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Article

Measurement of Debt Tax Shield Effect and Capital Structure Optimization: Evidence from Chinese Industrial Enterprises

Sen Jiang^{1,*}

¹ Jinan Licheng No. 2 High School, Jinan, China

* Correspondence: Sen Jiang, Jinan Licheng No. 2 High School, Jinan, China

Abstract: Debt financing can create significant tax benefits through the deductibility of interest expense, but excessive reliance on debt may also increase financing costs, liquidity pressure, and overall financial risk. This study examines how debt tax shield effects can be accurately measured and incorporated into capital structure assessment for selected Chinese industrial enterprises. The empirical analysis focuses on SAIC Motor, Midea Group, and CRRC over the 2022 to 2024 period, utilizing publicly disclosed and audited consolidated annual reports. A non-experimental comparative financial approach is adopted to ensure robust evaluations. The statutory debt tax shield is estimated using reported interest expense and the standard corporate income tax rate, while the realized debt tax shield is measured using firm-year effective tax rates. Furthermore, the study systematically compares debt tax shield intensity, leverage, interest-bearing debt ratios, interest coverage, and profitability across firms and over time. The results indicate meaningful differences between statutory and realized tax-shield estimates, alongside substantial heterogeneity in financing structures and debt-servicing capacity among the three enterprises. Crucially, a larger debt tax shield does not necessarily correspond to a more efficient capital structure when interest-bearing debt exposure and financial resilience are considered simultaneously. Consequently, the study proposes firm-specific capital structure optimization directions based on actual financial performance rather than relying on a universal optimal leverage ratio, providing valuable insights for corporate financial management.

Keywords: capital structure; tax shield; debt financing; corporate taxation; leverage

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1. Introduction

1.1. Research Background

Debt financing plays a dual role in corporate financial management. On the benefit side, borrowing generates interest expense, and deductible interest reduces taxable income, thereby creating a debt tax shield. The basic mechanism can be expressed as debt financing, interest expense, tax deduction, and debt tax shield. By lowering the after-tax cost of debt, this mechanism gives firms an incentive to include debt in their financing mix. For capital-intensive industrial enterprises, where production facilities, equipment, technology, and working capital often require substantial external financing, the tax implications of debt are economically significant [1].

These benefits, however, are accompanied by financing costs and risk. Higher debt levels can increase interest burden, refinancing pressure, liquidity limitations, and exposure to financial distress. Capital structure therefore cannot be evaluated on the assumption that more debt necessarily produces greater benefits. Although additional borrowing may enlarge the potential tax shield, it may also weaken debt-servicing capacity and financial flexibility. The relevant question is thus whether the tax benefits

generated by debt are sufficient to justify the associated financing burden. This trade-off motivates examining the debt tax shield and capital structure jointly rather than as separate issues.

1.2. Research Problem and Gap

Three issues motivate this study [2]. First, debt level is not equivalent to the debt tax shield. Capital structure analysis commonly emphasizes leverage, measured as total liabilities divided by total assets. However, leverage does not directly indicate how much tax benefit is generated by interest-bearing financing. A firm may report substantial liabilities without generating a proportionally large tax shield because not all liabilities incur deductible interest. This study therefore measures the debt tax shield directly using reported interest expense and income tax information.

Second, the statutory corporate income tax rate does not necessarily represent the effective tax burden. A uniform 25% rate may overstate or understate the tax benefit associated with interest deductions. For example, Midea Group reports that Mainland Chinese operations are generally subject to a 25% corporate income tax rate, while certain qualified high-technology enterprises receive a preferential 15% rate. Accordingly, this study distinguishes between the Statutory Debt Tax Shield, calculated using the statutory rate, and the Realized Debt Tax Shield, estimated using the effective tax rate derived from tax expense and profit before tax.

Third, a larger tax shield does not necessarily imply a more appropriate capital structure. Capital structure efficiency also depends on leverage, interest-bearing debt, interest coverage, and profitability. Evaluating the tax shield without these indicators may therefore provide an incomplete assessment of financing efficiency [3].

1.3. Research Questions

This study addresses three research questions [4]. RQ1: What are the magnitudes of the statutory and realized debt tax shields among the selected Chinese industrial enterprises? RQ2: How do debt tax shield intensity, financial leverage, and debt-servicing capacity differ across firms and evolve over time? RQ3: How can the joint consideration of debt tax shield utilization and debt-servicing capacity support capital structure optimization?

