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Research on the Impact of Supply Chain Dependence on Enterprise Performance: Based on the Perspective of Supply Chain Networks

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Abstract:
This article takes Chinese A-share listed companies in Shanghai and Shenzhen from 2009 to 2022 as the research object, and empirically tests the impact of supply chain dependence on corporate performance. It was found that supply chain dependence has a suppressive effect on short-term performance of enterprises, but an enhancing effect on long-term performance. Furthermore, both customer dependence and supplier dependence have different effects on corporate performance. Heterogeneity testing found that the impact of supply chain dependence on firm performance is more significant in non-state-owned enterprises and enterprises in western provinces and regions. Based on the lifecycle, the inhibitory effect of supply chain dependence on short-term performance is more significant in growing enterprises; The improvement of long-term performance is more effective in mature enterprises. Expansion testing found a non-linear U-shaped relationship between supply chain dependence and firm performance.

Keywords: supply chain dependence, enterprise performance, property rights nature, lifecycle

INTRODUCTION

In April 2022, Chinese Government issued by the State Council "on speed up the construction of national unified market opinion" (hereinafter referred to as "opinion"), the opinions pointed out that in order to our country market resources endowment advantage into strong national competitiveness, make our country in the global competition firmly grasp the development of the initiative, will actively promote the modernization of industrial chain and supply chain, enhance the level of industrial chain and supply chain. Supply chain dependence involves not only the supply of raw materials, but also includes logistics, production technology, equipment maintenance and other aspects. When the enterprise cannot normally obtain the required materials or services, its production capacity and product delivery capacity will be affected, thus affecting the performance and competitive advantage of the enterprise.

In the short term, supply chain dependence may negatively impact business performance. For example, if a company relies too much on a supplier or region, if there are problems in the supply chain, such as natural disasters, political turmoil or supplier collapse, the company will face risks of production interruption, order delays and rising costs. However, in the long term, moderate supply chain dependence has a benign effect on enterprise value. By establishing strategic partnerships with suppliers, enterprises can realize resource sharing, technology innovation and cost optimization. The efficient operation of the supply chain can improve the production efficiency, product quality and customer satisfaction of enterprises, thus enhancing the market competitiveness of enterprises.

Although supply chain dependence has certain risks, companies can reduce risks and improve performance by diversifying supply chain, inventory management and technology applications. At the same time, enterprises should also pay attention to the sustainability and social responsibility of the supply chain, and actively manage the environmental, labor and ethical issues in the supply chain to ensure sustainable development and build a good corporate reputation. Therefore, it is essential for companies to understand and manage supply chain dependency. By developing appropriate strategies, building stable partnerships, and continuously improving supply chain processes, companies can achieve supply chain stability and value creation in the short and long term. Based on the above background, this paper takes China's Shanghai-Shenzhen A-share listed companies in 2009-2022 as the research object to empirically test the impact of supply chain dependence on enterprise performance, and provides certain enlightenment significance for enterprises to improve the supply chain system.

THEORETICAL ANALYSIS AND HYPOTHESIS ARE PROPOSED

Supply Chain Dependence and Short-term Performance

From short-term innovation performance, supplier concentration is not conducive to the improvement of enterprise innovation performance, according to the theory of resource dependence, enterprises in rely on only a small number of suppliers or customers, the assets of the proprietary will enhance [1], decision autonomy and flexibility will decline, leading to operating risk increase is not conducive to the promotion of enterprise performance [2]. The high concentration of suppliers means that

enterprises concentrate on buying a large number of raw materials from a small number of suppliers, which makes the product pricing and quality change of suppliers seriously affect the production and operation of enterprises, that is, enterprises will heavily rely heavily on suppliers, and suppliers have strong bargaining power [3]. If the enterprise is highly dependent on a supplier, once the supplier has problems, such as production interruption, quality problems or insufficient supply shortage, the enterprise will not be able to obtain the required materials or services in time, resulting in reduced production capacity and order delay [4]. In highly centralized supply chains, enterprises tend to respond slowly to the changing market demand and the competitive environment. Due to the rigidity of the supply chain, [5] enterprises may not be able to quickly adjust their product portfolio or develop new products, thus losing the market opportunity [6].

High customer concentration will make enterprises in a passive position in the transaction, enterprises have to take the initiative to reduce product prices, improve product quality to maintain customer relations, so that the transaction activities normally. Higher customer concentration will lead to more dedicated assets being invested downstream of the supply chain. This situation increases the dependence of the enterprise on key customers, and the initiative of the enterprise transactions will reduce [7]. The more concentrated the customer, the less say the enterprise will have in product pricing, which will have a negative impact on the company's financial performance [8]. Based on the transaction cost theory, the increase of customer concentration will reduce the company's inventory turnover rate, which is ultimately reflected in the reduction of the company's financial performance. In the case of high concentration, if the key customer resources are lost, the inventory of the enterprise will be excess and the income will fluctuate, thus affecting the benefit of the enterprise [9]. Further, the higher the customer concentration, the operating risk that the enterprise should bear will increase, and the financing constraint will intensify, which leads to the decline of the risk bearing capacity of the enterprise [10].

