

# Heterogeneity of Debt Sources and Firm Value: A Perspective Based on Capital Allocation Efficiency

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## Abstract

This study adopts an analytical perspective centered on debt source heterogeneity, selecting Chinese A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2015 to 2024 as the research sample. It systematically examines the impact of debt source heterogeneity on corporate value and its underlying mechanisms. Empirical results indicate that debt source heterogeneity exerts a significant positive effect on corporate value. In terms of mechanism pathways, this effect enhances capital allocation efficiency by alleviating financing constraints, reducing capital misallocation, and mitigating agency conflicts, thereby driving corporate value growth. Heterogeneity analysis further reveals that these effects are more pronounced in non-state-owned enterprises and smaller firms. This study provides new empirical evidence for understanding the economic consequences of debt source heterogeneity, offering important theoretical and practical implications for improving corporate debt governance structures and enhancing corporate value.

## Keywords

Heterogeneity of Debt Sources, Capital Allocation Efficiency, Enterprise Value, High-Quality Development

## 1. Introduction

At the macroeconomic level, the clustering and development of numerous high-value enterprises can generate powerful industrial cluster effects, driving high-quality development across entire industries and even the national economy. Enhancing corporate value also attracts top talent, drives technological advance-

ment, and fosters management innovation—all crucial engines for sustained economic growth. Simultaneously, elevated corporate value serves as a key driver for business development. High-value enterprises typically exhibit strong innovation capabilities and market adaptability, enabling them to continuously introduce new products or services that meet market demands, thereby fueling sustained growth and expansion. Elevating corporate value stands as a core operational objective, significantly boosting shareholder returns (Yang, 2025). The enhancement of corporate value also signifies the improvement of a company's profitability, which provides shareholders with more stable investment returns, thereby attracting more investors and increasing the company's market influence and capital operation capabilities. Therefore, enterprises should continuously pursue value maximization to achieve sustainable development and make positive contributions to the socio-economy. At the micro level, the increase in corporate value is a crucial factor driving economic growth. How can corporate value be enhanced? From the perspective of corporate financing, the key lies in establishing a matching financing structure to balance capital needs and risk sharing. In China's existing social financing system, debt financing dominates the scale of social financing. It serves as a vital source of funding for the rapid growth of most enterprises, influencing their long-term sustainable development through aspects such as production and operations, innovation and R&D, and resource allocation. A reasonable debt structure can balance capital demands, reduce financing costs, and foster innovation, providing support for sustainable operations and high-quality development of enterprises (Rajan, 1992; Bolton & Scharfstein, 1996; Colla et al., 2013; Ni et al., 2024).

The debt structure of enterprises in China exhibits heterogeneity characteristics (Li et al., 2014), debt source heterogeneity refers to the diversity of corporate debt financing channels. From the perspectives of financial markets and commodity markets, corporate debt sources include financial liabilities and operational liabilities. Based on the origin of debt entities, corporate debt can be categorized into financial institution loans, trade credit, corporate bonds, and other types of debt. From the standpoint of debt contract parties, terms, and fulfillment mechanisms, corporate debt financing can be classified as relationship-based or transaction-based (Huang & Chen, 2025). Against the backdrop of debt heterogeneity in China's corporate debt structure and the "debt-driven investment" growth model, this study explores whether corporate debt heterogeneity has an effect on enterprise value enhancement, aiming to provide new insights for enterprises in formulating financing strategies to improve corporate value.

## **2. Theoretical Analysis and Research Hypotheses**

### **2.1. Heterogeneity of Debt Sources and Firm Value**

From the perspective of overall debt heterogeneity, information asymmetry commonly exists between indebted enterprises and creditors. This situation makes it difficult for creditors to accurately grasp the details of how corporate managers

