

Financial Leverage and Operational Efficiency: An Empirical Study on the Survival Performance of Mongolian Small and Medium-Sized Mining Enterprises

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Abstract: *The formation and evolution of financial leverage in Mongolian small and medium-sized mining enterprises are influenced by both resource endowment constraints and the financing environment, demonstrating significant industry-specific heterogeneity. The study proceeds from three dimensions, namely capital structure characteristics, transmission mechanisms, and the association with survival performance, thereby revealing the internal logic through which financial leverage affects operational efficiency. The analysis shows that mineral resource endowments shape the debt financing structure, the extraction cycle leads to asymmetric changes in capital costs, and fluctuations in leverage affect financial flexibility via free cash flow transmission. Interest expenses continuously erode marginal profits, the asset turnover ratio undergoes dynamic adjustments, and fixed costs together with financial leverage produce a synergistic amplification effect. Debt repayment capacity imposes a sensitive constraint on the survival period, a substitution relationship exists between financing flexibility and operational agility, and the leverage buffer capacity has a limited boundary under external price shocks. The study finds that financial leverage has a threshold range; beyond the critical point, it transforms from an efficiency-adjustment tool into a risk-accelerating carrier. Essentially, leverage choice represents a dynamic trade-off between resource allocation flexibility and financial safety boundaries.*

Keywords: *Financial Leverage; Operational Efficiency; Survival Performance; Capital Structure; Mongolian Small and Medium-Sized Mining Enterprises*

Introduction

In the development of mineral resources in Mongolia, small and medium-sized mining enterprises serve as important participants, and their survival is continuously influenced by financing conditions and financial decisions. Mining development features capital intensity, lengthy cycles, and significant cash flow volatility. Financial leverage, while providing funds for scale expansion, also introduces fixed interest burdens. Under the environment of limited external financing channels and high debt costs, how leverage affects operational efficiency and subsequently influences survival performance becomes the key to understanding corporate behavior. Existing studies mostly focus on large mining enterprises and lack a systematic examination of the leverage characteristics and threshold effects of small and medium-sized enterprises under resource constraints. This study focuses on this issue, starting from the characteristics of capital structure, analyzing the transmission paths of leverage, and examining the nonlinear relationship between leverage thresholds and survival performance. It aims to reveal the special logic of leverage utilization in resource-based small and medium-sized enterprises, provide an industry-specific analytical framework for mining financial decisions, and enrich relevant theoretical understandings.

1. Analysis of the Capital Structure and Leverage Level Characteristics of Mongolian Mining Enterprises

1.1 Debt Financing Structure under the Constraints of Mineral Resource Endowments

The distribution of mineral resources in Mongolia exhibits significant regional differences. The types of minerals, their grades, and occurrence conditions directly shape the financing availability and debt composition of small and medium-sized mining enterprises. Different mineral types, such as coal, copper, and fluorite, vary in their extraction value and capital return cycles, which leads financial institutions to adopt differentiated strategies in credit rationing. Enterprises in high-grade mining areas can typically obtain more collateral-backed loans, with long-term loans accounting for a higher proportion of debt financing. In contrast, enterprises developing low-grade or associated minerals face stricter credit conditions, and their debt composition relies more on short-term borrowings and trade financing. Furthermore, the clarity of mining rights ownership and the standardization of resource reserve verification directly affect external creditors' assessment of corporate asset security, thereby influencing the debt maturity structure and cost of capital. Under the environment of limited external financing channels, the debt financing structure of Mongolian small and medium-sized mining enterprises is essentially endogenous to the potential economic value and liquidity of the resources they control, thus forming differentiated capital structure characteristics based on resource endowments.

