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The Impact of Supply Chain Concentration on the Stability of EVA in Manufacturing Firms: A Moderating Effect Analysis Based on Industry Competition Level

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Abstract. This paper uses A-share listed manufacturing companies in China from 2003 to 2024 as a research sample to empirically examine the nonlinear impact of supply chain concentration on the stability of corporate economic value added (EVA) and explores the role of industry competition intensity (HHI) in this process. The results show that: First, supply chain concentration has a significant inverted U-shaped impact on the stability of manufacturing companies' EVA. Within a moderate concentration range (below the critical inflection point of approximately 52.5%), the synergistic effect brought about by concentration dominates, significantly reducing transaction costs and enhancing the robustness of value creation. However, once this threshold is crossed, the "lock-in effect" and risk lock-in caused by over-reliance become dominant, thus exacerbating the company's operational volatility. Second, industry concentration (high HHI) has a significant direct positive promoting effect on corporate EVA stability, but it does not play a significant moderating role in the aforementioned inverted U-shaped relationship. This indicates that the impact of supply chain structure on value stability stems more from internal corporate governance decisions and resource allocation than from shifts in the external industry competitive landscape. This study breaks through the traditional linear debate on the economic consequences of supply chain concentration and provides empirical evidence for manufacturing enterprises to optimize their supply and demand structure.

Keywords: Supply chain concentration, EVA stability, Industry competition level, Inverted U-shaped relationship, Risk management

1. Introduction

In the context of a radical restructuring of the international manufacturing industry chain, and the rising levels of external uncertainty, Chinese manufacturing companies are subjected to more sophisticated external fluctuations. To achieve operational efficiency and supply chain synergy, manufacturing enterprises are likely to form close cooperation with several core nodes. This centralization trend has become a hallmark of the contemporary industrial system. Nevertheless, the regular macroeconomic shocks that have occurred over the past few years have served as a warning bell; excessive reliance on one node may create a severe case of the so-called risk contagion

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phenomenon, resulting in turbulence in corporate value creation. As early as 80-90 years ago, classic literature by Hendricks and Singhal has been pointing to the fact that even small problems in supply chains can negatively affect the operating performance for a long time [1]. More recently, Zhang et al. have also verified that in the event of sudden systemic risks, highly centralized supply chains are capable of severely increasing the vulnerability and operational resistance of manufacturing enterprises [2]. Due to the high fixed cost structure and significant operating leverage of the manufacturing sector, the stability in value creation becomes extremely important compared with the short-term increase in profits. Thus, what is the best way to balance the so-called "efficiency dividend" and the so-called "volatility risk" caused by centralization has become a topic of immediate concern in high-quality development.

The economic effect of supply chain concentration has been debated in academia for a long period. A perspective suggests that concentration can be used to minimize communication expenses and information asymmetry. Patatoukas has demonstrated that medium concentration is beneficial to asset usage due to economies of scale [3]. Wang et al. also, in their most recent research on the Chinese market, noted that the synergistic innovation effects can enhance the total factor productivity of the enterprises through concentration of key supply chain partners [4]. Some other arguments argue that great concentrations will make enterprises sensitive to the operation shock of upstream and downstream. Dhaliwal et al. also pointed out that extreme concentration would greatly raise the level of equity capital costs [5]. Campello and Gao also noted that such structural dependency will hurt the financial resilience of enterprises in case of limited financing or volatility within the market [6]. Li and Zhu also stated that a highly centralized client base will exacerbate the issue of information asymmetry, which in turn increases the danger of a stock price crash of the listed company [7]. Upson and Wei recently clarified more on the fact that supply chain concentration is one of the crucial factors influencing the changes in the cost of capital of a corporation and this will directly affect the value of an enterprise over time [8].

Even though the effect of supply chain structure on firm performance has been thoroughly researched in the existing literature, it is yet unknown how supply chain stability affects economic value added (EVA) in non-linear relationships. Choi et al. reassessed supply chain complexity and argued that, as opposed to a straightforward linear relationship, there is an explicit phased trade-off between firm performance and supply chain concentration [9]. This gives the paper a clear theoretical chance to examine the inverted U-shaped effect. Moreover, the variable of environment at the meso level remains neglected in most of the existing research. The empirical paper written by Hou and Robinson supported the central role of industry competition (HHI) in risk pricing [10]. It is inferred that the intensity of industrial competition can be very influential in the moderation of micro-supply chain risk transmission, but the relationship is not discussed extensively within the current academia.

The present paper examines empirical evidence to find out how supply chain concentration may affect EVA stability and what its mechanisms are by means of data analysis of manufacturing companies listed in China A-share between 2003 and 2024. This paper has a marginal contribution in the following three areas. Firstly, this paper can contribute to the construction of indicators by breaking with the conventional net profit indicator, and adopting the newly constructed metric of EVA stability after the cost of capital is deducted based on the most recent theory of capital cost valuation [6, 8] to capture more realistically the ability of manufacturing firms to preserve their values in a volatile setting. Secondly, regarding extending the logical framework, this paper incorporates the inverted U-shaped nonlinear relationship along with the meso-level industry competition moderator effect, thus breaking the single linear debate of the benefits and downsides of

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supply chain concentration [3, 9]. Last but not least, in terms of its implications for management practice, this paper offers different recommendations to the manufacturing companies, stating that companies need to be well-matched to the competitive situation in their relevant markets to enhance supply-demand structuring.