allocate funds, thereby hindering effective oversight. When a company's debt heterogeneity is high, it will strive to enhance the quality and intensity of its information disclosure to meet the diverse needs of different creditor groups. This measure effectively mitigates information asymmetry between indebted firms and creditors (Hu & Zuo, 2019). Whether viewed from the proactive perspective of firms voluntarily enhancing disclosure to demonstrate sound operations or the reactive perspective of passively increasing transparency due to external creditor demands, it strengthens both internal and external oversight and constraint mechanisms, thereby promoting sustained high value levels for the firm. From a risk resilience perspective, debt heterogeneity fortifies defenses for stable corporate value growth by diversifying risks and enhancing financial flexibility. A monolithic debt structure exposes companies to concentrated risk exposure, whereas debt heterogeneity achieves risk dispersion and hedging through diversified maturity structures and diversified funding sources (Hu & Tan, 2015). Diverse financing sources reduce reliance on any single channel. When certain financing avenues tighten, alternative debt instruments can still ensure capital supply, boosting financial resilience. Simultaneously, the differing risk characteristics of various debt instruments can cushion the impact of external environmental fluctuations on the enterprise, reducing the transmission of financial risks to operational risks. This safeguards operational stability and provides a secure foundation for sustained value growth. From a corporate governance optimization perspective, debt heterogeneity mitigates agency conflicts through diverse oversight mechanisms, providing institutional safeguards for value enhancement. Collaborative supervision by multiple debt holders reduces the costs and risks associated with a single oversight entity while strengthening checks on internal governance. This minimizes agency cost losses and indirectly drives corporate value growth (Wei, 2018). Debts from different sources exhibit significant differences in funding costs, oversight intensity, information requirements, and maturity flexibility. A rational mix of debt types not only achieves functional complementarity—precisely matching the enterprise's differentiated funding needs for short-term operations, long-term growth, and special development—but also effectively alleviates the financing limitations and constraints of relying on a single debt source. Furthermore, through the synergistic effects of multiple oversight entities, it curbs agency behaviors such as excessive investment by management and interest appropriation by major shareholders, reducing capital misallocation and resource waste. Simultaneously optimizing the financing cost structure, lowering financial risk and liquidity pressure, further enhancing capital turnover efficiency and investment returns, strengthening corporate profit stability and sustainable development capabilities, elevating market valuation levels, and ultimately translating into value enhancement (Li & Wang, 2020). Based on the above analysis, this paper proposes Hypothesis I.

Hypothesis H1: Heterogeneity in debt sources promotes the enhancement of firm value.

## 2.2. Mechanism of Debt Source Heterogeneity on Firm Value

The heterogeneity of debt sources manifests in differences among various funding providers—including bank loans, trade credit, bond financing, and non-bank financial institution debt—regarding oversight mechanisms, financing costs, and functional positioning. Through functional complementarity, diverse debt sources generate synergistic effects. Their rational combination enables precise matching of capital with investment projects of varying cycles and types, effectively alleviating financing constraints, mitigating agency conflicts, and reducing capital misallocation and waste. This significantly enhances capital allocation efficiency (Xu & Wang, 2019). Firstly, debt source heterogeneity fosters a collaborative oversight system among diverse creditors: banks, leveraging their professional information-gathering capabilities, constrain inefficient long-term corporate investments through pre-loan project reviews, in-loan fund tracking, and post-loan cash flow monitoring; suppliers, relying on their supply chain information advantage, implement close, real-time oversight, compelling firms to optimize short-term working capital allocation; bond investors create external market oversight through market-based pricing mechanisms and disclosure requirements; non-bank financial institutions strengthen process constraints on capital usage via contractual clause design. The oversight mechanisms of diverse creditors complement and counterbalance each other, addressing the blind spots of single-creditor oversight while enhancing governance intensity through “oversight competition.” This effectively curbs self-interested behaviors by management and controlling shareholders, directing capital precisely toward high-growth, high-return, low-risk core projects, thereby fundamentally improving the decision-making efficiency of capital allocation (Ni & Zhang, 2025). Secondly, the financial characteristics of different types of debt precisely match the diverse capital needs of enterprises: long-term bank credit and public bonds are suited for long-term strategic investments, ensuring the continuous advancement of projects; trade credit aligns with short-term working capital needs, enhancing fund turnover efficiency; non-bank financial financing (such as trust and leasing) caters to innovative and customized capital demands, bridging gaps left by traditional financing; while policy-based financing directs capital toward strategic emerging industry projects. This precise alignment of “fund attributes-capital needs” mitigates risks of idle or mismatched capital, maximizes capital utilization efficiency, and improves the execution efficiency of capital allocation. Finally, diverse debt sources form a “pool of financing alternatives”. When a particular channel (such as bank credit) becomes constrained due to policy tightening or market volatility, enterprises can supplement funding through commercial credit, bond financing, and non-bank financing, preventing high-quality projects from stalling due to funding gaps. On the other hand, the coexistence of heterogeneous debt sends positive signals to the market about the enterprise’s stable operations and sound credit standing, reducing external investors’ information screening costs. This further eases financing constraints and ensures adequate funding for high-return investment projects. Alleviating financing