1.2 Asymmetric Relationship between the Extraction Cycle and the Cost of Capital

Mining development follows the cyclical pattern of exploration, construction, extraction, and mine closure and reclamation. The intensity of capital demand and the risk exposure differ fundamentally across stages, thereby inducing asymmetric changes in the cost of capital. In the exploration stage, geological uncertainty is high, and enterprises typically find it difficult to obtain low-cost debt capital, with equity financing dominating and the implicit cost of capital remaining at a high level. When the project enters the construction stage, as investment in mine infrastructure increases, expenditures on equipment procurement and underground engineering result in substantial capital immobilization. Debt financing begins to intervene at this stage, but the risk assessment premium remains significantly higher than that in the mature extraction stage. During the extraction stage, cash flow gradually stabilizes, the debt repayment capacity of enterprises strengthens, and the cost of capital declines correspondingly. However, small and medium-sized mining enterprises in Mongolia often struggle to overcome the high-cost capital phase in the early stage, and the cyclical fluctuation of the cost of capital exerts continuous pressure on the accumulation of their financial leverage. A temporal mismatch exists between the high cost of capital at the front end of the extraction cycle and the relatively abundant cash flow at the back end, which leads enterprises to face an intertemporal balancing dilemma in leverage utilization. The stagewise escalation of the cost of capital constrains the sustainability of debt financing^[1].

1.3 Impact of Leverage Ratio Fluctuations on the Free Cash Flow of Mining Enterprises

The leverage ratio of small and medium-sized mining enterprises in Mongolia is not a static indicator; instead, it exhibits significant fluctuation characteristics along with the progress of resource extraction, fluctuations in mineral product prices, and changes in refinancing conditions. In the initial stage of leverage ratio increase, the injection of debt capital helps expand the scale of extraction and upgrade equipment, which theoretically enhances the capacity to generate operating cash flow. However, as the leverage ratio continues to rise, the rigidity of fixed interest expenses strengthens. When mineral product prices decline or extraction costs increase, the free cash flow of enterprises faces a dual squeeze. On the one hand, the prepayment of debt principal and interest reduces the capital reserve available for maintenance capital expenditures and exploration succession. On the other hand, the financial risk premium induced by high leverage leads to tighter supplier credit policies, which further occupies working capital. Leverage ratio fluctuations ultimately transmit to the stability of free cash flow by affecting the financing flexibility and capital turnover efficiency of enterprises. When the leverage ratio exceeds the range that the profit volatility of an enterprise can bear, the free cash flow turns from positive to negative, thereby weakening the financial buffer capacity of the enterprise to cope with changes in extraction conditions and market shocks, and forming a negative feedback loop between the leverage ratio and cash flow.

2. Transmission Mechanism of Financial Leverage on Operational Efficiency

2.1 Erosion Effect of Interest Expenses on the Marginal Profits of Mining Enterprises

The operational efficiency of small and medium-sized mining enterprises in Mongolia is first reflected in the level of marginal profit achieved per unit of output. As a fixed contractual cost of debt financing, interest expenses have the contractual rigidity of being deducted in advance during the profit formation process. The marginal profit structure of a mining enterprise is jointly determined by the selling price of mineral products, the variable cost of extraction, and the fixed financial expenses. Although interest expenses do not fluctuate with the current extraction volume, they continuously participate in profit distribution and compress the conversion space from earnings before interest and taxes into retained earnings. As the scale of debt financing accumulates, the proportion of interest expenses in the total cost composition of an enterprise gradually rises. Even when the established extraction scale and selling price are maintained, the net profit margin still shows a downward trend, and the marginal profit curve undergoes a systematic shift under the effect of the financial burden. The deeper mechanism of this erosion effect lies in the fact that interest expenses have no direct relationship with the output efficiency of the enterprise's production and operation activities, yet they take precedence over capital accumulation and reinvestment inputs in the profit distribution sequence, thereby structurally weakening the capacity of net earnings retention per unit of resource output.

The financing environment in which small and medium-sized mining enterprises in Mongolia operate further amplifies the erosion effect of interest expenses on marginal profits. Constrained by the limited diversity of financing channels and the availability of credit ratings, these enterprises typically obtain debt capital with a high risk premium, and their debt interest rates are significantly higher than the average market level, resulting in a more severe profit leakage per unit of debt burden. When mineral product prices are in an upward cycle, the price dividend can still cover the interest erosion, and the marginal profit contraction exhibits a hidden characteristic. However, once prices enter a downward channel or extraction costs rise rigidly due to increasing mining depth, the proportion of interest expenses in the profit structure increases passively, and the erosion effect turns from hidden to explicit. More critically, the continuous crowding-out of marginal profits by interest expenses weakens the internal capital accumulation capacity of enterprises, making it difficult to replenish the capital reserves for exploration succession, equipment renewal, and safety investment. Consequently, the capital input capacity for subsequent extraction activities is constrained, forming a negative cumulative cycle between the financial burden and the decline in operational capacity^[2].