In conclusion, the following assumptions are made:

H1: Supply chain dependence has an inhibitory effect on the short-term performance of enterprises;

Supply Chain Dependence and Long-term Performance

Based on the supply chain collaboration theory, supplier collaboration and customer collaboration have a significant positive impact on innovation performance, and close cooperation with suppliers and customers can promote the improvement of innovation performance. By working together with suppliers and customers, enterprises can obtain more innovative ideas and resources [11]. Suppliers often have the expertise and technical capabilities so that they can advise companies on new product design, material research and development, or production processes [12]. At the same time, working closely with customers to understand their needs and market dynamics can help enterprises to develop more competitive products or services [13]. Based on the perspective of supply chain configuration, enterprises can improve enterprise performance on the one hand, and on the other hand, it also has the effect of increasing performance fluctuations [14]. The market-oriented allocation of factors and the elasticity of supply chain can improve the operating efficiency of enterprises, which is conducive to the improvement of operators' performance, and has the greatest positive impact on the operating efficiency of logistics industry, and reduces the positive effect on the operating efficiency of retail industry, wholesale industry, catering industry and tourism industry [15]. In the context of the acceleration of digital technology and the integration of supply chain, supply chain digitalization has significantly improved enterprise performance, and management empowerment and innovation empowerment are the specific path and mechanism of supply chain digitalization to drive the improvement of enterprise performance. Through digital supply chains, enterprises can monitor and track key data such as logistics, inventory and orders in real time. This enables enterprises to accurately understand the situation of each link of the supply chain, and make timely decisions and adjustments. Real-time visibility helps reduce inventory costs, reduce order delays, and improve delivery accuracy and customer satisfaction [16]. The more concentrated the supply chain relationship is, the higher the social trust level around the enterprise is, and the more the enterprise can achieve performance optimization. In the case of centralized supply chain relationship, it is easier for enterprises to achieve information transparency and product traceability. Enterprises can better understand the information of the business conditions, quality standards and environmental responsibilities of the supply chain partners, and conduct effective supervision and management. This will help to improve product quality, reduce risks, and enhance the trust of enterprises in the society [17]. Green supply chain management practice management development is thriving, green supply chain management practice leverage enterprise performance growth [18]. Green supply chain management can reduce business costs by saving energy, reducing waste and optimizing logistics [19]. For example, the use of energy-efficient equipment and processes, optimizing transportation routes and storage layout, and reducing resource waste and waste disposal costs [20]. These initiatives could improve corporate profitability by reducing corporate energy consumption [21], transportation costs, and waste disposal costs [22,23]

In conclusion, the following assumptions are made:

H2: Supply chain dependence has an improvement effect on the long-term performance of enterprises.

(1) Data source and sample selection

Considering the impact of the financial crisis in 2008, this paper studies the Shanghai-Shenzhen A-share listed companies in 2009-2022 to empirically test the impact of supply chain dependence on enterprise performance [24]. All data involved are from the Taian database (CSMAR) [25]. In order to ensure the validity of the data, according to the following standards for the original data screening: eliminate the financial industry enterprise data, eliminate the missing value of listed companies, eliminate the sample by ST or * ST company samples, finally obtain effective sample number is 29519, all the data used in the process of sorting, calculation and regression of the software is Stata17.0. In order to avoid the influence of extreme values, all continuous variables are tailed by 1%[26,27].

(2) Model design and variable description

To test the underlying hypothesis, the model was constructed (1). Where, i is each enterprise, t is each year, Controls is the collection of control variables, Year is the fixed effect of year, and Indus is the fixed effect of industry, which is the residual. ε . The description of all variables can be seen from Table 1.

$$Roe_{i,t} / TobinQ_{i,t} = a_0 + a_1 GYL_{i,t} + a_i Cobtrols_{i,t} + \sum Year + \sum Indus + \varepsilon_{i,t} \quad (1)$$

Table 1. Variable description

Type	Symbol	Explain
explained variable	Roe	Short-term performance, net profit / net assets
	TobinQ	TobinQ, Stock Price Number of shares issued / net asset value
explanatory variable	GYL	Supply chain dependence, the average of the sum of the procurement and sales ratio of the top five suppliers and customers
controlled variable	Size	Enterprise size, the natural logarithm of the total assets
	Lev	Asset-liability ratio, liabilities / total assets
	INV	Inventory / asset ratio, inventory / asset
	Growth	Sales revenue growth rate
	Board	Board size
	Indep	The proportion of independent directors
	TOP1	The largest shareholder shareholding ratio
	SOE	The nature of property rights, state-owned enterprises assign a value of 1, otherwise it is 0
	ListAge	The age of the enterprise, take natural logarithm

The explained variables are Roe and Tobin Q. Among them, the return on equity Roe measures the short-term performance of the enterprise, and Tobin Q measures the long-term performance of the enterprise. The return on equity is usually used to measure the short-term performance of an enterprise, reflecting how the enterprise uses the capital invested by shareholders to obtain profits within a certain period of time. Tobin Q is a more comprehensive indicator, and the higher Tobin Q is often considered a reflection of good long-term performance because it means an company can create more market value relative to its asset value. The explanatory variable is supply chain dependence, which is calculated as "the average of the sum of the purchase sales ratio of the top five suppliers and customers". In addition, this paper also considers control variables such as enterprise size, asset-liability ratio, inventory-asset ratio and growth rate of sales revenue. The selection of the control variables is considered as follows:

Larger enterprises are usually able to achieve a cost advantage through scale expansion. Such economies of scale can be achieved through higher production efficiency, procurement capacity and division of labor, thus reducing the cost per unit of product or service. Therefore, large-scale enterprises may have a competitive advantage in cost control, and perform well in performance indicators.

A lower asset-liability ratio usually indicates that an enterprise has a lower financial risk and has more stable operating conditions. This means that companies are better able to respond to external shocks and economic cycle fluctuations to improve performance. And low debt-liability ratios make it easier for companies to obtain financing and capital to support their

expansion and investment plans. This financial flexibility can provide more development opportunities for enterprises, and maintain a competitive advantage in the market competition, thus promoting performance improvement.

A lower inventory to asset ratio may indicate better inventory management capabilities. This means that companies can adjust their procurement and production plans in a timely manner to adapt to changes in market demand. Effective inventory management can reduce the risk of expiration, loss and price reduction, improve sales conversion rate and customer satisfaction, and thus promote performance improvement.