constraints addresses capital allocation deficiencies from the “funding supply side”, ensuring capital flows to all projects with positive net present value. This enhances the breadth and effectiveness of capital allocation. Efficient capital allocation concentrates resources on core businesses, high-growth projects, and technological R&D initiatives. This enhances the return on core assets and strengthens the competitiveness of primary operations, directly boosting current profitability while fostering sustained cash flow generation capabilities that drive intrinsic value growth. Enhanced capital allocation efficiency prevents idle capital, inefficient investments, and reckless expansion. It reduces capital stagnation and ineffective expenditures, mitigates financial risks stemming from failed investments or broken capital chains, optimizes capital structure, strengthens risk resilience, stabilizes investor expectations, and elevates market value. Efficient capital allocation drives the divestment of low-yielding, non-core assets, redirecting existing capital to advantageous sectors. This achieves optimized resource integration and intensive utilization, elevates asset operational efficiency and total factor productivity, generates economies of scale and synergies, and further amplifies the enterprise’s value creation capacity. Efficient capital allocation secures funding for R&D investments, capacity upgrades, and market expansion, driving technological innovation, product enhancement, and core competitiveness development. This fosters long-term competitive advantages, laying a solid foundation for sustained value growth and unifying short-term profit enhancement with long-term value appreciation. Based on this analysis, we propose Hypothesis II.

Hypothesis H2: Debt source heterogeneity enhances corporate value by improving capital allocation efficiency.

### **3. Research Design**

#### **3.1. Sample Selection and Sources**

This study utilizes Shanghai and Shenzhen A-share listed companies from 2015 to 2024 as its research sample. Following standard academic practices, the sample underwent the following screening and processing: 1) Exclusion of listed companies in the financial and real estate sectors; 2) Removal of listed companies marked as ST and \*ST; 3) Elimination of listed companies with negative net worth from the sample; 4) Samples with missing data for key variables were deleted. Additionally, to mitigate the potential adverse effects of extreme values on the research results, all continuous variables underwent trimming at the upper and lower 1% extremes. Following these screening steps, a final set of 26854 valid observations suitable for regression analysis was obtained. All research data used in this paper were sourced from the CSMAR database.

#### **3.2. Variable Definitions**

##### **3.2.1. Dependent Variable**

Tobin’s Q ratio (TQ) represents the ratio of a firm’s market value to its total assets. It serves as a predictor of investment risk and returns. Uninfluenced by changes

in accounting policies, Tobin's Q facilitates cross-firm value comparisons and provides a more comprehensive reflection of a firm's market value.

### 3.2.2. Explanatory Variables

Debt Source Heterogeneity (DHI) draws upon relevant research (Hu & Mao, 2015; Dong & Wang, 2024) to construct a Debt Source Heterogeneity Index, calculated as follows:

$$DHI_{i,t} = \frac{1 - (ID_{i,t}^2 + CD_{i,t}^2 + BD_{i,t}^2 + OD_{i,t}^2)}{1 - \frac{1}{4}} \quad (1)$$

In formula (1), within the relevant research framework, DHI represents the Debt Source Heterogeneity Index. ID measures the proportion of financial institution borrowings within total liabilities, calculated as:  $ID = (\text{Short-term borrowings} + \text{Long-term borrowings}) / \text{Total liabilities}$ ; CD reflects the proportion of trade credit in total liabilities, calculated as:  $CD = (\text{Amount of Notes Payable} + \text{Amount of Accounts Payable} + \text{Amount of Prepayments Received} + \text{Amount of Long-Term Payables}) / \text{Total Liabilities}$ ; BD denotes the proportion of corporate bonds in total liabilities, calculated as:  $BD = \text{Amount of Bonds Payable} / \text{Total Liabilities}$ ; OD represents the share of other debts in total liabilities, calculated as:  $OD = 1 - ID - CD - BD$ . When DHI equals 0, it indicates a relatively homogeneous structure of debt sources. Conversely, when DHI reaches 1, it signifies that the company's debt levels are perfectly balanced across all categories. Generally, a low DHI value suggests a narrow range of debt sources, while a high DHI value reflects a high degree of heterogeneity in the company's debt composition.