1.4. Research Contributions

This study makes three contributions. First, it measures the debt tax shield directly from reported interest expense rather than using leverage as an indirect proxy. Second, it distinguishes statutory from realized debt tax shields by incorporating discrepancies between nominal tax rules and firm-level effective tax burdens. Third, it integrates tax-shield measurement with debt-servicing capacity, leverage, and profitability to evaluate capital structure efficiency and optimization. Accordingly, capital structure optimization is conceptualized as a balance between tax benefits and financial resilience, not merely the maximization of debt-related tax savings [2].

2. Theoretical Background and Literature Review

2.1. Debt Tax Shield Theory

The debt tax shield provides the theoretical basis for examining how financing decisions affect a firm's after-tax cost of capital [5]. Under a corporate tax framework, interest paid on eligible debt is generally deductible before taxable income is determined. Debt financing therefore creates a tax benefit that equity financing does not provide in the same form. The basic relationship is:

$$DTS = \text{Interest Expense} \times \text{Tax Rate} \quad (1)$$

where DTS denotes the debt tax shield. Deductible interest reduces taxable profit and consequently lowers corporate income tax payable [3]. The effective after-tax cost of debt is therefore lower than its corresponding pre-tax financing cost.

This mechanism is particularly relevant to industrial enterprises because their operations often require substantial investment in fixed assets, equipment, technology,

inventories, and working capital. Debt can therefore be an important financing source, while the associated interest deductions generate tax benefits [6]. However, tax-shield value depends not only on outstanding debt but also on recognized interest expense and the applicable tax rate. Accordingly, this study uses reported interest expense rather than total liabilities as the direct basis for measuring the tax shield.

2.2. Trade-Off Theory of Capital Structure

Although debt generates tax benefits, its contribution to firm value is not unlimited [2]. Capital structure decisions involve both benefits and costs. On the benefit side, debt provides interest tax deductions, lowers after-tax financing costs, and generates potential tax shields, making moderate borrowing economically attractive.

On the cost side, higher debt increases contractual interest obligations and may reduce financial flexibility [7]. Firms with greater debt exposure may face refinancing pressure, tighter liquidity conditions, and greater sensitivity to changes in interest rates or operating cash flows. If borrowing exceeds the level supported by earnings and cash generation, financial distress risk and associated costs may increase.

Capital structure optimization therefore reflects a balance between the marginal tax benefit and marginal financing cost of additional debt. Neither higher nor lower leverage is inherently preferable. The appropriate structure depends on whether debt-related tax benefits remain compatible with interest-servicing capacity and financial flexibility. Accordingly, this study does not estimate a single “optimal debt ratio” for all Chinese industrial enterprises [8]. Instead, it evaluates firm-level capital structure efficiency by jointly considering tax-shield utilization and debt-servicing capacity.

2.3. Statutory and Effective Tax Burden

The statutory corporate income tax rate may differ from the effective tax burden reported in consolidated financial statements [8].

$$ETR = \frac{\text{Income Tax Expense}}{\text{Profit Before Tax}} \quad (2)$$

This distinction matters because large industrial groups often include subsidiaries subject to preferential tax treatments, deferred taxation, varying regional tax policies, or other tax adjustments [2]. Applying a uniform statutory rate to all interest expense may therefore fail to reflect the actual tax benefit realized at the group level.

Midea Group illustrates this difference [7]. In 2024 and 2023, profit before income tax was RMB46,692 million and RMB40,279 million, respectively, while income tax expense was RMB7,933 million and RMB6,532 million. These figures imply effective tax rates below the standard 25% benchmark. The annual report notes that differing tax rates applicable to subsidiaries reduced the overall tax expense relative to a calculation based solely on the statutory rate.

Accordingly, this study adopts two tax-shield measures. The Statutory Debt Tax Shield represents the potential benefit calculated using the standard tax rate, whereas the Realized Debt Tax Shield uses the firm-specific effective tax rate [9]. Their comparison indicates how closely the theoretical tax advantage of debt aligns with actual financial outcomes.

2.4. Analytical Framework

Three analytical expectations guide the empirical analysis. E1: Greater interest-bearing debt tends to generate a larger potential debt tax shield because additional borrowing generally increases deductible interest expense. E2: Realized tax shields differ from statutory tax shields because effective tax burdens vary across firms and years. E3: Higher debt tax shields do not necessarily indicate superior capital structures when debt-servicing capacity deteriorates [8].