The growth rate of sales revenue has a great impact on corporate profitability. Higher sales growth means that sales are increasing, potentially leading to higher profit and net income levels. This can promote the healthy and sustainable development of enterprises and improve their performance. Companies can attract more customers and market share, thus improving their brand value and market position. This competitive advantage can promote long-term growth and performance improvement [28].

Smaller boards are often more efficient. Too large board size may lead to lengthy decision-making processes and difficult communication, which may affect the flexibility and ability to respond quickly. Appropriate control of the size of the board of directors helps to improve the efficiency of decision-making, and thus promote the improvement of enterprise performance [29,30].

Independent directors have independent status and views in the board of directors and can provide objective and neutral supervision. A higher proportion of independent directors means a more effective internal supervision mechanism, which can reduce potential conflicts of interest and misconduct, protect the interests of shareholders, and improve corporate performance.

The investment decision of the largest shareholder will directly affect the performance of enterprises. If the investment decisions are in line with the interests of the company and the market demand, it can bring better growth and profit performance; otherwise, if the investment decisions are improper, it may lead to resource waste, business risks and other problems, affecting the performance level of the enterprise.

State-owned enterprises are usually an important part of the government in the economy, whose business goal is not only profit, but also includes social responsibility and national interests. In terms of resource allocation and market access, SOEs usually enjoy preferential policies and government support. However, due to problems such as management system and profit distribution mechanism, state-owned enterprises may have problems such as low efficiency and insufficient innovation, which may affect enterprise performance.

Corporate age of establishment is usually associated to the funds and resources available. Long companies may have more time to accumulate capital, build supply chains and network, which may help improve their performance. However, young companies may face challenges such as financing difficulties and limited resources, which may have a certain impact on their performance. However, younger companies may be more flexible and agile, better able to adapt to market changes and adopt innovative strategies.

RETURN TO THE RESULTS

Descriptive Statistics

Table 2. Descriptive statistics

	sample book	mean	standard error	least value	crest value
R oe	29,519	5.981	12.973	-57.946	34.760
TobinQ	29,519	2.063	1.367	0.802	15.607
GYL	29,519	33.114	16.553	5.550	81.390
Size	29,519	22.258	1.269	20.029	26.102
Lev	29,519	0.420	0.200	0.061	0.870
INV	29,519	0.139	0.122	0.001	0.650
Growth	29,519	0.159	0.357	-0.508	1.824
Board	29,519	2.112	0.194	1.609	2.639
Indep	29,519	37.747	5.370	33.330	57.140
TOP1	29,519	33.528	14.619	8.861	72.638
SOE	29,519	0.320	0.467	0.000	1.000
ListAge	29,519	2.137	0.823	0.000	3.367

Table 2 presents the descriptive statistical results. Among them, the minimum value of equity yield Roe is-57.946, the maximum value is 34.760, and the average value of Tobin Q value is 2.063. For explanatory variables, the mean value of supply chain dependent GYL index was 33.114, the minimum value was 5.550, and the maximum value was 81.390, indicating a large gap in supply chain dependence of different enterprises. For the control variables, the enterprise size index is naturally logarithmic, and the maximum value is not very different; the average value of Lev is 0.420, indicating that the average debt level of about 42% exists during the study period. The average value of the board of directors size index Borad is 2.112, and the average shareholding ratio of the largest shareholder is 33.528. Property SOE is a virtual variable distributed 0-1,0 is non-state-owned enterprise and 1 is state-owned enterprise. In conclusion, the explained variables, explanatory variables and control variables selected in this paper are all distributed within the reasonable interval.

Regression Analysis

Table 3. Basic regression results

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
GYL	-0.044***	-0.038***	0.014***	0.006***
	(-8.898)	(-8.241)	(30.491)	(11.931)
Size		3.081***		-0.365***
		(42.139)		(-48.906)
Lev		-24.004***		-0.527***
		(-56.931)		(-12.240)
INV		9.182***		-0.021
		(12.721)		(-0.279)
Growth		10.455***		0.332***
		(55.067)		(17.131)
Board		1.033**		0.066
		(2.308)		(1.438)
Indep		-0.019		0.008***
		(-1.281)		(5.340)
TOP1		0.090***		0.001**
		(18.141)		(2.443)
SOE		-0.064		-0.135***
		(-0.359)		(-7.435)
ListAge		-1.695***		0.270***
		(-16.626)		(25.908)
_cons	6.475***	-51.449***	2.461***	9.675***
	(4.712)	(-23.378)	(18.740)	(43.060)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	29519	29519	29519	29519
R-squared	0.036	0.254	0.207	0.300

Table 3 presents the regression results. Among them, (1) - (2) are listed as the regression relationship between enterprise supply chain dependence and short-term performance. Without considering the control variable, the regression coefficient value of explanatory variable GYL is-0.044, which is significant at 1% level, indicating a significant negative relationship. After adding the control variable, the regression coefficient value of supply chain dependent GYL on short-term performance Roe is-0.038. The above results fully show that supply chain dependence has an inhibitory effect on the short-term performance of enterprises, mainly due to the following reasons: First, supply risk. If the enterprise is highly dependent on one or some key suppliers, once these suppliers have problems, such as quality problems, delivery delays, emergencies, etc., it will directly affect the production and operation of the enterprise, thus affecting the short-term performance of the enterprise. Second, cost fluctuations. Changes in the supply chain may lead to fluctuations in raw material costs, transportation costs and other aspects. Especially when enterprises rely on a few suppliers, such fluctuations may have a large impact on the cost structure of the enterprise, thus affecting the short-term performance of the enterprise. Third, production stability. The instability of the supply chain may lead to the uncertainty of production planning, including the stagnation of production lines, the delay of orders and

other problems, thus affecting the production stability of the enterprise, and then affecting the short-term performance of the enterprise.

