

Research on the relationship between supply chain concentration, inventory management and performance based on regression model-Take Chinese auto manufacturing companies as an example

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Abstract. In order to explore the relationship between supply chain concentration, corporate performance and corporate inventory management level of Chinese auto manufacturing enterprises, this paper uses the results of the Hausman test combined with the effect regression model to analyze the data of 71 Chinese listed auto manufacturing enterprises from 2017 to 2019. The research results show that: (1) Supply chain concentration is positively correlated with enterprise performance; (2) Supply chain concentration is positively correlated with inventory management level; (3) Inventory management level is positively correlated with enterprise performance; (4) The mediating effect of inventory management level is not significant.

Keywords: supply chain concentration, inventory management level, corporate performance, Chinese auto manufacturing enterprises, regression model.

1. Introduction

With the development of economic globalization, more and more enterprises realize the inadequacy of traditional enterprise management methods. As one of the pillar industries in China, the automobile manufacturing industry has its economic contribution and important influence on many related industries ^[1]. The supply chain of the automobile manufacturing industry is one of the most complex supply chain systems ^[2], and it revolves around the core manufacturing enterprises in the midstream, and studying the complex relationship between variables will help improve the management ability and level of Chinese automobile manufacturing enterprises.

The automobile industry is a technology-intensive industry, and capital, manpower and technical input are crucial to enterprise costs. Through close cooperation with upstream and downstream enterprises, timely adjustment of production and investment is conducive to the improvement of supply chain concentration and helps enterprises achieve lean inventory management, reduce inventory pressure and inventory costs, thereby positively impacting business performance. According to the operation management theory, when the concentration of sellers is high, the reduction of the number of sellers can reduce the uncertainty of demand and weaken the influence of the bullwhip effect. Therefore, enterprises establish stable cooperative relations with a few major suppliers and sellers, and improve the concentration of the supply chain, which is conducive to the reduction of inventory levels and the improvement of inventory turnover rates, thereby improving corporate performance. Especially for Chinese automobile manufacturing enterprises, if there is a backlog of inventory, the enterprise will face higher inventory management costs and inventory scrapping risks, which is not conducive to the improvement of enterprise performance. However, in the existing research ^[3, 4, 5], the research on the positive and negative correlation between supply chain concentration, enterprise performance and inventory management level is still unclear. At the same time, there are few studies on whether inventory management level has a mediating effect between supply chain concentration and enterprise performance.

Therefore, this paper divides supply chain concentration into supplier concentration and seller concentration. Based on the data of 71 Chinese listed auto manufacturing companies from 2017 to 2019, the Hausman test combined effect regression model is used to study the relationship between

supply chain concentration, corporate performance and corporate inventory management. In order to build the best supply chain partnership and improve performance for Chinese auto manufacturing enterprises, policy recommendations are put forward, so as to promote enterprises to obtain greater benefits in the fierce market competition.

2. Model establishment and data sources

2.1 Principles of sample selection and data sources

In order to study the relationship between supply chain concentration, inventory management and enterprise performance of automobile manufacturing enterprises, this paper selects and processes the experimental samples according to the following four principles: (1) Select automobile manufacturing enterprises according to the industry classification standard of China Securities Regulatory Commission in 2012; (2) Select consolidated statement data and exclude the data reported by the parent company; (3) Exclude companies with abnormal financial data such as ST or *ST; (4) Eliminate companies with missing research variable data.

According to the above-mentioned sample selection principles, 24 vehicle manufacturers and 47 auto parts manufacturers were selected from the domestic A-share listed companies, and a total of 71 Chinese listed auto manufacturers were studied. The research period is from 2017 to 2019, and a total of 213 valid observations are collected. The data is mainly from the Wind database and the annual reports of 71 listed companies.

2.2 Variable selection

Referring to the existing research results ^[6-17], this paper selects supplier concentration as the explanatory variable, and return on total assets (ROA) as a measure of the explained variable. The level of inventory management of enterprises is the intermediary variables, and using inventory turnover (IV) as a measure of the intermediary variable. Gross profit margin, company size, proportion of fixed assets, manufacturing purchasing manager index and inflation rate are taken as control variables. The specific definitions and symbols of each variable are shown in Table 1.