These expectations are not formal hypotheses requiring statistical testing. Instead, they structure the comparison of the selected firms over time. The analysis focuses on debt tax shield intensity, leverage, interest-bearing debt, profitability, and interest coverage, enabling assessment of capital structure efficiency as a balance between tax benefits and financial resilience.

3. Data and Methodology

3.1. Sample Firms and Data Sources

This study employs a non-experimental comparative financial design based solely on publicly disclosed audited annual reports. Three Chinese listed industrial enterprises are selected: SAIC Motor Corporation Limited, Midea Group Co., Ltd., and CRRC Corporation Limited. These firms represent distinct segments of industrial production and exhibit sufficient variation in operating structure and debt financing to support robust comparative analysis.

SAIC Motor operates in automobile manufacturing, with vehicle production and sales constituting its principal business activities; its A-share stock code is 600104. Midea Group engages in diversified industrial and consumer manufacturing, encompassing smart-home products, intelligent building technology, energy solutions, industrial technology, and industrial robotics and automation; its listed stock code is 000333. CRRC specializes in rail transportation and industrial equipment manufacturing, including railway equipment, urban rail systems, new-energy-related equipment, and associated industrial technologies. Such sectoral and operational distinctions enable examination of debt tax shield effects across firms with differing capital intensity and financing structures [10].

The analysis covers the period 2022–2024, yielding nine firm-year observations. This timeframe is selected to ensure availability of consecutive, comparable consolidated financial statements for all three firms, including prior-year comparative figures. Only consolidated financial statements are utilized; parent-company statements are excluded to maintain consistency in accounting scope and avoid conflation of entity-level and group-level reporting. Both SAIC Motor and Midea explicitly separate consolidated statements from company-only statements in their audited 2024 reports. All monetary values are converted to RMB million prior to analysis to ensure cross-firm comparability.

Table 1 summarizes the sample composition, industry representation, and financial-reporting basis used in the analysis.

Table 1. Sample Firms and Data Sources

Firm	Industry	Stock Code	Study Period	Financial Statement Basis
SAIC Motor	Automobile manufacturing	600104	2022–2024	Consolidated
Midea Group	Industrial and consumer manufacturing	000333	2022–2024	Consolidated
CRRC	Rail transportation equipment	601766	2022–2024	Consolidated

3.2. Variable Definition and Measurement

Eight indicators are employed to link tax-shield benefits with capital structure and debt-servicing capacity. Their definitions are reported in Table 2. Effective Tax Rate (ETR) reflects the observed tax burden as a proportion of profit before tax. Statutory Debt Tax Shield (SDTS) quantifies the theoretical interest tax benefit using the standard 25% corporate income tax rate, whereas Realized Debt Tax Shield (RDTS) applies the firm-year effective tax rate. Debt Tax Shield Intensity (DTSI) normalizes RDTS by total assets to mitigate size-related variation across firms.

Table 2. Variable Definitions and Measurement

Variable	Definition
ETR	Income Tax Expense / Profit Before Tax
SDTS	Interest Expense $\times$ 25%
RDTS	Interest Expense $\times$ ETR
DTSI	RDTS / Total Assets

LEV	Total Liabilities / Total Assets
IBDR	Interest-Bearing Debt / Total Assets
ICR	EBIT / Interest Expense
ROA	Net Profit / Total Assets

Leverage (LEV) is calculated as total liabilities divided by total assets. Interest-Bearing Debt Ratio (IBDR) specifically captures financing obligations that incur interest expense. Such debt includes short-term borrowings, the current portion of interest-bearing non-current liabilities, long-term borrowings, and bonds or debentures payable when separately disclosed. Interest Coverage Ratio (ICR) measures the capacity of operating earnings to service interest obligations, while Return on Assets (ROA) indicates profitability relative to the asset base.

A consistent definition of interest expense is essential. Financial expenses are not treated as equivalent to interest expense because they may include interest income, foreign exchange gains or losses, transaction charges, and other financing-related items. CRRG provides a clear illustration: its 2024 financial-expense note reports borrowing interest, capitalized interest, lease-liability interest, interest income, exchange effects, and other components separately, while the aggregate financial expense is negative. Accordingly, the analysis uses the consolidated interest-expense amount attributable to debt financing rather than the aggregate financial-expense line.