(3) - (4) is the regression relationship between enterprise supply chain dependence and long-term performance. When the control variable is not considered, the regression coefficient value of explanatory variable GYL is 0.014, which is significant at 1% level, indicating a significant positive relationship. After adding the control variable, the regression coefficient value of supply chain dependence GYL on long-term performance TobinQ is 0.006. The above results fully show that the supply chain dependence can improve the long-term performance of enterprises. In the long term, supply chain dependence has a positive effect on performance may be because: first, integration of advantages. By establishing close partnerships with key partners in the supply chain, enterprises can share information, technology and resources to form advantage integration. This integration can help enterprises to improve production efficiency, reduce costs, and provide better products and services, thus enhancing the long-term competitiveness of enterprises in the market competition. Second, sustainable development. Supply chain dependence can encourage enterprises to pay more attention to sustainable development, including environmental protection, social responsibility and other aspects. The cooperation between enterprises and supply chain partners can promote the effective use of resources and the implementation of circular economy, so as to enhance the brand image and market recognition of enterprises, and provide strong support for the long-term development of enterprises. Third, innovation ability. Supply chain dependence can promote the innovation ability of enterprises. Through cooperation with partners in the supply chain, enterprises can acquire new knowledge and technology, improve their innovation ability, constantly launch new products, services and solutions, and bring competitive advantages to the long-term development of enterprises.

Further Inspection

Table 4. Further regression

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
	Customer concentration	Customer concentration	Supplier concentration	Supplier concentration
CUS	-0.027***		0.003***	
	(-7.940)		(8.228)	
SUP		-0.018***		0.004***
		(-4.873)		(11.272)
Size	3.130***	3.162***	-0.377***	-0.370***
	(43.570)	(43.676)	(-51.351)	(-50.066)
Lev	-23.837***	-24.050***	-0.549***	-0.508***
	(-56.537)	(-56.886)	(-12.727)	(-11.770)
INV	9.084***	9.340***	-0.016	-0.046
	(12.577)	(12.932)	(-0.215)	(-0.622)
Growth	10.440***	10.382***	0.339***	0.339***
	(55.010)	(54.732)	(17.459)	(17.504)
Board	1.077**	1.083**	0.056	0.064
	(2.408)	(2.420)	(1.232)	(1.390)
Indep	-0.019	-0.019	0.008***	0.008***
	(-1.268)	(-1.248)	(5.298)	(5.309)
TOP1	0.090***	0.090***	0.001**	0.001**
	(18.208)	(18.074)	(2.369)	(2.561)
SOE	-0.041	-0.120	-0.134***	-0.126***
	(-0.233)	(-0.677)	(-7.415)	(-6.985)
ListAge	-1.719***	-1.655***	0.271***	0.263***
	(-16.829)	(-16.231)	(25.942)	(25.284)
_cons	-53.058***	-53.800***	10.049***	9.800***
	(-24.569)	(-24.639)	(45.525)	(43.983)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	29519	29519	29519	29519
R-squared	0.254	0.253	0.298	0.300

Supply chain dependence can be divided into two types: customer dependence and supplier dependence. Among them, customer dependence refers to the degree of dependence on customer needs in the process of production and operation. If an enterprise is highly dependent on one or some customers, if the customer has problems, it will directly affect the enterprise

performance; supplier dependence is the dependence on other links of the supply chain in the production and operation process. If the enterprise is highly dependent on one or some key suppliers, once the supplier quality problems, delivery delays, emergencies, etc., it will directly affect the production and operation of the enterprise. In this section, As shown in Table 4,the supply chain dependence is subdivided into customer dependence and supplier dependence, where the customer dependence is "the ratio of top five customers to total annual sales" (CUS), and the supplier dependence is "the ratio of purchase volume of top five suppliers to total annual purchase volume" (SUP). Table 5 reports the main regression results.

In column (1) - (2), for short-term performance level, the regression coefficient of customer concentration CUS is-0.027, which is significant at 1%; the SUP regression coefficient of supplier concentration is-0.018, which passes the significance test. In columns (3) - (4), for the long-term performance level, the regression coefficient of customer concentration CUS is 0.003, and the SUP regression coefficient of supplier concentration is 0.004, both significant at the 1% level. The above results fully show that customer concentration and supplier concentration have a restraining effect on the short-term performance of enterprises, but they have an improvement effect on the long-term performance.

Robustness Test

(1) Replace the explanatory variable

To enhance the robustness of conclusions, replacement explanatory variables were used. For supply chain dependence, the customer concentration index (the sum of the top five customer sales to total sales) and the supplier index (the sum of the top five supplier purchases to total purchases) were used as the explanatory variable, and the results are reported in Table 5. It shows that the regression coefficient values of HHIC and HHIS are negative and have passed the significance test; for short-term performance, HHIC and HHIS are positive, significant at 1%. The above results are basically consistent with the basic regression, which further verifies the basic regression results and enhances the objectivity of the conclusions.

Table 5. Robustness test: replacing explanatory variables

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
	Customer concentration by Huffendal	Supplier concentration by Huffendal	Customer concentration by Huffendal	Supplier concentration by Huffendal
HHIC	-0.027***		0.007***	
	(-3.095)		(7.547)	
HHIS		-0.021**		0.010***
		(-2.104)		(10.094)
Size	3.424***	3.474***	-0.420***	-0.419***
	(38.240)	(38.214)	(-46.667)	(-45.612)
Lev	-25.448***	-25.639***	-0.519***	-0.482***
	(-50.397)	(-50.248)	(-10.214)	(-9.357)
INV	9.857***	10.065***	-0.100	-0.153*
	(10.998)	(11.204)	(-1.108)	(-1.688)
Growth	10.814***	10.813***	0.354***	0.357***
	(48.475)	(48.188)	(15.755)	(15.742)
Board	1.853***	1.830***	-0.002	-0.012
	(3.392)	(3.329)	(-0.044)	(-0.219)
Indep	0.004	0.003	0.006***	0.006***
	(0.207)	(0.180)	(3.266)	(3.068)
TOP1	0.098***	0.097***	0.000	0.000
	(16.042)	(15.840)	(0.373)	(0.433)
SOE	0.561**	0.568***	-0.113***	-0.090***
	(2.564)	(2.576)	(-5.110)	(-4.065)
ListAge	-1.897***	-1.879***	0.276***	0.267***
	(-15.046)	(-14.829)	(21.720)	(20.855)
_cons	-60.976***	-61.755***	11.128***	11.096***
	(-20.649)	(-20.718)	(37.453)	(36.885)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	21349	21002	21349	21002
R-squared	0.268	0.270	0.304	0.305