Table 1 Variable Definitions

Variable Name	Variable Symbol	Calculation Method
Panal A: Interpreted Variable		
ROA	Return on total assets	Earnings before interest and tax/average total assets
Panal B: Explanatory Variable		
SPP	Supplier concentration	The proportion of the purchase amount of the top five suppliers to the total purchase amount of the company
SLP	Retailer concentration	The proportion of the sales amount of the top five sellers to the total sales amount of the company
Panal C: Intermediary Variable		
IV	Inventory turnover	Average cost of main business/net inventory
Panal D: Control Variable		
S	Company size	Expressed by main business income
GM	Gross profit rate	(Main business income-main business cost)/main business income
FAP	Proportion of fixed assets	Fixed assets/total assets
PMI	Manufacturing purchasing managers index	Average of 12 months in the current year
Infl	Inflation rate	(Purchase price index of industrial producers in current year-purchase price index of industrial producers in

		last year)/purchase price index of industrial producers in last year
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2.3 Research methods

For Chinese automakers, since there are other factors that vary with individuals but not with time, and are related to explanatory variables, this paper uses S, GM, FAP, PMI and Infl as control variables on the basis of the above analysis. Individual fixed-effect regression models for panel data were established respectively.

2.3.1 The relationship between concentration degree, enterprise performance and inventory management level

In order to study the relationship between the concentration of suppliers and sellers, the performance of Chinese auto manufacturers and the level of inventory management, regression models A and B are constructed respectively, as shown in Equations (1), (2) and Equations (3), (4).

$$ROA_{i,t} = \alpha_i + \beta_1 SPP_{i,t} + \beta_2 \log(S_{i,t}) + \beta_3 GM_{i,t} + \beta_4 FAP_{i,t} + \beta_5 PMI_t + \beta_6 Infl_t + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \alpha_i + \beta_1 SLP_{i,t} + \beta_2 \log(S_{i,t}) + \beta_3 GM_{i,t} + \beta_4 FAP_{i,t} + \beta_5 PMI_t + \beta_6 Infl_t + \varepsilon_{i,t} \quad (2)$$

In equations (1) and (2), since the automobile industry is a large economic industry, the powerful automobile industry market in the real world presents more and more prominent oligopoly characteristics. S is expected to be positive, then GM, FAP, PMI and the coefficients for Infl are all expected to be positive.

$$IV_{i,t} = \alpha_i + \beta_1 SPP_{i,t} + \beta_2 \log(S_{i,t}) + \beta_3 GM_{i,t} + \beta_4 FAP_{i,t} + \beta_5 PMI_t + \beta_6 Infl_t + \varepsilon_{i,t} \quad (3)$$

$$IV_{i,t} = \alpha_i + \beta_1 SLP_{i,t} + \beta_2 \log(S_{i,t}) + \beta_3 GM_{i,t} + \beta_4 FAP_{i,t} + \beta_5 PMI_t + \beta_6 Infl_t + \varepsilon_{i,t} \quad (4)$$

In formulas (3) and (4), since large enterprises have the ability to concentrate on demand and can use their own advantages to improve their own inventory management level, S is expected to be positive. Higher gross margins mean relatively higher prices, lower demand, and lower inventory turnover, so GM is expected to be negative. Also, since greater investment or technological transformation of the enterprise in equipment, warehouse, information technology, etc. is conducive to improving the level of automation and informatization of the enterprise, thereby improving the level of inventory management, the FAP is expected to be positive. The development of the macro economy is conducive to the improvement of the level of corporate inventory management, so the manufacturing PMI and Infl are both expected to be positive.

2.3.2 The relationship between inventory management and enterprise performance

In order to study the hypothesized positive correlation between the inventory management level and performance of Chinese automobile manufacturers, the regression model C is constructed as shown in Equation (5).

$$ROA_{i,t} = \alpha_i + \beta_1 IV_{i,t} + \beta_2 \log(S_{i,t}) + \beta_3 GM_{i,t} + \beta_4 FAP_{i,t} + \beta_5 PMI_t + \beta_6 Infl_t + \varepsilon_{i,t} \quad (5)$$

In formula (5), the inventory turnover coefficient of IV is expected to be positive, and the positive and negative expectation analysis of the remaining control variable coefficients is the same as formulas (3) and (4).