2. Research methods

2.1. Data source

The present article has chosen the manufacturing companies that are listed on the A-share market in China during 2003-2024 as its initial research subjects. As a way of ensuring the accuracy of the empirical information and the credibility of the findings of the research, this paper has undertaken an intensive selection and cleaning of the original sample. Initially, the invalid samples that could not contain any significant financial data (including Economic Value Added (EVA), the share of the purchases made by the top five suppliers, and the share of the sales made by the top five buyers) were totally removed. Secondly, in order to reduce the influence of extreme outliers on the fit of ordinary least squares (OLS), this paper uses 1 percent winsorization on all continuous variables. Finally, the financial and corporate governance data necessary to conduct the research come from CSMAR database, and all the data cleaning, matching, and merging procedures are carried out automatically in the form of Python programming language.

2.2. Variable selection

Concerning the explained variable, the selected indicator that will be used in this paper as the core indicator of the explained variable is Economic Value Added (EVA) stability, with a specific measure of EVA caliber 2. In order to correctly describe the stability of corporate value creation, this paper has calculated the three-year rolling standard deviation of the target company's EVA between year t and t-2. As the bigger standard deviation indicates that the performance fluctuates more drastically, this paper makes use of the negative value of the standard deviation as the ultimate stability indicator; i.e., the higher the value is, the more stable the corporate value creation process is. At the same time, in order to make the regression coefficients more economically understandable and displayable, this paper equally treats the unit of the explained variable as being billion yuan (i.e., the initial values divided by). In the case of the core explanatory variable, this paper chooses Supply Chain Concentration (SCC) to indicate the level of dependence of the enterprise on both the upstream and downstream core manufacturers. Its actual methodology is the arithmetic mean of the total amounts of the top five biggest suppliers' purchase ratio plus the top five largest customer sales ratio, and its value is strictly set to have an interval of [0,1]. As an illustration, in case the purchases of a company are dominated by five of the top five suppliers (40 percent) and its sales are dominated by five of the top five customers (60 percent), the overall supply chain concentration would amount to 50 percent. On the topic of moderating and controlling variables, the measure of industry competition is the Herfindahl-Hirschman Index (HHI) based based on main business revenue (HHI). Note here please that the HHI value is inversely related to the intensity of market competition: e.g., when the HHI of some particular industry tends to 1, it means that the sub-sector is very high in concentration, and market competition can be characterized as oligopolistic or even monopolistic, with low competitiveness. Also, in order to ensure that interference by other unobservable factors does not affect the results, the model includes strict fixed effects. Firstly, by placing the year fixed effects (Year FE) in the year 2003-24, the overall factors of macroeconomic policy and economic

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cycle, which vary across time, but affect all enterprises in the same way, are significantly controlled. Secondly, industry fixed effects (Industry FE) are introduced using the 2012 industry classification standards of the CSRC to address the endogenous changes in value creation due to the differences in production model, technology barriers, and market environment of various subsectors in the manufacturing industry.

2.3. Model construction

To check the nonlinear effect of supply chain concentration on the stability of corporate EVA and the possible moderating effect of industry competition, this paper builds a panel data regression model that contains quadratic terms of the main explanatory variables. The precise econometric model used as a benchmark is described below:

$$Stability_{i,t} = \beta_0 + \beta_1 SCC_{i,t} + \beta_2 SCC_{i,t}^2 + \beta_3 (SCC_{i,t}^2 \times HHI_{i,t}) + \beta_4 HHI_{i,t} + Controls + \epsilon_{i,t} \quad (1)$$

The above model uses the subscript i to denote a particular company, t denotes year; is the explained variable, which is the negative value of the three-year rolling standard deviation of the EVA in billion yuan and is the supply chain concentration and its square term. These are the list of control variables indicated earlier. The purpose is to reduce even further the influence of macroeconomic cycles and industry properties; this is the random error. The present paper estimates the model parameters through the method of ordinary least squares (OLS). Clearly, during the empirical investigation, a significant negative coefficient of the quadratic expression can indicate a strong positive effect of the inverted U-shaped connection between supply chain concentration and EVA stability. That means moderate concentration can help enhance stability, but excessive concentration leads to increased risk, hence confirming the main theoretical premises of the present paper. Finally, this paper has included the moderating variable HHI and its interaction term by extending this baseline model to perform the test of the moderating effect of the competitive environment.

3. Empirical results and analysis

3.1. Main effects regression results

The estimation results of the OLS regression are shown in Table 1. Controlling for the effect of years, the results of model (1) provide the data result of the supply chain concentration of the regression model:

Table 1. Test of the impact of supply chain concentration on EVA stability

Variables	(1) Stability
Constant	-0.346***
	-0.043
SCC	1.539***
	-0.101
SCC²	-1.466***

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Table 1. (continued)

	-0.126
Year FE	Yes
Industry FE	Yes

Note : Significant at the 1% level.