(2) Eliminate the epidemic period

In 2019, the COVID-19 pandemic ravaged the world and had a significant impact on China's economy. Due to the outbreak and the implementation of lockdown measures, the production activities of many enterprises have been severely disrupted. Factory lockdowns, transportation restrictions and supply chain disruptions lead to shortages of raw materials and components, which in turn affect the production and supply of products. To avoid epidemic factors, the data for 2020 and beyond were eliminated and the remaining samples were regressed back, and the results are reported in Table 6. It can be seen that the sign of both short-term and long-term performance was basically the same as the regression coefficient value of GYL, and all passed the significance test and were significant at the 1% level.

Table 6. Robustness test: Excluding epidemic periods

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
GYL	-0.059***	-0.040***	0.015***	0.005***
	(-10.090)	(-7.059)	(26.376)	(8.382)
Size		2.630***		-0.460***
		(28.826)		(-50.617)
Lev		-19.157***		-0.372***
		(-37.053)		(-7.225)
INV		6.198***		-0.216**
		(7.216)		(-2.520)
Growth		8.660***		0.107***
		(38.203)		(4.738)
Board		0.882*		0.015
		(1.652)		(0.279)
Indep		-0.045**		0.007***
		(-2.482)		(4.102)
TOP1		0.084***		0.003***
		(14.178)		(4.660)
SOE		-0.146		-0.121***
		(-0.687)		(-5.714)
ListAge		-1.619***		0.350***
		(-12.578)		(27.325)
_cons	7.352***	-41.618***	2.342***	11.539***
	(5.074)	(-15.916)	(16.275)	(44.319)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	18093	18093	18093	18093
R-squared	0.040	0.212	0.254	0.384

(3) Consider the lagged utility

The impact of supply chain dependence on enterprise performance has been basically proved above, but only the relationship between the explanatory variables and the explained variables in this period. In this section, As shown in Table 7 ,the explanatory variables are tested between the first phase and the control variables, and the results are reported in Table 8. It can be seen that for short-term performance, the regression coefficient of GYL for Roe in the long-term performance, the regression coefficient of supply chain dependent GYL for Tobin Q is significantly positive, either unary regression or multiple regression. The above results further verify the basic hypothesis, and show that there is no endogenous ogeneity of independent and dependent variables are mutually causal.

The impact of supply chain dependence on enterprise performance has a time-lasting effect. Supply chain is a complex and dynamic system, and the position and dependence of an enterprise in the supply chain will affect its performance. A stable and reliable supply chain helps to improve business performance. If an enterprise has long-term partnerships and stable supply capacity in the supply chain, then it can better plan and control production processes and better meet customer needs.

Table 7. Endogeneity test: Considering lag effects

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	F.Roe	F.Roe	F.TobinQ	F.TobinQ
GYL	-0.045***	-0.044***	0.013***	0.004***
	(-7.905)	(-7.681)	(24.946)	(8.427)
Size		1.810***		-0.340***
		(19.662)		(-40.012)
Lev		-14.682***		-0.575***
		(-27.354)		(-11.611)
INV		8.005***		-0.060
		(8.907)		(-0.719)
Growth		6.612***		0.216***
		(28.050)		(9.909)
Board		1.609***		-0.017
		(2.906)		(-0.341)
Indep		0.012		0.007***
		(0.646)		(3.954)
TOP1		0.103***		0.003***
		(16.791)		(5.320)
SOE		0.295		-0.113***
		(1.345)		(-5.576)
ListAge		-1.530***		0.173***
		(-11.956)		(14.652)
_cons	9.455***	-28.821***	2.911***	10.001***
	(5.719)	(-10.336)	(18.968)	(38.874)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	23700	23700	23700	23700
R-squared	0.039	0.129	0.213	0.296

Table 8. Heterogeneity test: Heterogeneity based on property rights

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
	belong to the state	Non-state	belong to the state	Non-state
GYL	-0.024***	-0.041***	0.004***	0.007***
	(-3.156)	(-7.017)	(5.460)	(10.910)
Size	2.556***	3.655***	-0.311***	-0.414***
	(22.126)	(37.861)	(-30.309)	(-40.235)
Lev	-23.772***	-24.335***	-0.794***	-0.406***
	(-32.999)	(-46.384)	(-12.406)	(-7.256)
INV	7.215***	10.658***	0.286***	-0.154
	(6.190)	(11.545)	(2.758)	(-1.568)
Growth	9.535***	10.566***	0.156***	0.398***
	(27.858)	(46.350)	(5.140)	(16.364)
Board	0.988	1.584***	0.152**	-0.051
	(1.376)	(2.744)	(2.383)	(-0.828)
Indep	-0.033	0.017	0.012***	0.004**
	(-1.393)	(0.855)	(5.824)	(2.094)
TOP1	0.066***	0.102***	0.000	0.002***
	(7.876)	(16.405)	(0.271)	(2.737)
ListAge	-0.436**	-2.276***	0.026	0.357***
	(-2.185)	(-18.606)	(1.446)	(27.425)
_cons	-44.398***	-61.691***	8.791***	10.870***
	(-13.817)	(-19.686)	(30.797)	(32.550)
a particular year	control	control	control	control
trade	control	control	control	control
Obs.	9448	20071	9448	20071
R-squared	0.248	0.276	0.368	0.285