2.2 Dynamic Changes in Asset Turnover Ratio under the Adjustment of Leverage

As a core indicator for measuring the operational efficiency of mining enterprises, the asset turnover ratio reflects the capacity to generate operating revenue supported by unit asset size. The use of financial leverage forms a dynamic adjustment mechanism for turnover efficiency by changing the asset allocation structure and the pace of capital conversion. After debt capital is injected into an enterprise, it is typically allocated to long-term asset projects such as the purchase of extraction equipment, the development of underground engineering, and the construction of ore stockpiles. The immobilization of non-current assets formed in this way needs to be gradually released through the extraction cycle before it can be converted into operating revenue. In the initial stage of leveraged capital injection, the expansion of asset scale outpaces the progress of production capacity release, and the growth of operating revenue lags behind the increase in assets, causing the asset turnover ratio to exhibit a phased downward trend. As extraction activities enter a steady-state period, production capacity is gradually released and ore sales increase. Operating revenue then begins to match the previous asset investment, and the turnover ratio tends to recover. However, the magnitude and pace of the recovery depend on the continuity of the mine's geological conditions and the efficiency of extraction plan execution.

The complexity of extraction conditions and the irregular distribution of ore bodies faced by small and medium-sized mining enterprises in Mongolia often cause the pace of production capacity release to deviate from expectations, thereby artificially extending the time lag between asset investment and output, and correspondingly prolonging the recovery period of the turnover ratio under leverage adjustment. A more subtle transmission path lies in the fact that, under a high-leverage state, enterprises may passively compress the normal pace of productive asset renewal in order to maintain debt repayment capacity, which leads to equipment aging and diminishing marginal extraction efficiency. The extended service life of equipment and the lag in development engineering weaken the capacity of

unit assets to generate revenue, and the asset turnover ratio consequently exhibits a persistent low-level operation trend under leverage pressure. Furthermore, the asset collateral clauses attached to debt contracts may restrict the flexibility of enterprises to dispose of inefficient assets, and the failure to promptly divest idle assets further drags down the overall turnover efficiency. By influencing the direction of asset allocation, the pace of production capacity release, and the capacity for asset renewal, financial leverage indirectly regulates the dynamic path of the asset turnover ratio and thereby affects the continuity and stability of operational efficiency.

2.3 Synergistic Effect of the Fixed Cost Ratio and Financial Leverage

The cost structure of small and medium-sized mining enterprises in Mongolia is endogenous to the technical and economic characteristics of mine development. Amortization of mining rights, depreciation of underground engineering, and maintenance expenditures possess significant fixed cost attributes and do not vary proportionally with the extraction scale, thereby forming the endogenous basis of operating leverage. The presence of operating leverage amplifies the sensitivity of earnings before interest and taxes to fluctuations in extraction volume, and a unit change in output triggers a larger proportional fluctuation in profits. After financial leverage introduces debt interest, financial expenses are further added to the cost composition of the enterprise, and this portion of expenditure also has rigid characteristics. The two types of leverage form a structural synergistic amplification mechanism on the cost side. For enterprises with a high fixed cost ratio, the operating leverage effect alone already makes the profit level highly sensitive to the extraction scale. The addition of financial leverage extends this sensitivity to the net profit level, amplifying the magnitude and frequency of profit fluctuations. Consequently, the stability of operational efficiency faces the superimposed impact of dual leverage^[3].