2.3.3 The mediating role of inventory management level

In order to study whether the level of inventory management plays a mediating role in the influence of the concentration of suppliers and sellers and the performance of Chinese auto manufacturers, regression models D are constructed, respectively, as shown in Equation (6) and Equation (7).

$$ROA_{i,t} = \alpha_i + \beta_1 IV_{i,t} + \beta_2 SPP_{i,t} + \beta_3 \log(S_{i,t}) + \beta_4 GM_{i,t} + \beta_5 FAP_{i,t} + \beta_6 PMI_t + \beta_7 Infl_t + \varepsilon_{i,t} \quad (6)$$

$$ROA_{i,t} = \alpha_i + \beta_1 IV_{i,t} + \beta_2 SLP_{i,t} + \beta_3 \log(S_{i,t}) + \beta_4 GM_{i,t} + \beta_5 FAP_{i,t} + \beta_6 PMI_t + \beta_7 Infl_t + \varepsilon_{i,t} \quad (7)$$

In equations (6) and (7), the positive and negative expectation analysis of the control variable coefficients is the same as the above model.

3. Empirical Analysis

3.1 Descriptive statistical analysis

Out of a total of 213 samples, 105 samples have non-zero variable values, and the samples with zero variable values are discarded. Table 2 presents the descriptive statistical results of the main variables. It can be seen from the analysis that the selected samples have large differences in the values of explanatory variables, which meet the basic requirements of regression analysis.

Table 2 Descriptive Statistics of Main Variables

Variable	ROA	IV	SPP	SLP	GM	FAP	lnS	Infl	PMI
N	105	105	105	105	105	105	105	105	105
Average/mean value	3.18	5.87	29.68	39.22	19.11	0.22	22.30	0.05	51.07
Variance	11.71	4.41	16.82	21.58	14.64	0.10	1.52	0.03	0.61
Minimum value	-79.63	0.75	8.5	7.9	-48.19	0.04	18.59	-0.01	49.73
Maximum value	30.82	26.52	68.91	99.77	58.71	0.48	25.88	0.08	51.61

3.2 Hausman test results and analysis

Table 3 Hausman test results

Model	A	B	C	D
Variable Name	ROA	IV	ROA	ROA
SPP	0.4933	0.9292	—	0.7941
SLP	0.2909	0.9292	—	0.4772
IV	—	—	0.7926	—

It can be seen from Table 3 that the Hausman test result model indicates that models A and C should be set as individual random effect models; models B and D should be set as individual fixed effect models.

3.3 Regression model results and analysis

Table 4 Preliminary regression model results

	ROA	ROA (RE)	ROA (RE)	IV (RE)	IV (FE)	ROA (RE)	ROA (RE)	ROA (RE)
lnS	1.830	2.608	2.508	1.697	3.631	1.760	2.555	2.503
	(3.09)* *	(2.93)* *	(3.56)**	(4.22)* *	(3.71)* *	(3.10)* *	(3.00)* *	(3.53)* *
GM	0.465	0.481	0.495	-0.041	-0.050	0.516	0.484	0.496
	(6.03)* *	(8.61)* *	(6.91)**	(1.35)	(1.48)	(8.90)* *	(8.45)* *	(6.85)* *
FAP	2.158	14.061	7.321	-5.188	-1.702	1.560	14.402	7.346
	(0.43)	(1.70)	(0.95)	(1.16)	(0.51)	(0.23)	(1.64)	(0.89)
Infl	119.757	256.66 9	163.892	-7.506	11.797	108.829	257.353	163.636