Heterogeneity Test

Based on property rights and property heterogeneity

In this section, based on the heterogeneity of property rights, the total sample is divided into state-owned enterprises and non-state-owned enterprise sample groups, and the comparative regression analysis is conducted. The results are reported in Table 9. It can be seen that in column (1) - (2), the regression coefficient value of supply chain GYL for state-owned enterprises is-0.024, and the regression coefficient value for non-state-owned enterprises is-0.041, which has passed the significance test; in column (3) - (4), the regression coefficient value of supply chain GYL for state-owned enterprises is 0.004, and the regression coefficient value for non-state-owned enterprises is 0.007, which is significant at the 1% level. The above results fully show that the inhibitory effect of supply chain dependence on short-term performance and the improvement effect of long-term performance are more significant in non-state-owned enterprises.

Table 9. Test of heterogeneity: Based on life cycle heterogeneity

	Short-term performance		Long-term performance	
	(1)	(2)	(3)	(4)
	Roe	Roe	TobinQ	TobinQ
	growth period	maturation period	growth period	maturation period
GYL	-0.051***	0.015**	0.005***	0.006***
	(-9.064)	(2.139)	(7.128)	(9.528)
Size	2.671***	2.895***	-0.267***	-0.470***
	(29.701)	(26.712)	(-23.603)	(-49.286)
Lev	-14.879***	-29.104***	-1.069***	-0.048
	(-27.508)	(-48.342)	(-15.712)	(-0.908)
INV	7.685***	7.184***	0.178	-0.265***
	(8.576)	(6.793)	(1.578)	(-2.845)
Growth	4.055***	30.218***	0.209***	0.144**
	(17.459)	(42.621)	(7.169)	(2.313)
Board	1.030*	0.492	0.134*	0.010
	(1.867)	(0.749)	(1.939)	(0.172)
Indep	-0.013	-0.034	0.008***	0.008***
	(-0.714)	(-1.531)	(3.351)	(4.240)
TOP1	0.072***	0.094***	0.000	0.003***
	(11.864)	(12.769)	(0.565)	(3.974)
SOE	-0.951***	0.113	-0.115***	-0.170***
	(-4.239)	(0.442)	(-4.073)	(-7.575)
ListAge	-1.792***	-0.649***	0.225***	0.338***
	(-14.512)	(-4.197)	(14.485)	(24.908)
_cons	-44.704***	-42.855***	7.845***	11.555***
	(-16.381)	(-13.259)	(22.861)	(40.653)
Obs.	14761	14758	14761	14758
R-squared	0.163	0.313	0.291	0.358

Companies with high supply chain dependence face a number of risks, including raw material shortages, production pauses, delivery delays and so on. These risks may lead to a decline in business performance in the short term. For non-state-owned enterprises, they are more vulnerable to high supply chain dependence due to their relatively small size and relatively limited capital and resources. If there is a shortage or delay in the production and sales process of non-state-owned enterprises, this may lead to order cancellation and customer loss, which will affect the short-term performance of the company. In contrast, state-owned enterprises usually have stronger government support and capital reserves, and are more able to withstand risks. Due to its large size, there may be more vertical integration and diversification strategies, thus reducing the reliance on a single supply chain.

However, enterprises with high supply chain dependence may benefit from some improvement effects in the long term, especially for non-state-owned enterprises. First of all, the high dependence on supply chain means that enterprises have accumulated deep experience and professional knowledge in supply chain management. This allows companies to better optimize supply chain processes, improve efficiency, and achieve better synergies by coordinating the relationships between

suppliers and partners. This supply chain management capability can become one of the core competitiveness of enterprises and contribute to the improvement of long-term performance; secondly, high supply chain dependence can bring economies of scale. As enterprises establish long-term partnerships with suppliers and expand the scale, enterprises can obtain better procurement conditions and price advantages. This helps to reduce costs, improve profit margins, and gain an advantage in the market competition. For non-state-owned enterprises, it is easier to be relatively flexible and agile to find and establish partnerships in the supply chain. They can respond faster to changes in market demand and enhance market competitiveness by building a strong supply chain network. This supply chain flexibility and agility is important for long-term performance improvement. In contrast, soes may be subject to some restrictions in their supply chain, such as administrative approval procedures and resource allocation. This could lead to SOEs being relatively less flexible and agile in building flexible and efficient supply chain networks. However, SOEs can still improve their long-term performance through other ways, such as technological innovation, market share stability and so on.

Based on life-cycle heterogeneity

In this section, based on the life cycle heterogeneity, the total sample is divided into growth stage and mature stage for comparative regression analysis, and the results are reported in Table 10. It can be seen that in column (1) - (2), the regression coefficient of supply chain dependent GYL for growth enterprises is-0.051, and the regression coefficient value for mature enterprises is 0.015, which passed the significance test; in column (3) - (4), the regression coefficient of supply chain dependent GYL for growth enterprises is 0.005, and the maturity regression coefficient value is 0.006, significant at 1% level. The above results fully show that the inhibition effect of supply chain dependence on short-term performance is more significant in growth enterprises, while the improvement effect on long-term performance is more significant in mature enterprises.