Under the geological conditions of limited extraction scale and irregular ore body distribution faced by small and medium-sized mining enterprises in Mongolia, the dilution of fixed costs is difficult to achieve, and the operating leverage is naturally at a relatively high level. If financial leverage rises simultaneously at this point, the two types of leverage reinforce each other in the same direction, thereby significantly amplifying the profit fluctuation caused by a unit change in extraction volume. The positive effect of this synergistic effect is reflected in the stage of extraction scale expansion, where the dilution effect of fixed costs and the interest coverage capacity improve together, and the profit growth rate outpaces the revenue growth rate, leading to a marginal improvement in operational efficiency. However, during the stage of scale contraction or price decline, the rigidity of fixed costs combined with the rigidity of interest expenses accelerates the rate of profit contraction, and operational efficiency faces the risk of accelerated deterioration. The degree of synergy between the two types of leverage determines the sensitivity boundary of corporate profitability to fluctuations in extraction scale. When the synergy crosses the critical point, even a minor adjustment in output may trigger violent profit fluctuations, and the stability of operational efficiency is structurally weakened. This synergistic effect further shapes the survival adaptation characteristics of enterprises in the resource extraction cycle by influencing their ability to respond to market signals.

3. Examination of the Correlation between Leverage Thresholds and Corporate Survival Performance

3.1 Sensitivity Constraint of Debt Repayment Capacity on the Survival Period of Mining Enterprises

The survival period of small and medium-sized mining enterprises in Mongolia is closely linked to the lifespan of resource extraction, and the debt repayment capacity, as the core yardstick of the financial safety boundary, imposes a sensitivity constraint on enterprises in crossing the survival thresholds between extraction stages. Mine development follows the natural cycle of exploration, construction, stable production, declining production, and eventual mine closure, and the cash flow generation capacity varies significantly across these stages. When cash flow is abundant during the stable production stage, the debt repayment capacity indicators are at a relatively high level, and financial risks remain hidden beneath the appearance of profitability. When the enterprise enters the declining production stage, the decline in extraction grade and the increase in extraction costs occur simultaneously, operating cash flow tightens, and the debt repayment capacity subsequently deteriorates. If the debt principal and interest accumulated in the earlier period have not been fully absorbed at this point, the enterprise will face the dual dilemma of liquidity depletion and obstructed refinancing.

The sensitivity of debt repayment capacity to the survival period is manifested in the fact that, at specific nodes of the extraction cycle, a slight deterioration in the interest coverage ratio and the current ratio may trigger credit contraction and accelerate the exit of an enterprise. Constrained by the scale of resource reserves, small and medium-sized mining enterprises in Mongolia have a relatively short stable production period, and the slope of debt repayment capacity from peak to trough is steeper. Any unexpected change in extraction conditions may push an enterprise to the critical point of debt repayment, and the survival period is thus truncated by financial constraints. This sensitivity constraint is also reflected in the fact that a decline in debt repayment capacity will lead to tighter supplier credit policies and sluggish accounts receivable turnover, further compressing the working capital space, and forming a spiral transmission of deteriorating financial indicators and obstructed operating cycles. Ultimately, this triggers the exit mechanism of the enterprise before the end of the resource life span^[4].

3.2 Substitution Relationship between Financing Flexibility Space and Operational Flexibility

The use of financial leverage, while providing an enterprise with current capital support, simultaneously consumes its future financing flexibility space. Operational flexibility, in turn, depends on the ability of an enterprise to independently adjust its production pace and capital allocation direction in response to changes in extraction conditions. Small and medium-sized mining enterprises in Mongolia face production characteristics such as uncertainty in ore body continuity and dynamic changes in extraction difficulty, and they need to maintain a certain degree of operational flexibility to cope with the unpredictability of underground conditions. The rigid repayment obligations and asset collateral lock-in introduced by debt financing weaken the autonomous space for enterprises to reduce extraction scale, postpone investment, or alter extraction plans. A reduction in financing flexibility space means that the buffer for enterprises to withstand cash flow fluctuations becomes thinner. Once extraction conditions deteriorate, enterprises can neither supplement liquidity through new financing nor quickly adjust operational strategies to reduce losses, and operational flexibility is consequently squeezed by a high-leverage state.

