

An empirical study on the Influence of Supply Chain Concentration on Inventory Management of Chinese Manufacturing Enterprises

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Abstract. The development of manufacturing industry reveals a country's productivity level, and supply chain concentration and inventory management are extremely important for manufacturing enterprises, because it not only contributes to the internal and external circulation of manufacturing enterprises, but also brings certain economic value. Chinese enterprises sell their products all over the world by virtue of excellent supply chain and efficient inventory management. In this paper, we take Chinese listed manufacturing enterprises from 2007 to 2021 as the research object to explore the impact of supply chain concentration on their inventory turnover. The empirical results show that the higher the concentration of the supply chain, the higher the inventory turnover of manufacturing enterprises, that is, the higher the efficiency of inventory management. In addition, customer concentration will also play a positive role in regulating the relationship between the two.

Key words: Concentration of supply chain; inventory management; inventory turnover rate.

1. Introduction

Globalization closely links the knowledge, technology, materials and information of various countries, and the Internet and the supply chain are one of the key tools to spread them. As a big manufacturing country, China has a perfect industrial structure and plays an important role in the process of world globalization. The development of Chinese enterprises is constantly optimized due to the continuous dissemination of knowledge and product demand from other countries. Since the reform and opening up, Chinese manufacturing enterprises have been constantly transformed and upgraded, and more and more manufacturing enterprises have applied automated production equipment to the production line, which not only improves the delivery speed of manufacturing enterprises, but also enhances their value and core competitiveness. As the technology continues to develop, the competition between enterprises will no longer be limited to product features, but will also extend to enterprise innovation, sales and after-sales, supply chain and other aspects. As a result, the game between companies will become more intense. A large number of global top-ranking companies rely on suppliers with good reputation, because this not only affects their daily operations, but also affects the attitudes of customers and investors towards them, which also explains why having a good supply chain is particularly important for the long-term development of enterprises. The main function of the supply chain is the turnover of raw materials, commodities and other inventories. The process from purchasing raw materials from suppliers to converting within the enterprise to transporting products to distributors or customers is inseparable from the support of a strong supply chain. Since the COVID-19 pandemic, more and more countries have been surprised to find serious challenges in their supply chains, both in terms of anti-epidemic materials and living materials. In the early days of the pandemic, the amount of countries fought each other in the process of competing for supplies, and plenty of EU countries complained to each other that each other's aid was not in place, indicating that an excellent supply chain is crucial from the national level to the enterprise and individual level.

Inventory is an essential element in the daily production and operation of an enterprise, and the enterprise enhances its value and obtains profits by continuously converting it. Inventory management is traditionally a major concern of contemporary companies. Most scholars discuss the impact of supply chain concentration in all industries, and few scholars pay attention to industries

such as retail. In view of this, this work only takes the manufacturing industry as the research object, because the dependence of the manufacturing industry on the supply chain is different from that of other industries. This research consists of five parts, the first part is the introduction; the second part is the literature review, which is a theoretical review of the previous scholars' research; the third part proposes the research design and variable definition according to the hypothesis of the article; the fourth part is the empirical analysis, the quantitative analysis is carried out through the collected data; the fifth part is the conclusion.

2. Literature review

The concentration of the supply chain involves the concentration of suppliers and the concentration of customers, and it has been the goal of many enterprises to connect the two closely. The concentration of the supply chain is based on the partnership between suppliers, production enterprises and customers. It is an important medium for the delivery of raw materials and products, which can optimize the relationship between suppliers, manufacturers and customers and reduce certain costs. Kong (2011) reported that the social network relationship between suppliers and customers can reduce transaction costs by reducing the risk of information asymmetry, such as loan fees, advertising expense and so on. Wang et al. (2016) found that the higher the concentration of suppliers and customers, the more advantageous it will be for enterprises to go to the bank for loans, and the stronger the bank borrowing capacity of enterprises will be. James et al. (2020) held that the higher the degree of dispersion of suppliers in an enterprise, the greater the risk that the enterprise will face, and the higher the cost of debt it will face. Liu et al. (2022) determined that the market power of suppliers can enhance customer stability.