Table 10. Heterogeneity test: Based on regional distribution heterogeneity

	Short-term performance			Long-term performance		
	(1)	(2)	(3)	(4)	(5)	(6)
	Roe	Roe	Roe	TobinQ	TobinQ	TobinQ
	east	central section	west	east	central section	west
GYL	-0.037***	-0.027**	-0.039***	0.005***	0.006***	0.008***
	(-6.914)	(-2.198)	(-2.927)	(8.417)	(4.868)	(5.599)
Size	3.222***	3.416***	2.733***	-0.327***	-0.515***	-0.409***
	(37.429)	(16.425)	(13.161)	(-37.476)	(-24.305)	(-19.434)
Lev	-23.527***	-28.208***	-23.516***	-0.569***	-0.635***	-0.185
	(-47.187)	(-24.915)	(-19.503)	(-11.250)	(-5.506)	(-1.515)
INV	9.885***	5.827***	8.614***	-0.150*	0.303	0.178
	(11.796)	(2.930)	(3.851)	(-1.759)	(1.499)	(0.784)
Growth	10.584***	9.930***	9.878***	0.339***	0.284***	0.317***
	(46.939)	(20.016)	(19.809)	(14.808)	(5.625)	(6.267)
Board	0.880	1.989*	0.925	0.050	0.112	0.045
	(1.634)	(1.738)	(0.739)	(0.911)	(0.958)	(0.353)
Indep	-0.015	-0.011	-0.049	0.007***	0.009**	0.013***
	(-0.847)	(-0.284)	(-1.176)	(3.830)	(2.401)	(2.981)
TOP1	0.089***	0.107***	0.066***	0.001	0.001	0.001
	(15.396)	(8.049)	(4.502)	(1.506)	(0.661)	(0.942)
SOE	0.283	-0.344	-0.252	-0.136***	-0.034	-0.202***
	(1.291)	(-0.771)	(-0.524)	(-6.105)	(-0.751)	(-4.135)
ListAge	-2.036***	-1.007***	-1.097***	0.246***	0.382***	0.253***
	(-16.959)	(-3.572)	(-3.677)	(20.228)	(13.322)	(8.381)
_cons	-57.118***	-54.325***	-46.217***	8.690***	13.042***	10.378***
	(-19.906)	(-9.501)	(-8.653)	(29.847)	(22.410)	(19.174)
a particular year	control	control	control	control	control	control
trade	control	control	control	control	control	control
Obs.	21215	4495	3809	21215	4495	3809
R-squared	0.258	0.292	0.285	0.297	0.388	0.352

In growth stage enterprises, the tolerance for supply chain delay or interruption is low due to their relatively small scale and limited resources. These companies often do not have a diversified supply chain network, and it is difficult to find alternatives quickly. Therefore, the high supply chain dependence has a more significant impact on the short-term performance of these enterprises. In the mature enterprises, they usually have a more stable and diversified supply chain network, with more abundant experience and resource reserves. These companies often take steps to reduce supply chain risks, such as setting up alternative suppliers and strengthening logistics management. Therefore, although there are still some risks to supply chain dependence, the short-term performance impact of mature enterprises may be relatively small.

As mature enterprises and suppliers to establish long-term partnership and scale, enterprises in supply chain management has accumulated deep experience and professional knowledge, which makes the enterprise can better optimize the supply chain process, improve efficiency, and coordinate the relationship between suppliers and partners to achieve better synergies. For mature enterprises, high supply chain dependence can bring economies of scale effect. By establishing a long-term cooperation relationship with suppliers and expanding the scale, enterprises can obtain better procurement conditions and price advantages. This helps to reduce costs, improve profit margins, and gain an advantage in the market competition. In contrast, in the growth period, due to the relatively small scale and limited resources, the dependence on the supply chain may not be high enough, or may not have established a complete supply chain network. Therefore, at this stage, enterprises need to invest more energy and resources in the supply chain construction, and actively explore new suppliers and partners to achieve long-term performance improvement.

Based on regional distribution heterogeneity

Table 11. Nonlinear tests

	(1)	(2)
	Roe	TobinQ
GYL	-0.124***	-0.017***
	(-7.485)	(-10.399)
GYL^2	0.001***	0.000***
	(5.400)	(14.306)
Size	3.026***	-0.380***
	(41.031)	(-50.566)
Lev	-23.984***	-0.521***
	(-56.908)	(-12.155)
INV	9.268***	0.002
	(12.842)	(0.034)
Growth	10.463***	0.334***
	(55.131)	(17.294)
Board	0.962**	0.047
	(2.151)	(1.027)
Indep	-0.022	0.008***
	(-1.468)	(4.860)
TOP1	0.090***	0.001**
	(18.057)	(2.214)
SOE	-0.065	-0.135***
	(-0.367)	(-7.483)
ListAge	-1.707***	0.266***
	(-16.748)	(25.679)
_cons	-48.802***	10.389***
	(-21.655)	(45.285)
a particular year	control	control
trade	control	control
Obs.	29519	29519
R-squared	0.255	0.305

Based on regional distribution heterogeneity, the total samples were divided into three groups for comparative regression analysis. The eastern region mainly includes Guangdong, Jiangsu, Zhejiang, Shandong, Beijing, Shanghai, Hebei, Fujian, Tianjin, Liaoning and Hainan, and the central region mainly includes Hunan, Hubei, Henan, Jilin, Anhui, Shanxi, Jiangxi and

Heilongjiang. The rest are areas in the western provinces. In Table 11, the regression coefficient value of GYL for ROR Roe is-0.039 in western provinces, significant at the 1% level, and the regression coefficient value of TobinQ is 0.008 in western provinces, which passed the significance test. The negative impact of supply chain on short-term performance of enterprises is more significant in the western region and the effect of enterprises in the western region.

In the western region, due to the relatively lagging infrastructure construction of transportation and logistics, there may be more obstacles and uncertainties in the operation of the supply chain, thus increasing the risk of enterprises. In addition, some enterprises in the western region may lack advanced supply chain management concepts and experience, which may also lead to low supply chain efficiency, thus affecting short-term performance. Companies in the eastern region may benefit from a more developed infrastructure and supply chain networks, as well as a more mature market environment and supply chain management experience. These companies may have some advantages in supply chain optimization and risk management, thus performing more robust in short-term performance.

