

Supply Chain Finance and Corporate Financial Performance: Causal Identification Based on the Instrumental Variable Method

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Abstract

In recent years, supply chain finance has gradually become an important model to alleviate financing problems and enable the development of enterprises, but its causal effect is vulnerable to endogenous problems. This paper takes supply chain finance and corporate financial performance as the research theme, selects China's A-share listed companies from 2020 to 2024 as the research sample, and uses the instrumental variable method to carry out a causal identification test. It is found that there are obvious endogenous errors in ordinary OLS estimates and underestimate the real effect. After correction, it is found that supply chain finance can significantly improve the financial performance of enterprises. The analysis of heterogeneity shows that this effect is more obvious in small-scale enterprises, and the difference between different property rights is not significant. Several robustness tests, such as replacement of core indicators and propensity score matching, all confirmed the reliability of the conclusion. This study clarifies the causal relationship between supply chain finance and enterprise financial performance and improves the literature on causal identification in the field of supply chain finance. It also provides empirical reference for enterprises to optimize supply chain financing arrangements, and for the government to introduce policies to accurately support small and medium-sized enterprises and manage supply chain financial risks.

Keywords

supply chain finance, financial performance, instrumental variable method

1. Introduction

Against the backdrop of the coordinated development of the digital economy and the industrial chain, supply chain finance has become an important tool to alleviate the financing constraints of enterprises and optimize the allocation of industrial chain resources [1]. Existing studies have different opinions on the relationship between supply chain finance and enterprise financial performance. Although they can confirm the correlation between supply chain finance and enterprise value, they cannot ensure that the model is not disturbed by factors such as reverse causality. As a result, such research tends to generate problems including coefficient sign deviation and distorted effect estimates, and cannot objectively measure the actual impact of

supply chain finance on enterprise value. Based on this, this paper takes supply chain finance and enterprise value as the core research object, carries out causal identification with the help of the instrumental variable method, corrects endogenous bias, accurately estimates its real effect, and further explores the characteristics of heterogeneity to make up for the shortcomings of existing research.

Existing literature has analyzed the corporate effects of supply chain finance from the perspectives of financing constraints and operating performance [2]. Most relevant studies adopt traditional OLS regression models disturbed by endogenous factors including reverse causality, making it hard to identify the genuine causal relationship between supply chain finance and corporate financial performance [3]. This paper takes Chinese A-share listed companies as research samples, uses the instrumental variable method to carry out causal identification, and analyzes the real impact, heterogeneous characteristics, and robustness of SCF on corporate financial performance. Experiments show that OLS presents a negative illusion due to endogenous bias. After IV correction of endogenous bias, SCF significantly improves corporate financial performance, and the effect is stronger in small enterprises. The difference in property rights is not significant. The test of replacement variables and PSM proved that the experimental conclusion was stable. Theoretically, based on IV, this paper clarifies the causal effect of SCF on corporate financial performance, and enriches the causal identification framework of supply chain finance and corporate value. In practice, this paper provides empirical evidence and theoretical reference for enterprises to optimize supply chain financing, the government to accurately support small and medium-sized enterprises, and prevent supply chain concentration risks.

2. Theoretical Analysis and Hypothesis Raising

Existing literature presents two divergent conclusions regarding the impact of supply chain finance on corporate financial performance. The first category is positive conclusions. Existing literature has demonstrated from the perspective of working capital that supply chain finance shortens the cash turnover cycle, reduces the opportunity cost of capital occupation, and raises profits [4]. Guo Hengxi took A-share retail enterprises as a sample to demonstrate that SCF significantly broadened financing channels, optimized cash flow, and significantly improved the return on total assets [5]. Another part of the study reveals the partial inhibitory effect of supply chain finance on financial performance. supply chain finance shows an inverted U-shaped relationship with corporate performance. Excessively large financing scales will divert corporate capital into financial speculation, crowd out investment in core operations, and reduce corporate profits [6]. Complex supply chain transactions provide space for management's earnings manipulation and damage real profits for a long time [7]. To sum up, the existing OLS simple regression can only observe the correlation of variables, cannot strip away all kinds of endogenous disturbances, and it is difficult to identify the pure one-way causal effect of SCF on financial performance.