	(0.65)	(0.86)	(0.66)	(0.18)	(0.46)	(0.62)	(0.85)	(0.65)
PMI	-4.616	-11.308	-6.523	0.827	-0.042	-4.119	-11.364	-6.512
	(0.53)	(0.79)	(0.56)	(0.41)	(0.04)	(0.51)	(0.79)	(0.56)
SPP		0.106		0.023			0.105	
		(2.73)*		(0.95)			(2.69)*	
		*					*	
SLP			0.075		0.065			0.075
			(2.58)*		(2.62)*			(2.51)*
IV						0.136	0.046	0.005
						(1.15)	(0.33)	(0.04)
_cons	182.341	493.519	257.497	-72.544	-74.977	157.346	497.166	257.028
	(0.43)	(0.71)	(0.46)	(0.70)	(1.34)	(0.40)	(0.71)	(0.45)
R2	0.42				0.37			
N	207	105	131	105	131	207	105	131

* p<0.05; ** p<0.01

The preliminary regression results are shown in Table 4. The results show that at the 1% confidence level, supplier concentration is positively correlated with firm performance. Other things being equal, for every 1% increase in supplier concentration, corporate performance will increase by 0.106. At the 5% confidence level, retailer concentration is positively related to firm performance. However, there is no obvious correlation between supplier concentration and enterprise inventory management level. The model is improved and the individual fixed effect model is used again for regression. The regression results are shown in the improved regression model 1 of Table 5. Correlation results between variables did not change.

Table 5 Regression Results of Improvement

	Improved Regression Model 1 Results				Improved Regression Model 2 Results		
	IV (FE)	ROA (FE)	ROA (FE)	ROA (FE)	ROA (RE)	ROA (RE)	ROA (RE)
SPP	0.059		-0.165			0.100	
	(2.71)**		(0.47)			(2.58)*	
lnS	4.924	0.487	-9.626	-2.301	1.382	2.242	2.195
	(4.26)**	(0.26)	(0.71)	(0.30)	(2.62)**	(2.67)**	(3.19)**
GM	-0.061	0.862	1.138	0.998	0.526	0.491	0.501
	(1.23)	(4.36)**	(2.81)**	(4.68)**	(9.57)**	(9.15)**	(7.42)**
FAP	-1.996	-13.708	30.884	11.536	1.217	13.494	6.834
	(0.45)	(0.43)	(0.68)	(0.31)	(0.19)	(1.58)	(0.85)
PMI	-0.725	-2.779	-11.386	-6.409	-4.233	-11.800	-6.595
	(0.36)	(0.42)	(1.20)	(0.77)	(0.52)	(0.81)	(0.56)
Infl	23.866	75.882	227.524	144.734	110.900	266.143	166.575
	(0.57)	(0.52)	(1.12)	(0.79)	(0.63)	(0.88)	(0.66)
IV		-0.054	0.733	0.330	1.062	0.665	0.725
		(0.21)	(1.68)	(0.94)	(3.45)**	(1.29)	(1.60)
IVsqr					-0.041	-0.027	-0.032
					(3.76)**	(1.47)	(1.94)
SLP				-0.045			0.075
				(0.27)			(2.66)**
_cons	-68.288	117.610	759.218	352.724	168.055	523.966	265.456
	(0.70)	(0.32)	(1.14)	(0.63)	(0.42)	(0.74)	(0.47)
R2	0.34	0.31	0.21	0.32			

N	105	207	105	131	207	105	131
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* $p < 0.05$; ** $p < 0.01$

In order to further improve the models C and D, a new explanatory variable $IV_{sqr} = IV * IV$ is added on the original basis, and the improved regression results are shown in the improved regression model 2 of Table 5. It can be found that the explanatory variables IV and IV_{sqr} are significantly combined with the explanatory variable ROA at the 1% significance level. It shows that there is a significant positive correlation between the concentration, enterprise performance and inventory management of Chinese automobile manufacturing enterprises. At the same time, the addition of the intermediate variable inventory management will not have a significant impact on the relationship between supply chain concentration and enterprise performance, so there is no mediation effect of inventory management.

4. Conclusions

This paper uses individual fixed-effect or random-effect panel data regression model to study the relationship between supply chain concentration, inventory management level and enterprise performance, and draws the following conclusions: (1) Supply chain concentration is positively correlated with enterprise performance and inventory management level. (2) Inventory management level is positively correlated with corporate performance. (3) The mediating effect of inventory management level is not significant.

