Construction of a Data Asset Valuation Model for Steel Enterprises Based on the Multi-Period Excess Return Method: A Case Study of Hebei Iron & Steel Co., Ltd.

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Abstract: With the rapid development of the digital economy, data has become a core factor driving economic growth. The formal implementation of the Ministry of Finance's 2024 Interim Provisions on Accounting Treatment for Enterprise Data Resources signifies that data assets can be recognized as either "intangible assets" or "inventories." However, as policies for data asset recognition take effect , enterprises face challenges in valuation.This paper focuses on corporate data assets, constructing a dynamic valuation model based on the multi-period excess return method to overcome limitations of traditional income approaches. Case validation using Hebei Iron & Steel reveals that in capital-intensive industries, the implicit value of data assets is difficult to fully capture through conventional methods, with assessment results showing negative excess returns. This highlights the applicability of current methods in asset-heavy sectors.The study further proposes improvements regarding factors for data asset valuation, providing theoretical foundations and practical pathways for the standardized transformation of data assets from "resources" to "assets."

***Keywords*:** data assets; value assessment; multi-period excess return method

1. Introduction

The digital economy is reshaping the global economic landscape at an unprecedented pace.The China Digital Economy Development Research Report (2024) indicates that China's digital economy reached 53.9 trillion yuan in 2023, accounting for 42.8% of GDP, marking a shift in economic growth from "factor-driven" to "data-driven." Concurrently, the national level continues to refine the top-level design of data elements: In 2022, the "Twenty Data Measures" first proposed establishing a data property rights system with Chinese characteristics;In October 2023, the National Data Administration was inaugurated, forming a new governance system centered on data institutions, focused on data resource development and utilization, and supported by infrastructure. In 2024, the Ministry of Finance's "Interim Provisions on Accounting Treatment for Enterprise Data Resources" officially took effect, permitting eligible data resources to be recorded on balance sheets as either "intangible assets" or "inventories" for the first time.With the formal implementation of policies permitting data assets on balance sheets, assessing their value has become a critical issue in the digital economy era. However, due to the unique attributes of data assets, academia has yet to establish a unified methodology for their valuation. Among currently applied methods, the multi-period excess return approach most accurately reflects the true value of data assets. Therefore, this paper employs the multi-period excess return method to analyze Hebei Iron & Steel Co., Ltd. as a case study.

2. Conceptual Framework for Constructing the Multi-Period Excess Return Model

During a company's ongoing operations, all assets contribute to generating income. This income contribution can be specifically broken down into the sum of contributions from four categories: fixed assets, current assets, intangible assets, and other assets. Since data assets can generate returns over multiple operating cycles, the income approach requires considering returns across several operating periods—i.e., multi-period excess returns. Thus, the multi-period excess return model is as follows:

$$V = \sum_{t=1}^{n} \left(E - E_w - E_f - E_i \right) \times \left(1 + i \right)^{-t} \tag{1}$$

Where: V denotes the value of the enterprise's data assets; E denotes the enterprise's free cash flow; Ew, Ef, Ei denote the contribution values from current assets, fixed assets, and other intangible assets (excluding data assets), respectively; i denotes the discount rate for data assets; n denotes the income period [1].

3. Process for Evaluating the Value of Hebei Iron & Steel Co., Ltd.'s Data Assets Using the Multi-Period Excess Return Method

3.1 Forecasting the Company's Free Cash Flow

3.1.1 Operating Revenue Forecast

To ensure the reasonableness and accuracy of the forecasted operating revenue, this paper obtained revenue data from the first quarter of 2020 to the second quarter of 2025 from annual reports. The FORECAST function was used to forecast Hebei Iron & Steel Group's operating revenue from the third quarter of 2025 to the fourth quarter of 2027, calculating the projected operating revenue for the period 2025–2027.Combining the quarterly total revenue forecasts yields the annual total revenue projections shown in Figure 1:

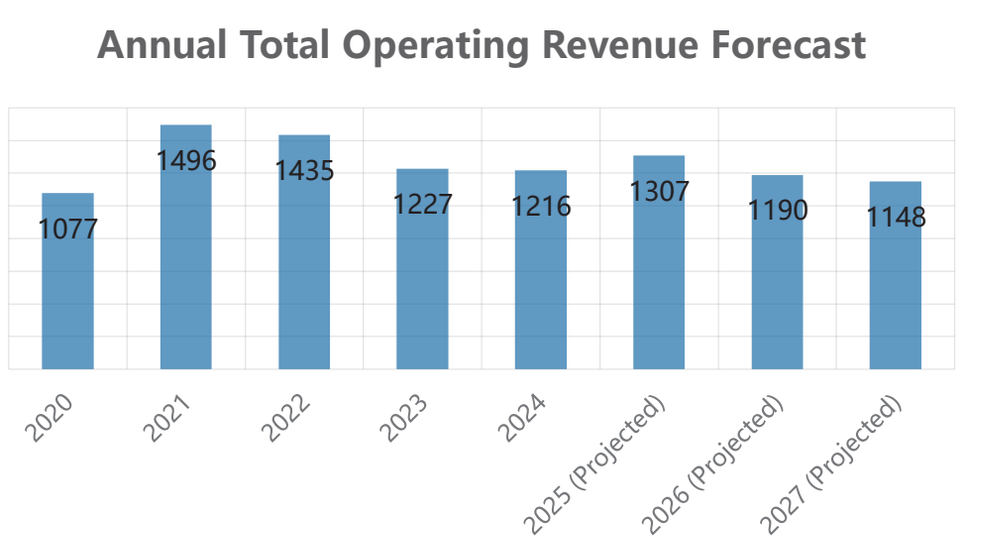

Figure 1. Hebei Iron & Steel Co., Ltd. Forecast for 2025–2027

3.1.2 Cost and Expense Forecast

During cost forecasting, historical data from annual reports indicates fluctuating trends in Hebei Iron & Steel's cost expenses. Therefore, this study employs the average historical ratio of cost expenses to operating revenue to project future cost expenses.

Table 1. Cost and Expense Forecast for Hebei Iron & Steel Co., Ltd. (2025–2027)

Year	2025	2026	2027
Operating Costs	1170	1064	1027
Taxes and Surcharges	7.7113	7.021	6.773
Financial Expenses	58.658	58.407	51.522
Selling Expenses	1.367	1.245	1.2
Administrative Expenses	29.956	27.251	26.312
Research and Development Expenses	29.381	26.751	25.807

3.1.3 Depreciation and Amortization Forecast

Fixed assets and intangible assets are utilized by enterprises over their lifecycles, necessitating the reasonable allocation of their wear and tear. Hebei Iron & Steel Co., Ltd. maintains a relatively stable ratio of annual depreciation and amortization to operating revenue. Therefore, the forecast is based on the average ratio of 41.92% observed over the five-year period from 2022 to 2024.

Table 2. Hebei Iron & Steel Co., Ltd. Depreciation and Amortization Forecast for 2025-2027

Year	2025	2026	2027
Total Depreciation and Amortization	547.89	498.85	481.24

3.1.4 Capital Expenditure Forecast

Capital expenditures should be calculated as the cash paid for the acquisition and construction of fixed assets, intangible assets, and other long-term assets disclosed in the annual report, minus losses from the disposal of fixed assets, intangible assets, and other long-term assets. Since the amounts recorded under the loss from disposal of fixed assets, intangible assets, and other long-term assets have been relatively small in recent years, this paper adopts the cash paid for the acquisition and construction of fixed assets, intangible assets, and other long-term assets as disclosed in the annual report as the capital expenditures.

Hebei Iron & Steel Co., Ltd.'s capital expenditures from 2020 to 2024 exhibit significant fluctuations and structural growth characteristics.Over the five-year period, the company invested a cumulative total of RMB 88.87 billion in long-term asset construction, with an average annual capital expenditure of RMB 17.774 billion, accounting for 15.26% of cumulative revenue during the same period. Specifically, the proportion of capital expenditures to revenue at HBIS has remained relatively stable in recent years. Therefore, this paper selects the average ratio of expenditures to revenue from 2022 to 2024 (14.93%) as the forecast benchmark.

Table 3. Hebei Iron & Steel Co., Ltd. Capital Expenditure Forecast for 2025-2027

Year	2025	2026	2027
Capital Expenditures	195.14	177.67	171.40

3.1.5 Working Capital Forecast

Working capital represents the net amount obtained by subtracting total current liabilities from total current assets. The net change in working capital is calculated by subtracting the previous period's working capital from the current period's working capital. This analysis employs data from Hebei Iron & Steel Co., Ltd.'s annual reports over the past five years for forecasting purposes.