3.3. Debt Tax Shield Measurement

The statutory debt tax shield for firm i in year t is computed as:

$$SDTS_{it} = InterestExpense_{it} \times 25 \quad (3)$$

The effective tax rate is computed as:

$$ETR_{it} = \frac{IncomeTaxExpense_{it}}{ProfitBeforeTax_{it}} \quad (4)$$

The realized debt tax shield is then computed as:

$$RDTs_{it} = InterestExpense_{it} \times ETR_{it} \quad (5)$$

Because absolute tax-shield amounts are strongly influenced by firm size, RDTs is standardized by total assets:

$$DTSI_{it} = \frac{RDTs_{it}}{TotalAssets_{it}} \quad (6)$$

Differentiating SDTS from RDTs enables assessment of whether the tax benefit implied by the statutory rate diverges from that derived from each firm's actual tax burden [1].

3.4. Capital Structure Assessment

Capital structure is first measured through total leverage:

$$LEV_{it} = \frac{TotalLiabilities_{it}}{TotalAssets_{it}} \quad (7)$$

Debt directly associated with financing costs is measured as:

$$IBDR_{it} = \frac{InterestBearingDebt_{it}}{TotalAssets_{it}} \quad (8)$$

Debt-servicing capacity is assessed using interest coverage [11]. EBIT is approximated consistently from disclosed accounting information as:

$$EBIT_{it} = ProfitBeforeTax_{it} + InterestExpense_{it} \quad (9)$$

and:

$$ICR_{it} = \frac{EBIT_{it}}{InterestExpense_{it}} \quad (10)$$

The analysis does not estimate capital structure through a controlled experimental design or an assumed universal optimal leverage ratio. Instead, it combines longitudinal comparison, which examines changes within each firm from 2022 to 2024, with cross-firm comparison, which evaluates differences among the three enterprises [12]. Financial efficiency is then assessed jointly through DTSI, LEV, IBDR, ICR, and ROA. The calculated firm-year results are subsequently reported in Table 3 and the two data figures in Chapter 4, ensuring that all capital-structure conclusions are derived from actual annual-report data rather than hypothetical scenarios.

Table 3. Debt Tax Shield and Capital Structure Indicators of the Sample Firms, 2022–2024

Firm	Year	Interest Expense (RMB mn)	ETR (%)	SDTS (RMB mn)	RDTs (RMB mn)	DTSI (%)	LEV (%)	IBDR (%)	ICR (times)	ROA (%)
SAIC Motor	2022	2,706.13	18.63	676.53	504.03	0.051	66.03	12.11	11.37	2.31
SAIC Motor	2023	3,447.46	22.77	861.87	784.82	0.078	65.94	12.57	8.53	1.99
SAIC Motor	2024	3,796.72	44.50	949.18	1,689.66	0.177	63.77	13.11	3.77	0.61
Midea Group	2022	1,830.92	14.72	457.73	269.52	0.064	64.05	15.45	20.09	7.05
Midea Group	2023	2,808.10	16.22	702.03	455.41	0.094	64.14	14.70	15.34	6.94
Midea Group	2024	2,453.36	16.99	613.34	416.83	0.069	62.33	13.78	20.03	6.41
CRRC	2022	1,069.21	10.96	267.30	117.24	0.026	56.80	5.93	16.08	3.25
CRRC	2023	1,102.21	11.01	275.55	121.40	0.026	58.35	5.51	15.85	3.09
CRRC	2024	1,122.49	10.14	280.62	113.86	0.022	59.01	3.41	16.53	3.05

Note: SDTS is calculated using the 25% statutory rate; RDTs is the ETR-based tax-shield estimate. DTSI, LEV, IBDR, ICR, and ROA are calculated according to Section 3. Later restated comparative values are used where disclosed.

4. Results and Discussion

4.1. Capital Structure and Debt Financing Characteristics

The three firms display distinct capital-structure patterns over 2022–2024. SAIC Motor remained the largest firm by total assets, though its asset base increased from RMB990.11 billion in 2022 to RMB1,006.65 billion in 2023 before declining to RMB957.14 billion in 2024. Total liabilities followed a similar trend, rising from RMB653.81 billion to RMB663.74 billion and then falling to RMB610.41 billion. Consequently, its leverage ratio declined from 66.03% in 2022 to 63.77% in 2024. However, interest-bearing debt remained elevated, increasing from approximately RMB119.90 billion in 2022 to RMB126.52 billion in 2023 and stabilizing at RMB125.47 billion in 2024. The underlying annual reports separately disclose short-term borrowings, current portions of long-term borrowings and bonds, and longer-term financing used in this calculation.