Based on this, Chinese auto manufacturing enterprises should pay attention to the relationship management between suppliers and retailers in the supply chain relationship, and actively coordinate with related enterprises. Therefore, the following management suggestions are put forward for Chinese automobile manufacturers: (1) For suppliers, further integrate and stabilize procurement channels, strengthen close cooperation with suppliers, and improve supplier concentration. (2) In terms of retailers, the concentration of retailers should be appropriately increased through centralized sales, the inventory turnover rate of enterprises should be improved by forming supply chain partnerships, and inventory management should be strengthened to further expand enterprise benefits.

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References

- [1] Lei Xunping. An Empirical Study on Supply Chain Risk Assessment of China's Automobile Manufacturing Industry: Analysis Based on Entropy Weight Extension Decision Model[J]. Computer Engineering and Application, 2015,51(12):264-270.
- [2] New Trend of Global Automobile Consumption in 2020[J]. Board of Directors, 2020(04):13-14.
- [3] Cui Yongli, Zhang Ling, Wang Jianzhong. Review of Domestic Research on the Influence of Supply Chain Concentration on Corporate Behavior[J]. Modern Business, 2018(20):96-98.
- [4] Li Yanping. Research on the Impact of Supply Chain Concentration on Business Performance and its Path[D]. Wuhan: Zhongnan University of Economics and Law, 2017.
- [5] Jiang Xiaohao. Supply Chain Concentration, Internal Control and Enterprise Performance-Based on the Empirical Data of A-Share Manufacturing Listed Companies in Shenzhen[D]. Beijing: Capital University of Economics And Business, 2017.
- [6] Wang Yong. Comparative Study on Inventory Turnover Rate of Wholesale Industry between China and America and its Influencing Factors[J]. Business Research, 2013,28(08):42-47.
- [7] Zhuang Bochao, Yu Shiqing, Zhang Hong. Capital Operation and Performance of Supply Chain Concentration: An Empirical Study Based on Listed Manufacturing Companies in China[J]. Soft Science, 2015,29(03):9-14.

- [8] Wang Chunhao, Zhang Jie, Ma Jun. Research on the Impact of Lean Inventory Management on Enterprise Performance —— An Empirical Test from Chinese Manufacturing Listed Companies[J]. Management Review, 2017,29(05):165-174.
- [9] Zhao Quanwu, Liao Yonghai, Huang Yafeng. An Empirical Study on Inventory Management and Enterprise Performance of Manufacturing Enterprises —— Based on Panel Data of Shanghai and Shenzhen Manufacturing Listed Companies from 1997 to 2010[J]. Mathematical Statistics and Management, 2012,31(02):207-216.
- [10] He Zhihua. An Empirical Study on Supply Chain Inventory Management and Enterprise Performance of Automobile Manufacturing Industry[D]. Dissertation of Southwest Jiaotong University .2015.
- [11] Zhou Yu. Performance Analysis of Financial Indicators of Listed Companies in Pharmaceutical Industry[J]. Northern Economic and Trade, 2015(07):135-136+144.
- [12] Cui Yongli, Zhang Ling, Wang Jianzhong. Review of Domestic Research on the Influence of Supply Chain Concentration on Corporate Behavior[J]. Modern Business, 2018(20):96-98.
- [13] Li Yanping. Research on the Impact of Supply Chain Concentration on Business Performance and its Path[D]. Wuhan: Zhongnan University of Economics and Law, 2017.
- [14] Jiang Xiaohao. Supply Chain Concentration, Internal Control and Enterprise Performance-Based on the Empirical Data of A-Share Manufacturing Listed Companies in Shenzhen[D]. Beijing: Capital University of Economics And Business, 2017.
- [15] Zhao Zhengjia, He Zhihua. Research on the Relationship between Supply Chain Inventory Management and Performance of Automobile Manufacturing Enterprises[J]. Industrial Engineering and Management, 2018,23(02):98-106.
- [16] Patatoukas P N . Customer-Base Concentration: Implications for Firm Performance and Capital Markets[J] . Accounting Review,2012,87(02): 363-392.
- [17] Huang Changfu, Xu Yaqin. Integration of Industry and Finance, Investment Efficiency and Business Performance: an Empirical Study based on Panel Data of Listed Manufacturing Companies