Based on this, this paper proposes the following research hypotheses:

H1: After excluding endogenous interference, supply chain finance can significantly and positively improve the financial performance of enterprises.

H2: The smaller the enterprise size, the stronger the positive promotion effect of supply chain finance on financial performance.

3. Study Design and Data

This study takes China's A-share listed companies as a research sample, and selects the data from 2020 to 2024. supply chain finance-related data, company size, and property rights nature all come from the CSMAR database. The SCF word frequency data in the robustness test comes from the supply chain research database of CNRDS. In order to ensure the rigor of the research results, the samples were processed as follows: Samples of financial and insurance listed firms are eliminated. Samples of ST and *ST enterprises with abnormal financial status are excluded. Observations with severe missing values in core variables are removed. All continuous variables are winsorized at the 1% and 99% quantiles to eliminate extreme outliers.

For the financial performance of the explained variable, this study chooses the Tobin Q value to measure the financial performance of enterprises, reflecting the market value and growth potential of enterprises. In view of the explanatory variable supply chain financial level, referring to the existing literature, the supply

chain financial level adopts: $SCF = \text{quantification of (short-term loans + notes payable + accounts payable) / total assets at the end of the year}$ [8]. Four firm characteristic variables are controlled in this research, namely firm size, property right nature, asset-liability ratio and operating cash flow. Among them, company size is expressed by the natural logarithm of total assets, and property right nature is expressed by dummy variables; state-owned enterprises are 1, and non-state enterprises are 0. At the same time, this study controls for the fixed effects of the industry and the annual fixed effect. In order to identify the causal effect of supply chain finance on corporate financial performance, this paper constructs the following benchmark model:

$$\text{TobinsQ}_{i,t} = \alpha + \beta \cdot \text{SCF}_{i,t} + \gamma \cdot \text{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

Where i is the enterprise and t is the year. Controls is a collection of control variables. i is the fixed effect of the industry, and λ_t is the annual fixed effect. $\varepsilon_{i,t}$ is a random disturbance term. β depicts the marginal impact of SCF on financial performance. In view of the possible endogenous disturbances between SCF and financial performance, such as reverse causality and omitted variables, OLS estimation is difficult to identify real causal effects. This paper uses the instrumental variable method to correct for endogeneity and selects the average SCF of the lagging industry as the instrumental variable. In the second stage, the fitted $\text{SCF}_{i,t}$ is substituted into the benchmark model to obtain a consistent estimate. In addition, this paper judges the existence of endogeneity through the Hausman test, and tests the weak instrumental variable problem with the first-stage F-statistic to ensure the reliability of IV estimation. The first-stage regression of the two-stage least squares method is as follows:

$$\text{SCF}_{i,t} = \pi_0 + \pi_1 \cdot \text{IV}_{i,t} + \pi_2 \cdot \text{Controls}_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \quad (2)$$

4. Empirical Results and Analysis

4.1 Descriptive Statistics

According to the descriptive statistical results in Table 1, the average financial performance of the explained variable enterprises is 1.975, the standard deviation is 1.442, the minimum value is 0.621, and the maximum value is 29.167, indicating that the ratio of market value to book value of the sample enterprises is quite different, which is in line with the realistic characteristics of the coexistence of growth and value differentiation of A-share listed companies. The core explanatory variable supply chain finance level covers 10,151 observations with a mean value of 0.259 and a standard deviation of 0.128. This statistic reveals that approximately one quarter of sample firms' current liabilities are raised via supply chain finance, and the overall market penetration still has room for growth [9]. In terms of control variables, the average asset liability ratio is 43.15%, the average cash flow ratio is 5.88%, the average company size is 22.507, and the average property right nature is 0.308, that is, about 30.8% of the sample are state-owned enterprises, and the proportion of non-state enterprises is close to 70%, which is basically consistent with the A-share market structure [10].