### 3.2.3. Mediating Variables

The capital allocation efficiency (E) is measured using Richardson's research methodology (Richardson, 2006), with reference to Liu (2023), as shown in Equation (2).

$$\begin{aligned} \text{Int}_t = & \alpha_0 + \alpha_1 \text{Growth}_{t-1} + \alpha_2 \text{Lev}_{t-1} + \alpha_3 \text{Cash}_{t-1} + \alpha_4 \text{Size}_{t-1} + \alpha_5 \text{Age}_{t-1} \\ & + \alpha_6 \text{Ret}_{t-1} + \alpha_7 \text{Int}_{t-1} + \varepsilon \end{aligned} \quad (2)$$

In Formula (2), Int represents the company's investment level; Growth denotes the growth rate of main business revenue; Cash equals cash and cash equivalents divided by total assets; Age indicates the company's listing duration; Size reflects the company's scale; Return signifies the company's stock return. Controlling for industry and year factors, we perform regression analysis on Equation (2) using econometric software to derive the expected new investment value for each company in year t. Then, by subtracting the expected investment from the company's actual new investment, we obtain the capital investment efficiency indicator—the residual ( $\varepsilon$ ). A positive  $\varepsilon$  indicates overinvestment, while a negative  $\varepsilon$  signifies underinvestment—both representing inefficient investment and indicating low capital allocation efficiency. Therefore, this paper takes the absolute value of the residual  $\varepsilon$  and then reverses its sign. This aligns inefficient investment with capital

allocation efficiency, yielding  $E = -|\epsilon|$ . A higher value of E indicates greater capital allocation efficiency.

### 3.2.4. Control Variables

To control for other factors potentially affecting firm value, the following control variables are included in the regression: firm age (Age), firm size (Size), revenue growth rate, ownership concentration (Top1), debt-to-equity ratio, current ratio, and cash holdings (Cash). Additionally, year (Year) and firm-specific fixed effects (Firm) are controlled for. Definitions of all control variables used in this paper are presented in **Table 1**.

**Table 1.** Variable definitions table.

Variable Type	Variable Name	Variable Symbol	Expression
Dependent variable	Corporate Value	TQ	Tobin's Q Ratio
Independent variable	Heterogeneity of Debt Sources	DHI	See calculation formula (1)
Mediating variable	Capital Allocation Efficiency	E	Perform regression analysis using Richardson's formula (Richardson, 2006), taking the opposite of the absolute value of the residual $\epsilon$
Control variable	Corporate Age	Age	Natural logarithm of firm's years in operation
	Corporate Size	Size	Natural logarithm of firm's total assets
	Growth Potential	Growth	Firm's operating revenue growth rate
	Shareholding Concentration	Top1	Shareholding ratio of largest shareholder
	Debt-to-Asset Ratio	Lev	Total liabilities/Total assets
	Current Ratio	Liq	Current assets/Current liabilities
	Cash Holding Level	Cash	Net cash flow from operating activities/Total assets
	Ownership Structure	Soe	State-owned enterprises = 1, otherwise = 0
	Year Fixed Effect	Year	Control for year fixed effects
Individual Fixed Effect	Firm	Control for individual fixed effects	

### 3.3. Model Construction

Based on the established research objectives, this study constructs Model 1 to test Hypothesis 1. The specific specification of Model 1 is as follows:

$$TQ_{i,t} = \alpha_0 + \alpha_1 DHI_{i,t} + Control_{i,t} + Year_t + Firm_i + \epsilon_{i,t} \quad (\text{Model 1})$$

In Model 1,  $i$ ,  $t$  represents individual firms and corresponding years, respectively. Firm value TQ serves as the dependent variable, with debt heterogeneity (DHI) as the independent variable. The model also controls for year and firm fixed effects. A statistically significant positive coefficient for debt heterogeneity (DHI) indicates that higher debt heterogeneity contributes to enhancing firm value.