Inventory management is a key link in the daily production and operation activities of enterprises, because it integrates the inventory of all kinds of raw materials into finished products, semi-finished products, defective products and so on. The liquidity of different inventory will be different, the liquidity of most products will be relatively poor, inventory can only rely on the supply chain to improve its liquidity. In the process of studying inventory management, inventory turnover rate is widely used as a measurement index. For example, Zhang et al. (2022) used inventory turnover rate as the measurement index of inventory management, which confirmed that the concentration of supply chain plays a positive role in the inventory turnover rate of Chinese listed enterprises in all industries. Li et al. (2017) pointed out that there is a significant positive correlation between supply chain concentration and inventory management efficiency, and a significant negative correlation between supply chain concentration and enterprise commercial credit management efficiency. Manufacturing industry is a very important part of industry, which converts materials into different resources according to market demand, which is the foundation of China, so this paper studies the manufacturing industry separately. Wang et al. (2021) determined that if manufacturing enterprises have a better supply chain relationship, it will enhance their ability to control uncertainty and enhance the efficiency of manufacturing enterprises to adjust products or markets. To sum up, it is concluded that the supply chain concentration of manufacturing enterprises has a certain impact on inventory turnover, so the following hypothesis is put forward:

H: The supply chain concentration of manufacturing enterprises is positively correlated with the inventory turnover rate of enterprises.

3. Research design

The paper uses the data of China's listed manufacturing enterprises in Shanghai and Shenzhen stock exchange from 2007 to 2021 as the research sample. All of data are collected from the CSMAR database and other major websites. In the process of sample processing, ST companies and samples with missing variables were first removed, and only manufacturing enterprises were retained in the sample. Then, all continuous variables are winterized by 1%, and finally we drop the missing variables during the merger process. There are samples that leave out key information. This article takes China in 2007 as the starting point of the sample, because China adopted new accounting standards and principle since that year, and various accounting measurement methods have changed, so the data before 2007 will not be used as measurement indicators.

The explained variable of this paper is supply chain concentration, which is the sum of the procurement ratio of the top 5 suppliers and the sales ratio of the top 5 customers, and divided by 2. The higher the indicator, the higher the concentration of the supply chain; this paper explains

Variable type	Variable names	Variable definition
Explained variables	Supply chain	The sum of the top 5 suppliers purchasing ratio and the top 5 customers selling ratio divided by 2.
Explanatory variables	Inventory	Operating cost/Average of beginning and ending inventory.
Control variables	Return on asset (ROA)	Net profit after tax divided by ending total assets
	Size	The natural log of ending assets
	Loss	If loss occurs, it is 1, otherwise it is 0
	Cashflowrate	Net cash flows from operating activities divided by total assets at the end of the period
	Lev	Total ending assets divided by total ending liabilities.

variable is the inventory turnover rate, which is the operating cost divided by the average value of the company's inventory from the beginning to the end of the period. The higher the indicator, the stronger the company's inventory turnover ability. At the same time, this paper refers to the research of most scholars and selects the following control variables:

Totally, this paper constructs the following model, and the Supply chain represents the explanatory variable supplier concentration, and the Inventory is the explanatory variable, representing the inventory turnover rate, and the Controls is the control variable. Since this paper only studies manufacturing enterprises, there is no need to control the industry, and just need to control the year, ϵ represents the residual, and the subscripts i and t represent respectively different individual companies and years.

$$\text{Supply chain}_{i,t} = a_0 + a_1 \text{Inventory}_{i,t} + a_2 \text{Controls}_{i,t} + \sum \text{Year} + \epsilon_{i,t}$$

4. Result

4.1 Descriptive statistics and pairwise correlations result

Table 1 is the descriptive statistics of our paper. After data cleaning process, there are 21,187 samples participated in the empirical research. The minimum value of inventory turnover rate is 0.058, the highest value is 7.755, and the average value is 1.193, which indicate that most manufacturing enterprises have inventory turnover situation is not good. This result is similar to the results of Qin Hailin and Duan Shucai (2022) which surveyed industrial enterprises; the average value of return on asset is 0.014 and the standard error is 0.021, indicating that the overall difference in ROA of the manufacturing industry do not have too much difference; only 8.5% of the manufacturing enterprises are loss money, and most of the manufacturing enterprises are in a state

of profit; the descriptive results of most of the data are similar to the results of previous papers, indicating that the data in the article are true and reliable. Table 2 shows the correlation problem. It can be seen from the table that there is no serious multicollinearity problem between the variables, which satisfies the basic assumption of the OLS model. Furthermore, Inventory is positively correlated with Supply, which preliminarily validates the direction of our empirical hypothesis.