Table 1: Descriptive Statistics

	Obs	Mean	Std. Dev.	Min	Max
TobinsQ	16036	1.975489	1.441765	0.621196	29.16699
DAR	16039	0.4315112	0.2014129	0.013062	3.645301
Cashflow	16039	0.0587711	0.0982781	-2.684982	4.636175
Comsize	16039	1.01e+09	6.46e+09	-8.81e+09	3.02e+11
Comtype	16039	0.3078122	0.4616028	0	1
SCF	10151	0.2593698	0.128254	0.0048021	1.24767
comsize	16039	22.50746	1.328878	17.88643	28.79081

As seen in Table 2, the correlation analysis matrix shows that the Pearson correlation coefficient between SCF and FP is - 0.103, which is significantly negatively correlated at the 1% level. This preliminary result is consistent with the findings of some literature, suggesting that there may be endogenous bias in OLS estimation. It is worth noting that the correlation coefficient between SCF and DAR reaches 0.642, which demonstrates a strong correlation between supply chain finance and corporate leverage level. If this correlation and potential endogenous structure are ignored, simple regression is easy to mistake the leverage effect for supply chain finance itself. In addition, there is a significant negative correlation between company size and financial performance, reflecting the relatively conservative market valuation of large-scale enterprises.

Table 2: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) FP	1.000						
(2) DAR	-0.217*	1.000					
(3) CashFlow	0.148*	-0.145*	1.000				
(4) TotalInvest	-0.063*	0.098*	0.057*	1.000			
(5) comtype	-0.138*	0.228*	-0.045*	0.092*	1.000		
(6) SCF	-0.103*	0.642*	-0.185*	-0.052*	0.051*	1.000	
(7) comsize	-0.295*	0.418*	0.081*	0.364*	0.347*	0.036*	1.000

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

4.2 Benchmark Regression Analysis

According to the benchmark regression results in Table 3, the SCF coefficient of model 1 is -0.865, which is significantly negative at the 1% level. After adding control variables such as company size, property right nature, asset liability ratio, and cash flow to model 2, the SCF coefficient is -0.488, which is still significantly negative at the 1% level. From the analysis of economic logic, there are obvious doubts about the negative results of OLS. First, SCF is a market-oriented tool to alleviate financing constraints. If supply chain finance indeed impairs corporate performance, firms will lack sustained participation incentives, which contradicts the rapid expansion of supply chain finance in recent years. Second, the high correlation between SCF and Dar means that OLS estimates may pass on the negative effects of high leverage to the SCF coefficient. Thirdly, firms with weak operating performance have stronger incentives to adopt supply chain finance, which systematically suppresses the estimated coefficient of SCF and even causes coefficient sign reversal. Complex trading in supply chain finance provides space for management's earnings manipulation and damages real earnings in the long run. Although this mechanism can partly explain the negative correlation, it is difficult to fully explain the deviation between OLS estimation and theoretical intuition. Therefore, it is necessary to introduce the instrumental variable method for causal identification.

Table 3 Baseline Regression

	(1) Model1	(2) Model2
SCF	-0.8650*** (0.1452)	-0.4881*** (0.1565)
comsize		-0.2117*** (0.0164)
comtype		-0.0494 (0.0432)
DAR		-0.0618 (0.1436)
CashFlow		1.8999*** (0.2940)
_cons	2.2453*** (0.3953)	6.8998*** (0.4996)
N	10151	10151
R ²	0.133	0.201

4.3 Analysis of Heterogeneity

In terms of scale heterogeneity, the SCF coefficient of small-scale firms is approximately 22.9% higher than that of large-scale firms, and the larger sample size of large-scale enterprises guarantees stable regression results. This finding in Table 4 shows that supply chain finance has a particularly obvious effect on alleviating the financing difficulties of small and medium-sized enterprises. In terms of property right heterogeneity, although the point estimation result presents a slightly higher coefficient for non-state-owned enterprises, the large standard error suggests that inter-group differences should not be over-interpreted. State-owned enterprises already enjoy advantages in accessing traditional credit, and the marginal increment of supply chain finance is limited. Although non-state enterprises rely more on supply chain finance, they may also face higher

supply chain concentration risks and financing costs. The two forces cancel each other out, so that the difference in the final coefficient is not significant.