## 4. Empirical Analysis

### 4.1. Descriptive Statistics

**Table 2** shows that the mean value of firm value (TQ) is 1.952, with maximum and minimum values of 8.223 and 0.829, respectively, indicating significant vari-

ation in firm value across companies. The statistical indicators for debt source heterogeneity (DHI) reveal a mean of 0.717, a maximum of 0.975, and a minimum of 0.155. This distribution pattern indicates substantial variations in debt source heterogeneity across firms, with some exhibiting relatively homogeneous debt structures. Furthermore, the statistical results for other variables align with existing research findings, further validating the appropriateness of the sample data employed in this study.

**Table 2.** Descriptive statistics.

Variable	Observed Value	Mean	Standard Deviation	Minimum	Maximum
TQ	26,854	1.952	1.107	0.829	8.223
DHI	26,854	0.717	0.148	0.155	0.975
Age	26,854	3.044	0.290	2.079	3.638
Size	26,854	22.34	1.227	20.010	26.34
Growth	26,854	0.129	0.351	-0.555	2.086
Top1	26,854	33.04	14.35	9.000	74.30
Lev	26,854	0.413	0.197	0.057	0.888
Liq	26,854	0.565	0.193	0.099	0.945
Cash	26,854	0.050	0.0642	-0.150	0.239
Soe	26,854	0.319	0.466	0	1

## 4.2. Correlation Analysis

Prior to conducting variable regression analysis, this study employed Pearson correlation analysis to examine the degree of correlation among variables. The correlation test results are detailed in **Table 3**. The correlation coefficient between enterprise value and debt heterogeneity was calculated to be 0.048, and this coefficient

**Table 3.** Correlation analysis.

	TQ	DHI	Age	Size	Growth	Top1	Lev	Liq	Cash	Soe
TQ	1									
DHI	0.048***	1								
Age	-0.142***	0.042***	1							
Size	-0.386***	0.199***	0.172***	1						
Growth	0.102***	0.021***	-0.114***	0.035***	1					
Top1	-0.086***	-0.102***	-0.051***	0.180***	0.001	1				
Lev	-0.261***	0.281***	0.146***	0.466***	0.036***	0.007	1			
Liq	0.141***	-0.236***	-0.119***	-0.235***	0.017***	-0.026***	-0.124***	1		
Cash	0.088***	-0.075***	0.010*	0.098***	0.043***	0.131***	-0.151***	-0.135***	1	
Soe	-0.167***	0.020***	0.239***	0.365***	-0.064***	0.225***	0.249***	-0.152***	-0.004	1

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

passed the significance test at the 1% level. This test result provides preliminary strong support for the core hypothesis of this study. Furthermore, the data presented in the table indicates that the correlation coefficients between the remaining variables all fall below 0.5. Concurrently, the multicollinearity test reveals that the variance inflation factor (VIF) for each variable has a maximum value of only 1.53, with an average of 1.02. This demonstrates that no severe multicollinearity issues exist among the variables.

### 4.3. Regression Analysis

**Table 4** details the regression analysis results examining the relationship between debt heterogeneity and firm value. Specifically, Column (1) displays regression results considering only the single variable; Column (2) presents regression results for the single variable after controlling for year and individual fixed effects; Column (3) shows regression results after controlling only for year fixed effects; and Column (4) presents regression results after incorporating a series of control variables while simultaneously fixing individual and time effects. Based on the empirical findings presented, the regression coefficient for debt heterogeneity exhibits a positive relationship regardless of whether control variables are included in the model. All estimated results pass statistical tests at the 1% significance level. This systematic evidence clearly demonstrates that debt heterogeneity exerts a significant positive impact on firm value, thereby providing robust empirical support for Theoretical Hypothesis 1.

