, will inevitably affect the production of the automobile manufacturing industry. In terms of insurance supply, non-material loss business interruption insurance and supply performance guarantee insurance can cover part of the loss caused by service interruption/delay when downstream enterprises acquire products. However, this insurance is in the exploratory stage, and Foshan City Insurance Company does not provide such insurance products for the time being.

3.5. Increased Trade Risks for Downstream Manufacturing Firms, Need to Expand Insurance Product Coverage

From the perspective of insurance demand, the number of foreign trade enterprises in Foshan City continues to increase, the scale of foreign trade continues to expand, from 2012 to 2022, Foshan City's foreign trade import and export trade volume in ten years from 384,678 million yuan to 616,070 million yuan, an increase of 60%, with an average annual growth rate of 6.6%. With the increasing uncertainty of future economic policies, enterprises' demand for export credit insurance will continue to rise. From the perspective of insurance supply, since 2016 the Foshan government has issued a number of policies in cooperation with China Credit Insurance Corporation (CICC) to strongly support the export of small, micro and medium-sized enterprises, but as mentioned earlier, the government has certain restrictions on the amount of import and export of enterprises. In the future, the government should lower the export size

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limit and help insurance companies continue to expand the coverage of export credit insurance to provide services such as accounts receivable protection and overseas recovery for enterprises' exports.

4. Conclusion

4.1. Build a Communication Platform between Insurance Companies and Manufacturing Enterprises to Improve Enterprise Risk Awareness

On the one hand, insurance companies can cooperate with the government to build a platform for exchanges with the manufacturing industry, strengthen pre-sales services, and improve enterprises' knowledge of insurance through media, network, and field publicity; on the other hand, enterprises should actively participate in the insurance and financial knowledge training, so as to better understand the focus of the risks they face in the supply chain, and provide timely feedback to the insurance company on the supply chain, especially the risk scope not covered by the current insurance products, so that the insurance company can collect timely information and develop new products. On the other hand, enterprises should actively participate in insurance and financial knowledge training so as to better understand the focus of risks they face in the supply chain, and provide timely feedback to insurance companies on the problems in the supply chain, especially on the scope of risks that cannot be covered by the current insurance products, so that the insurance companies can collect information in time to develop new products. Improve the ability of choosing insurance products and evaluating financial risks. At the same time, enterprises actively understand the relevant policies issued by the state and local governments, especially the insurance policies related to the production and operation of enterprises, and utilize insurance to reduce losses and risks.

4.2. Innovative and Improved Insurance Products to Expand Coverage of Supply Chain Risks

For insurance organizations, on the one hand, to improve insurance products, for the current Foshan City, small and medium-sized manufacturing industry to cope with supply chain risk and has not yet developed the type of insurance should be arranged for staff to go to the enterprise to conduct on-site visits, to understand the risk of enterprise pain points, while learning from the advanced experience of other provinces and municipalities, relying on the government and industry associations, to improve the development of the insurance terms and rates. On the other hand, it is necessary to improve the insurance service, for the insurance products that have not been developed for a long time, the use of insurance technology means to collect the feedback of users in order to adjust the products in time, and do a good job in the after-sales service of the insurance.

4.3. The Government Plays a Leading Role in Enhancing the "Bottom-up" Function of the Insurance Industry

As far as the government is concerned, it should firstly simplify the approval process of relevant insurance specialties to better serve the small and medium-sized manufacturing industries. Secondly, financial subsidies for supply chain risk insurance products for small and medium-sized manufacturing industries should be strengthened to reduce the financial burden of enterprises. According to the national policy and enterprise demand, the insurance products corresponding to the supply chain risk will be divided according to the degree of sociality, and the implementation of subtypes, sub-risk policy financial premium subsidies. Finally, the government can play a market-leading role in guiding insurance funds to support enterprise development.

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