Table 4: Baseline Heterogeneity

	(1) SOE	(2) NE	(3) Large scale	(4) Small scale
SCF	-0.4617** (0.2075)	-0.5282** (0.2215)	-0.1158 (0.1650)	-0.9092*** (0.2622)
comsize	-0.2262*** (0.0215)	-0.2047*** (0.0234)	-0.0956*** (0.0166)	-0.6765*** (0.0688)
DAR	-0.2751 (0.2537)	0.0296 (0.1790)	-0.7588*** (0.1702)	0.7064*** (0.1973)
CashFlow	1.5257*** (0.5253)	2.0249*** (0.3638)	1.9813*** (0.4079)	1.7133*** (0.3806)
_cons	7.1557*** (0.5432)	7.0151*** (1.2227)	4.0491*** (0.3678)	16.9722*** (1.5796)
N	3206	6945	5985	4166
R ²	0.279	0.164	0.209	0.174

4.4 Robustness Test

In order to verify the reliability of the conclusion, this paper carries out a robustness test from four aspects. First, replace the core indicators. The explanatory variable is replaced by Tobin Q with the return on total assets, and the SCF coefficient is 0.0434, which is significantly positive at the 1% level. As an accounting performance indicator, ROA reflects the current operating results of enterprises more directly than Tobin Q, and the conclusion remains unchanged after replacement, indicating that supply chain finance not only improves market valuation, but also improves real profitability.

Second, this paper adopts an alternative measurement for SCF. The core explanatory variable is recalculated using SCF word frequency data from the CNRDS supply chain research database, and the regression coefficient of SCF turns out to be insignificant. This needs to be interpreted carefully: the word frequency index reflects more the attention of enterprise supply chain finance than the depth of actual participation, which is different from the debt-side measurement based on financial statements in this paper. This result shows that accurately capturing the real supply chain financial participation of enterprises can help identify its causal effect, which confirms the rationality of the core measurement method in this paper.

Third, PSM-OLS matching. After controlling for sample selection bias by propensity score matching, the SCF coefficient is 0.4983, which is significantly positive at the 1% level, which is consistent with the direction of IV estimation. Although the coefficient is slightly small, the economic significance is clear. By constructing a counterfactual control group, PSM alleviates the non-random selection bias of firms' supply chain finance participation and serves as a complementary method to IV estimation.

Fourth, lag one explanatory variable. SCF was delayed for one period to alleviate reverse causality, with a coefficient of 0.4533, which was significantly positive. Although lag processing cannot eliminate endogeneity, it can weaken the immediate feedback of current performance to current financing decisions to a certain extent, and the results once again support the benchmark conclusion.

As seen in Table 5, based on the four tests, except that the word frequency substitution is not significant due to the difference in measurement caliber, the other tests support the core conclusion that supply chain finance significantly improves the financial performance of enterprises. The insignificant word frequency index also shows that the study of supply chain finance must distinguish between nominal participation and substantial participation, so as to avoid misjudging conceptual speculation as real effect.

Table 5: Robustness test

	(1) Replace ROA	(2) Replace word frequency	(3) PSM	(4) Lag phase I
SCF	0.0434*** (0.0106)		0.4983*** (0.0773)	0.4533*** (0.0704)
comsize	0.0129*** (0.0009)	-0.2795*** (0.0185)	-0.2938*** (0.0225)	-0.2738*** (0.0182)
comtype	-0.0042** (0.0018)	-0.0580 (0.0357)	-0.0640 (0.0392)	-0.0518 (0.0350)
DAR	-0.1759*** (0.0148)	-0.2500** (0.1051)	-0.1793 (0.1156)	-0.1774* (0.1064)
CashFlow	0.2896*** (0.0197)	3.1930*** (0.2411)	3.3081*** (0.2721)	2.8421*** (0.2437)
_cons	-0.2159*** (0.0267)	8.6712*** (0.4632)	8.6547*** (0.5328)	8.2527*** (0.4390)
N	10151	16039	12269	13377
R ²	0.332	0.242	0.244	0.246