The deeper logic of this substitution relationship lies in the fact that the current debt capital is exchanged for an overdraft of future decision-making freedom. In an environment of limited resources and uncertain extraction conditions, small and medium-sized mining enterprises in Mongolia need to make a trade-off between financing availability and operational adaptability. The choice of leverage level is essentially a substitution trade-off between two types of resource allocation flexibility. This substitution relationship is particularly significant under a high-leverage state. To maintain compliance with debt covenants, enterprises are often forced to continue with the established extraction plan, even when changes in geological conditions have already indicated the necessity for adjustment. Operational decisions thus fall into a path dependence dominated by financial constraints, and the flexibility space is structurally compressed below the critical threshold^[5].

3.3 Leverage Buffer Capacity under External Commodity Price Shocks

As price takers in the international mineral product market, small and medium-sized mining enterprises in Mongolia face an operating environment characterized by frequent fluctuations in external commodity prices. The buffer capacity of financial leverage in this process determines the stability of the survival performance of these enterprises. During the upward phase of mineral product prices, cash flow is abundant, the pressure to cover debt principal and interest decreases, and the negative effects of leverage are masked by price dividends. Enterprises tend to expand debt financing to pursue scale expansion. When prices enter a downward channel, the profit margin narrows, but the rigidity of interest expenses remains unchanged, and the buffer capacity of leverage begins to manifest. Moderate financial leverage can, to some extent, smooth profit fluctuations through the tax shield effect of financial expenses, thereby buying time for enterprises to adjust their extraction plans. Excessive leverage, however, deprives enterprises of any buffer room, as interest expenses crowd out maintenance capital investment, leading to a passive contraction of the extraction scale and further exacerbating the decline in revenue.

The boundary of the leverage buffer capacity depends on the sensitivity of corporate profitability to price changes and the degree of matching with the debt maturity structure. For small and medium-sized mining enterprises in Mongolia, extraction costs are relatively rigid, and price fluctuations are transmitted directly to the profit side. The buffer effect of leverage often briefly manifests in the early stage of price decline and then rapidly depletes, leaving the survival performance of enterprises exposed to the cyclical shocks of the external commodity market. The critical point at which the buffer

capacity is exhausted lies in the situation where the cash flow gap caused by the price decline exceeds the limits of the debt rollover capacity and the scope for cost compression. At this point, leverage not only fails to smooth the shock but instead becomes an accelerator that magnifies the transmission speed of the financial crisis, and the survival performance of enterprises faces a concentrated test at the bottom of the price cycle.

Conclusion

The utilization of financial leverage in Mongolian small and medium-sized mining enterprises exhibits significant resource endowment dependence. The debt financing structure is endogenous to the potential value and liquidity of mineral resources, and a temporal mismatch exists between the high cost of capital at the front end of the extraction cycle and the abundant cash flow at the back end. Leverage ratio fluctuations transmit to the stability of free cash flow by affecting financing flexibility and capital turnover. The erosion of marginal profits by interest expenses has contractual rigidity, the asset turnover ratio presents an asymmetric adjustment path under leverage regulation, and the synergistic amplification effect of the fixed cost ratio and financial leverage makes operational efficiency highly sensitive to fluctuations in extraction scale. Debt repayment capacity imposes a sensitivity constraint on the survival period of mining enterprises, a structural substitution relationship exists between financing flexibility space and operational flexibility, and the leverage buffer capacity under external commodity price shocks is constrained by the sensitivity of profitability and the matching degree of debt maturity. The study shows that financial leverage for Mongolian small and medium-sized mining enterprises has a critical threshold. Below the threshold, leverage performs the functions of resource aggregation and efficiency regulation; beyond the threshold, leverage transforms from a buffer tool into a risk-accelerating carrier, and the survival performance of enterprises faces a concentrated test when the leverage ratio crosses the critical point. The limitation of this study lies in the lack of detailed comparative analysis across different mineral types and extraction stages. Future research may further examine the heterogeneous performance of leverage thresholds among different types of mining enterprises, as well as the influence mechanism of changes in the external financing environment on corporate leverage adjustment behavior.

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