The ratio of working capital to revenue for Hebei Iron & Steel Co., Ltd. fluctuated minimally from 2022 to 2024. Therefore, to ensure more objective forecasting results, this study employs the average annual decrease rate of working capital from 2022 to 2024 (-4.39%) as the forecasting benchmark to generate the working capital forecast table.

Table 4. Forecast Table of Working Capital Increases for Hebei Iron & Steel Co., Ltd. from 2025 to 2027

Year	2025	2026	2027
Increase in Working Capital	-45.52	-52.24	-50.40

3.1.6 Free Cash Flow

Calculated using the corporate cash flow formula, the free cash flow is as follows:

Table 5. Hebei Iron & Steel Co., Ltd. Free Cash Flow Forecast for 2025-2027

	2025	2026	2027
Revenue	1307	1190	1148
Cost of Sales	1170	1064	1027
Taxes and Surcharges	7.7113	7.021	6.773
Financial Expenses	58.658	58.407	51.522
Selling Expenses	1.367	1.245	1.2
Administrative Expenses	29.956	27.251	26.312
Research and Development Expenses	29.381	26.751	25.807
EBIT	9.9267	5.325	9.386
Income Tax Rate	25%	25%	25%
Net profit	7.445	3.994	7.04
Depreciation and Amortization	547.89	498.85	481.24
Capital Expenditures	195.14	177.67	171.40
Change in Working Capital	-45.52	-52.24	-50.40
Free Cash Flow	405.715	377.414	367.28

3.2 Calculation of Discount Rate

3.2.1 Determination of Weighted Average Cost of Capital

Since the data asset revenue period for Hebei Iron & Steel Co., Ltd. spans three years from 2025 to 2027, the debt capital return rate uses the three-year loan interest rate (4.75%) announced by the central bank in 2024 as the benchmark value.The risk-free rate is based on the interest rate of the first three-year government bond issued in 2025 (1.93%). The beta coefficient is 0.82, and the market average return is selected as the average annual return of the CSI 300 Index over the past decade (9.09%).As of the end of 2024, HBIS Group's shareholders' equity totaled RMB 67.582 billion, accounting for 25.12% of total assets; total liabilities amounted to RMB 201.521 billion, representing 74.88% of total assets. Substituting these values into the CAPM model yields an equity capital cost of 7.80%. The weighted average cost of capital (WACC) for HBIS Group is ultimately calculated as 4.63% using the formula.

3.2.2 Determination of Data Asset Return Rate

This paper posits that data assets constitute intangible assets, hence employing the easily calculable return on intangible assets (ROIA) to represent the return on data assets. According to the 2024 financial statements, current assets, fixed assets, and intangible assets accounted for 24.29%, 59.44%, and 2.52% of total assets, respectively. Calculating the return on investment for intangible assets yields a ratio that simultaneously represents the return on data assets.

Table 6. Intangible Asset Return Rate of Hebei Iron & Steel Co., Ltd.

Company Name	Fixed Assets Ratio	Return on Fixed Assets	Current Assets Ratio	Return on Current Assets	Intangible Assets Ratio	WACC	Return on Intangible Assets
HBIS Group	59.44%	4.75%	24.29%	1.37%	2.52%	4.63%	58.48%

3.2.3 Projected Return Values Generated by Each Asset

When evaluating the value of Hebei Iron & Steel Co., Ltd.'s data assets using the excess return allocation method, the revenue contributions from different assets must be calculated separately. The company's total assets demonstrated stable growth from 2020 to 2024. Therefore, the average total asset growth rate from 2020 to 2024 (3.85%) was selected as the baseline to forecast the company's total assets for the next three years.

(1) Fixed Asset Revenue Forecast

The return on fixed assets for HBIS Group is the sum of the annual depreciation of fixed assets and the investment income generated by these assets. Since the ratio of capital expenditures on fixed assets to revenue has been relatively stable, the average ratio of 47% over the past five years is used to forecast future capital expenditures on fixed assets. Depreciation of fixed assets is projected based on the average depreciation ratio of 40.46% relative to operating revenue.

Table 7. Hebei Iron & Steel Co., Ltd. Fixed Asset Income Forecast for 2025-2027

	2025	2026	2027
Projected Fixed Asset Income	608.81	565.6	551.76

(2) Forecasted Return on Current Assets

When considering the growth rate of current assets, the average growth rate of current assets (-7.97%) is adopted as the benchmark to forecast the increase in current assets over the next three years. The expected rate of return on current assets is set at the one-year bank loan interest rate of 4.35%.