Midea Group exhibited a different pattern. Total assets grew from RMB422.56 billion in 2022 to RMB486.04 billion in 2023 and RMB604.35 billion in 2024, while total liabilities rose from RMB270.63 billion to RMB311.74 billion and RMB376.68 billion [13]. Although absolute liabilities increased, leverage remained near 64% in 2022–2023 and decreased to 62.33% in 2024. Total borrowings reached RMB83.31 billion in 2024 compared with RMB71.47 billion in 2023, but the interest-bearing debt ratio declined because asset growth outpaced borrowing growth.

CRRC maintained the lowest leverage among the three firms, though its ratio rose gradually. Total assets increased from RMB442.14 billion in 2022 to RMB471.79 billion in 2023 and RMB512.82 billion in 2024, while liabilities rose from RMB251.15 billion to RMB275.27 billion and RMB302.63 billion. In contrast, its disclosed borrowings, bonds, and notes decreased from RMB26.23 billion in 2022 to RMB26.00 billion in 2023 and RMB17.50 billion in 2024. Thus, the rise in CRRC's overall leverage was not driven by an increase in core interest-bearing debt.

Figure 1 compares the leverage trajectories of the three sample firms over 2022–2024. SAIC maintained the highest leverage throughout the period, Midea remained in the middle range but declined noticeably in 2024, while CRRC rose from 56.80% to 59.01%. The figure illustrates why total leverage and interest-bearing debt should be evaluated separately.

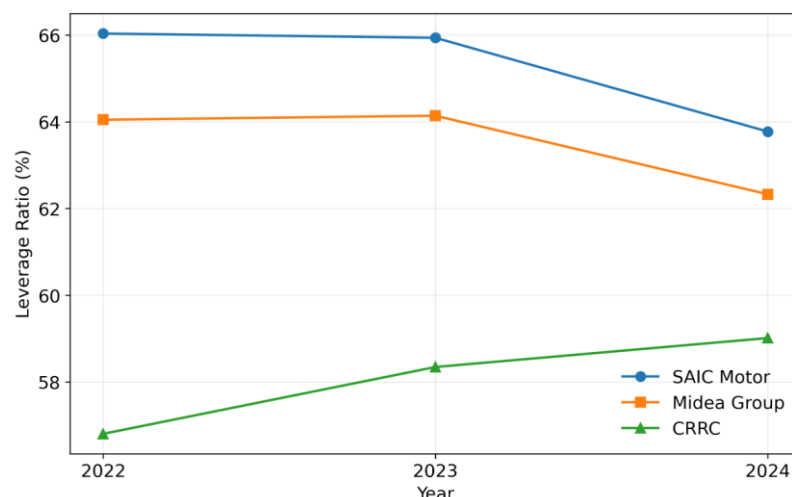


Figure 1. Leverage Ratio of the Three Sample Firms, 2022–2024

4.2. Measurement of the Debt Tax Shield Effect

Table 3 presents the main firm-year results. All monetary amounts are expressed in RMB million. SAIC recorded the largest interest expense throughout the period, increasing from RMB2,706.13 million in 2022 to RMB3,796.72 million in 2024. These figures are taken from the consolidated income statements rather than aggregate financial expenses. Midea's interest expense increased from RMB1,830.92 million in 2022 to RMB2,808.10 million in 2023 before declining to RMB2,453.36 million in 2024. Its 2024 financing reconciliation explicitly reports total accrued interest expense, including borrowing, debenture, and lease components. CRRC exhibited the most stable interest expense, ranging only from RMB1,069.21 million to RMB1,122.49 million.

Table 3 shows that absolute interest expense alone does not determine tax-shield efficiency. Differences in effective taxation and firm size materially affect the resulting RDTs and DTSI. This distinction is especially relevant for SAIC in 2024.

4.3. Statutory Versus Realized Debt Tax Shields

The comparison between statutory and realized debt tax shields reveals substantial heterogeneity. For Midea, the realized debt tax shield remained below the statutory benchmark in all three years because its effective tax rate ranged from 14.72% to 16.99%, well below the standard rate of 25%. The annual report provides a clear accounting explanation: while most operations in Mainland China are subject to the 25% statutory rate, qualified high-technology subsidiaries may apply a preferential 15% rate, and other subsidiaries may benefit from additional regional or policy-based tax incentives. The tax reconciliation also identifies variations in subsidiary-level tax rates, non-taxable income, non-deductible expenditures, and the utilization of prior-year tax losses as key factors causing the actual tax expense to diverge from a simple statutory-rate calculation.