Supply chain may have some specific advantages and opportunities in improving the long-term development of enterprises in western China. The western region has huge market potential, especially with the government's promotion of the western development strategy, the economic growth and consumption capacity are constantly improving. This provides a broader market space for enterprises, and is conducive to the long-term development of enterprises. In order to promote the development of the western region, the government usually introduces a series of policy support measures, including tax incentives, land policies, etc. These policies can provide certain support and convenience for enterprises in the long-term supply chain construction and operation.

Nonlinear relationship test

In this section, we construct the index GYL^2, Is the square term of the supply chain GYL. And further build a model (2) to test the non-linear relationship of supply chain dependence on enterprise performance.

$$Roe_{i,t} / TobinQ_{i,t} = b_0 + b_1 GYL_{i,t} + b_2 GYL_{i,t} * GYL_{i,t} + b_i Cobtrols_{i,t} + \sum Year + \sum Indus + \varepsilon_{i,t} \quad (2)$$

In Table 11, it can be seen that the regression coefficient values of GTL were significantly negative while GYL regardless of the explained variables were Roe or TobinQ[2]The regression coefficient values of L were all significantly positive. Consistent with the above results, it shows that supply chain dependence has a U-shaped impact on enterprise performance with first inhibition and then improvement.

Supply chain dependence may usually have an inhibitory effect on enterprise performance in the short term, but it has a promoting effect in the long term. This is due to the challenges and risks of the initial supply chain dependency that have a negative impact on performance. In the short term, when companies are highly dependent on specific suppliers or partners, they may be affected by risks such as supply chain disruption, quality problems, or delivery delays. These problems may lead to production disruptions, order delays, or customer dissatisfaction, with a short-term negative impact on enterprise performance. Over-reliance on a supplier may prevent access to better prices and services, thus increasing operating costs. This could have a negative impact on corporate profitability in the short term.

However, with the passage of time and the deepening of supply chain relationship, enterprises can obtain a long-term promotion effect from supply chain dependence. Establishing stable partnerships with suppliers and partners can promote information flow, resource sharing, and technological innovation. Such synergies contribute to improve productivity, reduce costs and provide better products and services, thus to long-term growth in corporate performance. Through long-term and stable cooperation with professional suppliers, enterprises can focus on their core business, so as to improve efficiency and competitiveness.

When the supply chain dependence is at the appropriate level, enterprises can better balance the costs, risks and benefits. Reasonable supply chain management and optimization can reduce costs and risks, and improve the efficiency and benefits of enterprises. The stability and reliability of the supply chain can enhance the market competitiveness and brand image of enterprises, and help enterprises to achieve long-term development.

CONCLUSIONS AND SUGGESTIONS

This paper takes the research object of Shanghai and Shenzhen A-share listed companies in 2009-2022 to empirically tests the impact of supply chain dependence on enterprise performance. Through the test, it is found that supply chain dependence has different effects on enterprise performance in different periods, which suppresses enterprise performance in the short term, but

it has a benign effect on enterprise value in the long term. The heterogeneity test found that the impact of supply chain dependence on enterprise performance was more significant in non-state-owned enterprises and enterprises in western provinces. Based on the life cycle, the inhibitory effect of supply chain dependence on short-term performance is more significant in growing enterprises, and the improvement effect of long-term performance is more effective in mature enterprises. According to the conclusion of this paper, the following suggestions are put forward:

First, enterprises should diversify their supply chains, reduce their dependence on a single supplier or region, and establish cooperative relationships with multiple suppliers to ensure the stability of the supply chain. If the enterprise relies too much on a single supplier, once the supplier has problems (such as production interruption, quality problems, etc.), the enterprise will face the risk of supply interruption, which will affect the production and delivery capacity. The monopoly position of a single supplier may lead to price increases or unstable supply, thus increasing the purchasing cost of the enterprise. Market demand and competition are changing, and over-reliance on a single supplier or region may prevent companies to respond to changes in market demand, thus missing opportunities. Therefore, enterprises should actively seek for other competitive suppliers, establish partnerships, and ensure the quality and reliability of suppliers through competitive bidding or negotiation.

Second, establish a long-term and stable partnership with suppliers for common development and innovation. This makes the supply chain more efficient and flexible, reduces costs and drives value creation. Building long-term partnerships with suppliers can build deeper understanding and trust and reduce communication costs and time. The two sides can better coordinate and plan supply chain activities to improve production and delivery efficiency. And long-term partnerships can help companies work with suppliers to optimize processes and reduce costs. By sharing information and resources, both parties can cooperate with each other to improve efficiency and reduce waste. From an innovation perspective, building long-term and stable partnerships with suppliers can encourage continuous innovation and improvement on both sides. Through joint research and development and sharing of best practices, companies can acquire new ideas and technologies from suppliers to drive innovation in products and services. Moreover, long-term partnerships can make it easier for companies to adapt to market changes and demand fluctuations. Suppliers understand the needs and preferences of enterprises, can better respond to changes, and offer flexible supply solutions.

Third, adopt advanced supply chain technologies, such as the Internet of Things, big data analysis and artificial intelligence, to realize the digital transformation of the supply chain. By implanting sensors and communication devices on items, IoT technology can enable real-time monitoring and management of logistics and inventory. Companies can track the location, transportation status and temperature of goods to get a better grasp of logistics and inventory conditions and timely adjust their supply chain plans. Artificial intelligence technology can help companies automate their supply chain management processes, such as automatic ordering, scheduling and purchasing. These technologies can reduce manual intervention and thus improve the efficiency and accuracy of the supply chain. Therefore, in the future era full of change, enterprises should actively promote digital reform, and then help their sustainable development.

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