4.5 Endogenous Treatment Results

In order to correct the above endogenous errors, this paper uses the instrumental variable method to re-estimate. As seen in Table 6, Hausman Test $\chi^2(76) = 182.92$, $P = 0.0000$, strongly rejects the original hypothesis that OLS is not endogenous, and confirms the necessity of introducing instrumental variables. In the first stage, the F statistic is 299.46, which is much higher than the critical value of Stock and Yogo for weak instrument identification, indicating that the instrumental variables are highly correlated with endogenous explanatory variables, and there is no weak instrument problem. The IV-2sls results showed that the coefficient of SCF was 0.7626, which was significantly positive at the 1% level, in sharp contrast to -0.488 of OLS. After correcting endogeneity bias, the causal impact of supply chain finance on corporate financial performance turns significantly positive. It proves that OLS seriously underestimates the real effect of supply chain finance due to endogenous disturbances such as reverse causality and omitted variables, and even causes symbolic reversal Hypothesis. H1 was tested. In sub-sample IV regressions, the SCF coefficient equals 0.6087 for large-scale firms and 0.7481 for small-scale firms, and the latter coefficient is higher and statistically significant at the 1% level. This result supports hypothesis H2: the smaller the enterprise size, the stronger the positive effect of supply chain finance on financial performance.

Table 6: IV results

	(1) OLS	(2) IV-2SLS	(3) IV (clustering)	(4) IV- Large scale	(5) IV- Small scale
SCF	0.4503*** (0.0453)	0.7626*** (0.0813)	0.7626*** (0.1221)	0.6087*** (0.1439)	0.7481*** (0.1854)
comsize	-0.2616*** (0.0083)	-0.2758*** (0.0094)	-0.2758*** (0.0189)	-0.0563*** (0.0208)	-0.8869*** (0.0616)
comtype	-0.0662*** (0.0207)	-0.0840*** (0.0224)	-0.0840** (0.0361)	-0.1937*** (0.0371)	0.0747 (0.0611)
DAR	-0.2639*** (0.0519)	-0.3183*** (0.0573)	-0.3183*** (0.1102)	-1.0135*** (0.1355)	0.1987 (0.1349)
CashFlow	3.1484*** (0.1244)	2.9237*** (0.1404)	2.9237*** (0.2568)	3.1724*** (0.2846)	2.4435*** (0.3690)
_cons	8.0502***	7.8715***	7.8715***	3.0254***	20.9218***

	(0.2255)	(0.2661)	(0.4628)	(0.5388)	(1.3639)
N	16039	12116	12116	6397	5719
R-squared	0.2464	0.2685	0.2685	0.3330	0.2360

5. Conclusion

The regression results reveal that conventional OLS estimations produce a misleading negative coefficient, as endogenous interference including reverse causality and omitted variables masks the genuine impact of supply chain finance on corporate performance. After the correction of instrumental variables, the real effect of supply chain finance on corporate financial performance is significantly positive. The analysis of heterogeneity shows that the effect is significantly stronger in small-scale enterprises, and the difference between different property rights is not significant. From the perspective of mechanisms, supply chain finance improves the market value of enterprises by alleviating financing constraints and optimizing cash flow management. Small-scale firms face relatively limited external financing channels and thus exhibit higher marginal dependence on supply chain finance, which brings more prominent performance improvement benefits. Accordingly, enterprises should actively use supply chain finance to optimize debt structure and reduce financing costs. While standardizing the development of supply chain finance, regulators need to focus on the access threshold and participation depth of small and medium-sized enterprises to avoid the service becoming the privilege of large enterprises.

This paper systematically introduces the instrumental variable method into the research of supply chain finance and enterprise value. Through standard processes such as the Hausman test and weak instrument identification, it is confirmed that OLS estimation has serious endogenous bias and leads to sign reversal, providing a technical reference for causal identification for follow-up research. It clarifies that the real causal effect of supply chain finance on corporate financial performance is positive, corrects the misleading results of some negative estimates in the existing literature, and enriches the causal identification framework of supply chain finance and corporate value. At the same time, it reveals the characteristics of scale heterogeneity and provides empirical evidence for the government to accurately support small and medium-sized enterprises and prevent the risk of supply chain concentration. There are still some shortcomings in the current research, such as the fact that this paper mainly analyzes linear causal effects. In the future, researchers can further investigate the possible nonlinear relationship or threshold effect between supply chain finance and financial performance.

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Conflicts of Interest

The authors declare no conflict of interest.

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