CRRC displays an even larger proportional difference. Its effective tax rate remained around 10–11%, resulting in a realized debt tax shield less than half the statutory amount throughout the period. CRRC's tax reconciliation explicitly attributes this gap to differential tax rates across subsidiaries, tax-exempt income items, non-deductible costs, carryforward deductible losses, and other government-supported tax incentives—including enhanced deductions for research and development expenditures.

SAIC followed the opposite pattern in 2024. Its effective tax rate rose to 44.50%, causing the ETR-based realized debt tax shield estimate of RMB1,689.66 million to exceed the statutory benchmark of RMB949.18 million. This should not be interpreted as an increase in the tax efficiency of debt financing. The company's tax reconciliation reports a RMB4.51 billion tax effect arising from deductible temporary differences or losses for which deferred tax assets were not recognized, alongside other positive and negative adjustments. Thus, the 2024 divergence reflects the group's overall accounting and tax

position. The result underscores the importance of reporting both statutory and effective-tax-rate-based measures jointly rather than relying on either in isolation.

4.4. Debt Tax Shield and Debt-Servicing Capacity

The relationship between Debt Tax Shield Intensity (DTSI) and Interest Coverage Ratio (ICR) clarifies the trade-off between tax benefits and financial risk. Figure 2 plots all nine firm-year observations, with DTSI on the horizontal axis and ICR on the vertical axis; each point is derived directly from the annual-report data summarized in Table 3.

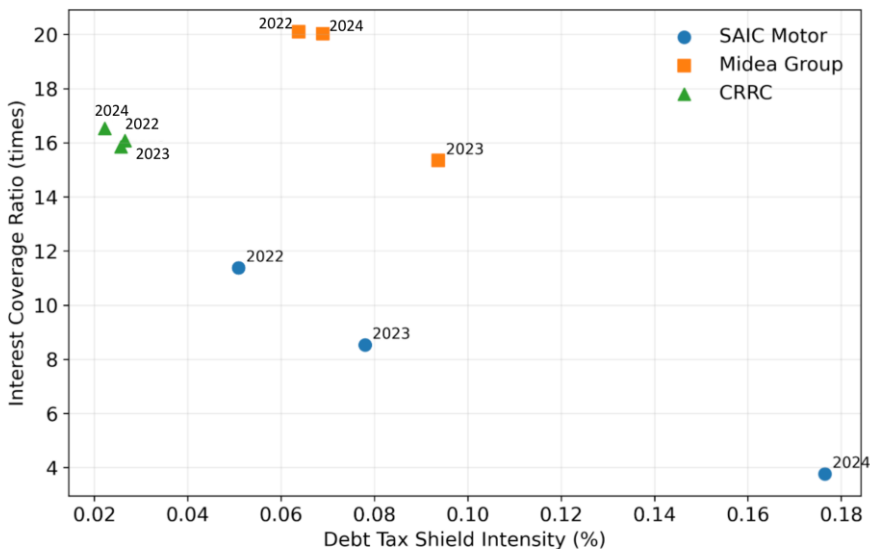


Figure 2. Debt Tax Shield Intensity and Interest Coverage of the Sample Firms, 2022–2024

Midea occupies the relatively high-coverage region of Figure 2. Its ICR was 20.09 times in 2022, declined to 15.34 in 2023, and recovered to 20.03 in 2024, while DTSI remained between 0.064% and 0.094%. The 2023 annual report independently reports interest coverage ratios of 20.09 and 15.34 times for 2022 and 2023, respectively, confirming the consistency of the calculation method used here.

CRRC exhibits lower tax-shield intensity but comparatively stable debt-servicing capacity: DTSI declined from approximately 0.026% to 0.022%, while ICR remained near 16 times. SAIC displays the most pronounced shift: DTSI rose from 0.051% in 2022 to 0.177% in 2024, whereas ICR fell from 11.37 to 3.77 times. This decline reflects the sharp reduction in SAIC’s profit before tax—from RMB25.97 billion in 2023 to RMB10.51 billion in 2024—despite higher interest expense [13].

Figure 2 therefore illustrates that a larger measured tax shield does not necessarily indicate stronger financial capacity. The observed pattern is descriptive rather than causal, yet it underscores the importance of jointly evaluating tax benefits and interest coverage in financial analysis.