**Table 4.** Benchmark regression results.

Variable	(1)	(2)	(3)	(4)
	TQ	TQ	TQ	TQ
DHI	0.362*** (0.060)	0.602*** (0.057)	1.253*** (0.061)	0.853*** (0.056)
Age			-0.069* (0.040)	0.934*** (0.201)
size			-0.314*** (0.013)	-0.615*** (0.029)
Growth			0.290*** (0.021)	0.184*** (0.017)
Top1			-0.002*** (0.001)	-0.002 (0.002)
Lev			-0.661*** (0.069)	0.120 (0.087)
Liq			0.626*** (0.059)	0.342*** (0.087)

**Continued**

Cash			2.304*** (0.168)	1.142*** (0.111)
Soe			0.023 (0.026)	-0.073* (0.042)
Constant	1.692*** (0.041)	1.519*** (0.041)	8.124*** (0.294)	11.987*** (0.838)
N	26,854	26,663	26,854	26,663
R-squared	0.002	0.666	0.278	0.695
Firm	NO	Yes	NO	Yes
Year	NO	Yes	Yes	Yes

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

#### 4.4. Robustness Tests

##### 4.4.1. Alternative Measures of Firm Value

Given that different measurement approaches for variables may yield divergent research outcomes, this study adjusts the measurement of firm value and conducts robustness tests to ensure the robustness of conclusions. Specifically, drawing on the research methodology of Zhang & Li (2021), we select return on equity (ROE) as an alternative indicator of firm value and re-conduct regression analysis. The results indicate that debt heterogeneity exhibits a significant positive correlation with enterprise value (ROE) (Table 5).

**Table 5.** Alternative measures for the explanatory variable.

Variable	ROE
DHI	0.1782* (0.1051)
Control	Yes
Year	Yes
Firm	Yes
Observed values	26,854
R-squared	0.1691

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

##### 4.4.2. Explanatory Variables Lagged by One Period

To mitigate the endogeneity effects of reverse causality on research conclusions, this study employs a robustness test using explanatory variables lagged by one period, while all other control variables utilize current-year data. In Table 6, Column (1) presents the regression results obtained after incorporating annual factors and firm fixed effects. The results indicate that the regression coefficient for

debt heterogeneity is 0.309, which passes the significance test at the 1% level. Column (2) of **Table 6** presents the results obtained after introducing control variables into the regression analysis. Analysis of the relevant data reveals that the regression coefficient for debt heterogeneity is 0.429, and this coefficient also passes the test at the 1% significance level. This result indicates that the heterogeneous characteristics of debt sources enhance firm value. The above analysis provides further strong validation for Hypothesis 1.

**Table 6.** Explanatory variables lagged by one period.

Variable	(1)	(2)
	TQ	TQ
L.x	0.3091*** (0.0566)	0.429*** (0.0545)
Control	NO	Yes
Year	Yes	Yes
Firm	Yes	Yes
Observed Values	20,307	20,307
R-squared	0.6286	0.6585

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

## 5. Further Analysis

### 5.1. Analysis of Mechanism of Action

The aforementioned research findings indicate that the heterogeneous characteristics of debt sources enhance corporate value. However, more in-depth analysis and investigation are still needed regarding the specific pathways and mechanisms of this effect. In the preceding theoretical analysis, debt heterogeneity can increase corporate value by improving the efficiency of capital allocation. Drawing upon the methodology employed by [Wen & Ye \(2014\)](#), this study constructs Models (2) and (3) to examine mediation effects. The specific model specifications are as follows:

$$E_{i,t} = \alpha_0 + \alpha_1 \text{DHI}_{i,t} + \text{Control}_{i,t} + \text{Year}_t + \text{Firm}_i + \varepsilon_{i,t} \quad (\text{Model 2})$$

$$\text{TQ}_{i,t} = \alpha_0 + \alpha_1 \text{DHI}_{i,t} + \alpha_2 E_{i,t} + \text{Control}_{i,t} + \text{Year}_t + \text{Firm}_i + \varepsilon_{i,t} \quad (\text{Model 3})$$