3.2. Moderating effect analysis

According to the inverted U-shaped regression findings, the linear term coefficient of SCC is significantly positive (1.5394) and the quadratic term coefficient is significantly negative (-1.4657). These two combine to form a statistically significant inverted U-shaped curve association due to the features of quadratic functions.

Through differentiation of the regression equation, it is obtained that the inflection point on the curve is at [value missing]. It would imply that as long as supply chain concentration levels are less than 52.5 per cent, there is a great possibility to increase the concentration to enhance operational stability, but as soon as the critical level is reached, concentration and stability will be inversely related.

4. Analysis and discussion

The experimental findings demonstrate that the concept of supply chain concentration has a two-edged sword effect on the stability of operations in manufacturing companies. The supply chain concentration range of up to 52.5 percent, that is, in the synergy area, allows manufacturing enterprises to greatly lower all transaction costs and develop an effective information and logistics synergy system through creating deep strategic partnerships with core suppliers and core customers. Empirical evidence indicates that in this range, each additional 10 percentage points in supply chain concentration causes the stability of EVA of the enterprise to be increased by an average of about 0.15 billion yuan.

Nevertheless, when the concentration goes beyond the 52.5% inflection point, companies become stuck in a risk-locked-in situation with too much reliance on a single node. At this point, each fluctuation in operations of the core partners would have a huge amplification effect via closely integrated supply chains and lead to catastrophic shocks in the process of value creation within the company.

Moreover, the research establishes industry concentration as highly positive in contributing to the stability of operations of the company, and the regression coefficient stands at 0.8317, which is significantly important at 1 percent based on Table 2. This finding shows that less competitive industries are associated with greater levels of operational stability of their companies. In spite of the fact that industry background is directly influential, the unimportant values of the interaction term indicate that the non-linear influence of the supply chain structure on stability is predominantly determined by the internal choices of the corporation and is not necessarily changed by alterations in the external competitive environment.

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Table 2. Test of the impact of supply chain concentration and HHI on EVA stability

Variables	(1) Stability	(2) Stability
Constant	-0.346***	-0.396***
	-0.043	-0.044
SCC	1.539***	1.562***
	-0.101	-0.101
SCC^2	-1.466***	-1.470***
	-0.126	-0.138
HHI		0.832***
		-0.146
SCC × HHI (Interact)		-0.266
		-0.969
Year FE	Yes	Yes
Industry FE	Yes	Yes

The supply chain concentration should be seen as a risk management measure in manufacturing companies, and it is suggested that the average share of the leading five suppliers and customers is 50 percent. The enterprises with the high SCC (supply chain concentration) have to actively manage the structural risks on the top side of the inverted U-shaped curve by adding alternative suppliers or diversifying the channels through which the sales are made.

5. Conclusion

The research sample in this paper is A-share listed companies in the manufacturing industry of China during 2003-2024, aiming at exploring through empirical testing whether supply chain concentration can have an influence on both the stability of the corporate Economic Value Added (EVA), in addition to its underlying mechanism. The findings reveal that supply chain concentration has an inverse U-shaped nonlinear relationship with corporate EVA stability: in situations where concentration is low, increasing concentration can assist to utilise the synergetic effect and minimize transaction costs and hence increase stability of value creation whereas when concentration exceeds the critical inflection point of 52.5% overdependence on core suppliers and customers makes EVA instability worse and threatens operational stability. In addition, the level of industry competition (HHI) has a linear positive effect on EVA stability, which means that those companies that are competing in more intensive industries tend to be more stable. But industrial competitiveness conditions do not play an important moderating role in changing the shape of the inverted U-curve, implying that the effect of the supply chain structure on stability has more to do with internal corporate decisions and resource allocation. At the same time, the relevance of year and industry fixed effects indicates that macroeconomic cycles and industry specifics are also important external factors in the value fluctuations of manufacturing companies.

In light of these conclusions, this paper develops appropriate practical recommendations and perspectives. It is important for managers in an enterprise to take a rational measure about whether or not it is appropriate to concentrate a supply chain and not be too hasty in seeking close integration with any given core customer or supplier. It is advised that the share of the top five partners should be kept at a moderate level, about 50 per cent. An enterprise with a high concentration level should

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diversify its structural risk through the creation of alternative suppliers or the expansion of the enterprise into new markets. Investors and creditors are advised that in evaluating the long term value of manufacturing enterprises, apart from concentrating on conventional profitability, they need to pay close attention to the stability of supply chain structures and take caution against highly concentrated companies exposed to high operational risks caused by external shocks (e.g., increasing raw materials prices or declining demand). The final point is that even though the current paper has strong empirical support, the study mainly considers the manufacturing industry. Further studies could also be conducted in other industries like services and high-tech industries to examine the heterogeneity of the effects of supply chain concentration in varied industrial features.

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