4.5. Capital Structure Efficiency and Optimization Assessment

The combined evidence from Table 3 and Figures 1–2 suggests distinct financing directions for the three firms. For SAIC Motor, overall leverage declined, but interest-bearing debt ratio (IBDR) increased from 12.11% to 13.11%, while interest coverage ratio (ICR) and return on assets (ROA) deteriorated substantially. This configuration does not support additional borrowing solely to enhance the tax shield [6, 11]. A more appropriate direction is to constrain further growth in interest-bearing debt, improve debt maturity and financing-cost management, and strengthen operating performance to support existing debt obligations.

For Midea Group, both leverage and IBDR declined by 2024, while interest coverage recovered to approximately 20 times and ROA remained the highest among the three firms. Its expanding asset base also reduced leverage despite a rise in absolute borrowings.

The evidence therefore supports maintaining a disciplined financing structure while preserving debt capacity, rather than pursuing either aggressive leveraging or premature deleveraging.

For CRRC, overall leverage increased moderately, yet IBDR fell markedly from 5.93% to 3.41% and ICR remained stable. This indicates that changes in total liabilities do not correspond directly to changes in interest-bearing financing. Its capital-structure direction is therefore better characterized as sustaining a conservative interest-bearing debt position and optimizing liability composition, rather than increasing debt solely to enlarge tax deductions [2].

These conclusions represent firm-specific adjustment directions, not estimates of a universal optimal leverage ratio [5].

5. Conclusion

5.1. Main Findings

This study measured the debt tax shield effect and assessed capital structure efficiency for SAIC Motor, Midea Group, and CRRC over 2022–2024. Regarding RQ1, the results show that all three firms generated measurable tax benefits from interest-bearing financing, but the statutory and realized tax shields differed substantially. The 25% statutory-rate measure generally overstated the realized tax shield for Midea and CRRC because their effective tax rates remained below the statutory benchmark. SAIC presented a different pattern in 2024, when its effective tax rate rose sharply and the ETR-based realized tax shield exceeded the statutory estimate. These results indicate that the theoretical value of interest deductibility cannot be assumed to equal the tax benefit reflected in consolidated financial statements.

Regarding RQ2, substantial cross-firm differences were observed in DTSI, leverage, interest-bearing debt ratios, and interest coverage. SAIC combined relatively high leverage and increasing interest-bearing debt exposure with weakening interest coverage and profitability in 2024. Midea maintained comparatively high interest coverage and profitability while reducing both leverage and interest-bearing debt intensity. CRRC exhibited the lowest interest-bearing debt ratio and relatively stable interest coverage despite a moderate increase in total leverage. These differences reflect not only financing scale but also asset growth, borrowing composition, profitability, and firm-specific tax positions.

Regarding RQ3, the evidence does not support the view that a larger debt tax shield necessarily represents a more efficient capital structure. Capital structure optimization should instead balance tax shield utilization with financial resilience. The appropriate outcome is therefore a firm-specific financing adjustment direction rather than a single estimated optimal leverage ratio.

5.2. Managerial Implications

Managers should avoid increasing debt solely to reduce corporate income tax, as additional interest deductions may impair coverage ratios and diminish financial flexibility. Conversely, deleveraging decisions should not rely exclusively on the total asset-liability ratio, since total liabilities often include substantial non-interest-bearing components. A more informative capital structure monitoring system should jointly consider the effective tax rate (ETR), debt tax shield intensity (DTSI), interest-bearing debt ratio (IBDR), and interest coverage ratio (ICR). This integrated approach distinguishes realized tax benefits from financing exposure and supports informed decisions regarding whether borrowing capacity should be preserved, constrained, or restructured through maturity and cost management.

5.3. Limitations and Future Research

This study is limited to three listed industrial enterprises and a relatively short 2022–2024 observation period. Annual reports do not specify the precise tax treatment of each individual debt instrument, and effective tax rates are affected by deferred taxation,

preferential tax policies, deductible losses, and overseas operations. Consequently, the analysis yields a firm-specific capital structure optimization assessment rather than an industry-wide optimal leverage ratio. Future research should broaden the framework to encompass a larger sample of Chinese A-share industrial firms, incorporate longer time-series data, and investigate whether the relationship between tax-shield utilization and financial resilience holds consistently across industries, ownership structures, and financing environments.

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