**Table 7** presents the results of the mediation effect test with capital allocation efficiency as the mediating variable. Column (1) in **Table 7** shows the regression results for Model 1. Column (2) in **Table 7** displays the regression analysis results between debt heterogeneity (DHI) and the mediating variable, capital allocation efficiency. The regression coefficient for debt heterogeneity and capital allocation efficiency is 0.014, passing the significance test at the 1% level. This indicates that heterogeneous debt sources contribute to enhancing corporate capital allocation efficiency. Column (3) of **Table 7** displays the regression results between debt het-

erogeneity and firm value after incorporating the mediator variable. The results indicate that when capital allocation efficiency is included, debt heterogeneity is positively correlated with firm value, and capital allocation efficiency is positively correlated with firm value. These findings suggest that capital allocation efficiency partially mediates the relationship between corporate debt heterogeneity and firm value (Wang & Zhang, 2020).

**Table 7.** Results of mediating effect tests.

Variable	(1)	(2)	(3)
	TQ	E	TQ
DHI	0.853*** (0.056)	0.014*** (0.003)	0.8450*** (0.055)
<i>E</i>			0.5760*** (0.1464)
Control	Yes	Yes	Yes
Year	Yes	Yes	Yes
Firm	Yes	Yes	Yes
Observed Values	20,307	20,307	20,307
R-squared	0.695	0.2715	0.6372

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

## 5.2. Heterogeneity Analysis

### 5.2.1. Heterogeneity Regarding Ownership Attributes

Based on differing ownership characteristics, this study meticulously divides the selected sample into state-owned enterprise (SOE) and non-state-owned enterprise (NSE) groups, conducting separate regression analyses for each. The regression results are detailed in columns (1) and (2) of **Table 8**. Analysis reveals that the DHI coefficient is positive at the 1% significance level for both SOE and non-SOE samples. This finding fully demonstrates that debt heterogeneity significantly enhances the value of enterprises with different property rights attributes. Further comparison reveals that the estimated DHI coefficient for non-state-owned enterprises is larger than that for state-owned enterprises, and the difference between the two coefficients is statistically significant at the 1% level. This suggests that debt heterogeneity has a more pronounced effect on enhancing the value of non-state-owned enterprises. This may be attributed to more pronounced agency conflicts in private enterprises, where the marginal effect of monitoring and constraints from diversified debt is higher.

### 5.2.2. Heterogeneity Regarding Firm Size

Enterprise scale is a critical factor influencing corporate value. By introducing an interaction term between enterprise scale and debt source heterogeneity under the benchmark effect, we conduct a heterogeneity analysis to examine whether the

positive impact of debt source heterogeneity on corporate value exhibits differences in intensity and marginal effects across varying enterprise scales. In Model (3), the coefficient of the interaction term (size  $\times$  DHI) (Luo, 2024) is  $-0.2134$ , which is significantly negative at the 1% level. This indicates that the positive effect of debt source heterogeneity on firm value weakens as firm size increases. In other words, debt heterogeneity has a stronger enhancing effect on firm value for smaller firms. This is because smaller firms face narrower financing channels and tighter financing constraints, making the optimization of financing structure and alleviation of constraints through debt heterogeneity more critical. In contrast, larger firms have broader financing channels, resulting in lower marginal value of heterogeneous debt.

**Table 8.** Heterogeneity analysis.

Variable	(1) non-state-owned enterprises	(2) State-owned enterprise	Full sample
	TQ	TQ	
DHI	0.9463*** (0.0707)	0.5717*** (0.0840)	0.853*** (0.056)
size			$-0.615$ *** (0.029)
size $\times$ DHI			$-0.2134$ *** (0.0495)
Control variables	Yes	Yes	Yes
Fischer's test		0.375***	
Year	Yes	Yes	Yes
Firm	Yes	Yes	Yes
N	18,293	8561	26,663
R-squared	0.6096	0.6981	0.6955

Note: \*\*\*, \*\*, and \* indicate significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses represent robust t-values adjusted for firm-level clustering.