Table 1 Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Inventory	21187	1.193	1.269	.058	7.755
Supply	21187	30.125	16.414	3.72	77.93
ROA	21187	.014	.021	-.025	.106
Size	21187	21.682	1.232	19.111	25.238
Loss	21187	.085	.278	0	1
Cashflowrate	21187	.978	1.799	.007	11.831
Lev	21187	.399	.207	.045	.959

Table2 Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1)Inventory	1.000						
(2)Supply	0.104*	1.000					
(3)ROA	0.366*	0.034*	1.000				
(4)Size	-0.070*	-0.225*	-0.220*	1.000			
(5)Loss	-0.050*	0.051*	-0.251*	0.019*	1.000		
(6)Cashflowrate	-0.058*	0.063*	0.117*	-0.235*	-0.101*	1.000	
(7)Lev	0.082*	-0.109*	-0.274*	0.397*	0.244*	-0.527*	1.000

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.2 Empirical result

Table 3 shows the empirical results of the paper. Column (1) is the main regression of the paper, which is tested by the OLS model. The first column result shows that the concentration of the supply chain is positively correlated with the inventory turnover rate, and hypothesis of our paper is established. By controlling the variables, we found that the higher the Return on asset (ROA) and the higher the asset-liability ratio of the enterprise, the higher the inventory turnover rate of the enterprise.

In order to make the empirical conclusions more convincing, the paper using the methods of replacing explanatory variables, and then we use the fixed-effects model for regression, and finally adding adjustment variables for further testing. Column (2) is the result of replacing the explanatory variable, the replaced explanatory variable is the Herfindahl index of supply chain concentration, which is the sum of the squares of the ratios of the top five supply chain purchases to the total purchases. The higher the index, the more concentrated the supply chain. The empirical results confirm the main hypothesis again. In column (3), on the basis of adding the fixed effect model, the variables that do not change with time are eliminated, so as to carry out the robustness test. It can be seen that the empirical results are still robust. Column (4) adds the customer concentration index as a moderating variable, and generates the multiplication term Supply* Customer with the explanatory variable. Through empirical analysis, we found that the customer concentration has positively effects on the relation between supply chain concentration and inventory turnover rate.

Table 3 Empirical result

VARIABLES	(1)	(2)	(3)	(4)
Supply	Inventory 0.009*** (7.10)	Inventory	Inventory 0.005*** (5.02)	Inventory 0.011** (2.53)
HHI-Supply		0.021*** (4.52)		
Supply* Customer				0.000*** (2.85)
Customer				-0.010*** (-6.02)
ROA	24.583*** (26.10)	24.805*** (22.87)	27.750*** (30.87)	24.704*** (25.76)
Size	-0.030 (-1.51)	-0.044** (-2.01)	-0.211*** (-5.80)	-0.031 (-1.62)
Loss	-0.024 (-0.72)	-0.080** (-1.99)	-0.023 (-0.93)	-0.069* (-1.96)
Cashflowrate	-0.012 (-1.58)	-0.020** (-2.06)	0.008 (1.60)	-0.023*** (-2.88)
Lev	1.247*** (11.67)	1.312*** (9.62)	1.021*** (9.23)	1.282*** (12.08)
Year	Yes	Yes	Yes	Yes
FE			Yes	
Constant	0.803* (1.95)	0.803* (1.95)	4.653*** (6.14)	0.910** (2.23)
Observations	21,187	21,187	21,187	17,444
Adj-R-squared	0.187	0.207	0.334	0.190
Number of id			2,778	

Cluster t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

Manufacturing enterprises are advised to actively deal with the relationship between suppliers and customers, increase the efficiency of inventory management, and timely and effectively deliver the value of the enterprise to the end users of the products. At present, the partnership between upstream and downstream enterprises in the supply chain has grown into an indispensable resource allocation mechanism. This kind of supply chain partnership based on competition theory has dynamic evolution, but enterprise practice and theoretical research should not only observe supply chain management from a local perspective, but should observe various impacts of supply chain management and supply chain partnership management on enterprises from a global perspective, that is, from the perspective of enterprise strategic management. Since the outbreak of the COVID-19 pandemic, the global situation has changed dramatically. Manufacturing enterprises are facing a series of challenges, such as intensified competitive environment, rising labor costs, overcapacity, lack of core competitiveness, etc. This suggests that it should formulate a reasonable development strategy and constantly adjust itself in the changes of the times, so as to clear the breakthrough of getting rid of difficulties and sustainable development while maintaining daily production and operation.

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