Table 8. Forecast of Current Asset Returns for Hebei Iron & Steel Co., Ltd. (2025-2027)

	2025	2026	2027
Projected Return on Current Assets	27.32	26.23	25.18

(3) Projected Intangible Asset Revenue

As evidenced by Hebei Iron & Steel Co., Ltd.'s historical financial reports, the intangible assets disclosed in its financial statements include land use rights, patent rights, and non-patented technologies. These assets generate revenue in a manner similar to fixed assets. Therefore, the methodology for forecasting intangible asset revenue in this study mirrors that for fixed assets, utilizing the sum of annual fixed asset depreciation and investment income derived from fixed assets. The projected intangible asset capital expenditures for the next three years are calculated using the average ratio of intangible asset capital expenditures to operating revenue over the past five years, which stands at 1.716%.

Table 9. Forecast of Intangible Asset Income for Hebei Iron & Steel Co., Ltd. (2025-2027)

Year	2025	2026	2027
Projected Intangible Asset Revenue	22.38	20.43	20.37

For off-balance-sheet intangible assets, this paper considers only data assets and human capital. Here, "Accrued Employee Compensation" in HBIS Group's financial statements is treated as human capital investment data. Analysis of historical labor input reveals that human capital investment accounts for an average of 0.45% of operating revenue. According to National Bureau of Statistics data, China's talent contributes an average of 34.5% to economic growth.This paper uses 34.5% as the labor contribution rate to forecast Hebei Iron & Steel Group's human capital contribution over the next five years.

Table 10. Forecasted Human Capital Contribution Value of HBIS Group for 2025-2027

Year	2025	2026	2027
Human Capital Investment	5.88	5.355	5.166
Return on Investment	34.5%	34.5%	34.5%
Contribution Value of Human Capital Investment	2.03	1.85	1.78

(4) Data Asset Valuation Using the Multi-Period Excess Return Method

The final valuation of data assets calculated using the multi-period excess return method represents the present value of future revenue from 2025 to 2027.

Table 11. Valuation of HBIS Group Using the Multi-Period Excess Return Method

Year	2025	2026	2027
Free Cash Flow	405.715	377.414	367.28
Fixed Asset Income	608.81	565.6	551.76
Income from current assets	27.32	26.23	25.18
Other Intangible Assets Income	22.38	20.43	20.37
Labor income	2.03	1.85	1.78
Discount factor	58.48%	58.48%	58.48%
Present Value	-160.79	-176.38	-193.2

The calculated present value of data assets is negative. This negative outcome fundamentally reflects that "non-data asset revenues significantly exceed the company's free cash flow." The primary reasons for this analysis are as follows: Fixed assets constitute the core revenue source, directly "consuming" FCF; data assets serve as "auxiliary attributes" without generating incremental revenue; data assets are in the "investment phase", yielding no short-term returns.

4. Conclusions and Recommendations

4.1 Research Findings

The valuation of data assets fundamentally requires a cognitive framework reconstruction that transcends traditional accounting paradigms and deeply integrates industry-specific characteristics.Case studies reveal that in capital-intensive manufacturing sectors like Hebei Iron & Steel, the value realization pathway of data assets exhibits distinct "embedded" characteristics — their economic utility manifests not as independently measurable excess returns, but through implicit channels such as optimized production processes, enhanced operational efficiency, and accelerated R&D iteration, ultimately translating into elevated corporate value.

4.2 Recommendations

To address the valuation challenges of data assets in capital-intensive industries, we recommend establishing a specialized assessment framework tailored for manufacturing. This framework could incorporate industry adjustment mechanisms based on the multi-period excess return method: First, set a "fixed asset contribution deduction cap", converting excess contributions beyond the enterprise's free cash flow using industry-average contribution rates. Second, introduce an "implicit value conversion factor" to quantify indirect benefits like efficiency gains and cost savings through a case repository.Third, develop a "Data Asset Contribution Separation Tool" utilizing machine learning to analyze data access frequency and correlations across application scenarios. Hebei Iron & Steel could collaborate with the China Iron and Steel

Association to establish an industry parameter benchmark database, providing technical support for the reasonable valuation of typical data assets like the "Freight Rate Intelligence Assistant" and promoting standardized application of valuation methods within the industry.

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