## 6. Conclusion and Recommendations

### 6.1. Research Findings

This study empirically examines the interrelationship among debt heterogeneity, capital allocation efficiency, and firm value using financial data from Shanghai and Shenzhen A-share listed companies from 2015 to 2024. The findings are as follows: 1) Heterogeneity in debt sources contributes to enhancing firm value. By optimizing the structural mix of debts from different sources—such as bank loans, trade credit, and bond financing—firms can effectively improve both their intrinsic profitability and external market valuation. 2) The mediation analysis reveals that debt heterogeneity enhances corporate value by improving capital allocation efficiency. Debt heterogeneity significantly boosts capital allocation efficiency by

alleviating financing constraints, strengthening diversified oversight, achieving precise matching between funds and investment projects, and curbing inefficient investment behaviors such as overinvestment and underinvestment. This, in turn, drives corporate value appreciation, forming a complete transmission chain: “optimized debt heterogeneity → enhanced capital allocation efficiency → increased corporate value.” 3) The value-enhancing effect of debt heterogeneity exhibits heterogeneous differences. Under varying ownership structures, its impact on corporate value is more pronounced in non-state-owned enterprises. Across different enterprise scales, debt heterogeneity consistently facilitates value enhancement and competitive advantage, with this effect being more pronounced in small-scale enterprises.

## **6.2. Research Recommendations**

Based on the above findings, and considering corporate operational practices, market environment optimization, and regulatory guidance needs, targeted recommendations are proposed from both corporate and regulatory perspectives. These recommendations aim to provide reference for enterprises to achieve value growth through debt structure optimization and enhanced capital allocation efficiency.

### **6.2.1. Optimize Debt Source Structure, Strengthen Capital Allocation Management, and Activate Value Growth Drivers**

1) Scientifically combine debt sources to leverage synergies from heterogeneous debt. Enterprises should abandon single-source debt financing models and rationally plan the allocation ratio of debt sources based on their operational needs, project characteristics, and industry attributes. By complementing diverse debt functions, achieve precise matching between funds and projects, laying the foundation for enhancing capital allocation efficiency. 2) Utilize debt oversight mechanisms to standardize capital allocation decision-making processes. Enterprises should proactively leverage the supervisory functions of heterogeneous debt to enhance internal governance. Establish a comprehensive capital allocation management system covering “project screening-fund deployment-process control-return assessment” to ensure capital focuses on core businesses and high-yield projects, thereby improving capital utilization efficiency and profit conversion capabilities. 3) Tailor strategies to specific attributes to unlock synergistic value between debt and capital allocation. Private enterprises should leverage their decision-making flexibility to strengthen market oversight’s constraints on capital allocation. State-owned enterprises must reduce administrative interference in debt allocation and capital direction, focusing on profitability goals to optimize debt structures and elevate market-oriented capital allocation.

### **6.2.2. Improve the Market Environment, Strengthen Guidance and Support, and Solidify the Foundation for Optimizing Debt and Capital Allocation**

1) Enhance the debt financing market system and broaden enterprises’ access to

heterogeneous debt financing channels. Regulators should further refine bond issuance mechanisms, lower financing thresholds for private enterprises and SMEs, streamline approval processes, and encourage market-based bond financing. Support non-bank financial institutions in developing customized debt products to meet specialized funding needs. Guide banks to optimize credit resource allocation, building a diversified, multi-tiered debt financing market that accommodates heterogeneous debt sources. 2) Strengthen information disclosure and market oversight to ensure efficient debt and capital allocation. Continuously refine the information disclosure system for listed companies, clarify disclosure requirements for market-based debt instruments such as bond financing and non-bank debt, and urge enterprises to truthfully and accurately disclose information on debt usage, capital allocation, and project returns to reduce internal and external information asymmetry. Strengthen investor protection in capital markets, guiding investors to focus on corporate debt structures and capital allocation efficiency. Use market-based pricing and oversight to compel enterprises to standardize debt management and capital utilization, fostering a market-oriented environment characterized by “high-quality debt structures + efficient capital allocation.” 3) Differentiate guidance on regional and sectoral debt allocation to narrow disparities in heterogeneity effects. Introduce specialized debt financing support policies for different industries, such as providing bond financing facilities for industrial upgrading projects in traditional sectors. Guide enterprises within industries to optimize debt structures and capital allocation, driving high-quality development across all enterprises through enhanced debt heterogeneity and improved capital allocation efficiency.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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