Evaluation of Data Assets for Internet Enterprises: A Case Study on K Company

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Abstract: The "Digital China" agenda has made data assets crucial for enterprises' competitiveness, especially on the Internet sector. However, the current method of evaluating their worth needs improvement. Taking K Company as an example, this study, based on analytic hierarchy process, uses the binomial tree model to evaluate the value of data assets by determining their potential worth. It aims to promote the growth of the data economy and digital transformation in manufacturing organizations by focusing on revenue.

Keywords: Data Asset Evaluation, Internet enterprise, APH Approach, Binomial Tree Option Pricing Model, K Company

1. Introduction

China's digital economy saw substantial growth, expanding by 38.6 percent to reach a total value of $39.2 trillion in 2020. Despite the implementation of laws by the Chinese government to promote data value evaluation, China's internet companies still need help in accurately assessing data assets[1]. The inherent characteristics of data assets, such as functional diversity, timeliness, value volatility, intangibility, reliability, and large data scales with solid correlation among data[2], make their valuation particularly complex[3]. Scholars have recently utilized asset pricing models to demonstrate data value, although these approaches have revealed certain limitations[4,5,6]. Some researchers have turned to theoretical methodologies, including the natural option technique and hierarchical analysis, to achieve more precise evaluations of data assets[7,8]. Additionally, real-world case studies have emphasized the importance of precision and scientific rigor in these evaluations[9]. This article aims to enhance data asset valuation methodologies by adopting a binomial tree option pricing model with an analytic hierarchy approach, particularly for internet enterprises – K company, to comprehensively examine the value of data assets from enterprise operation and investment perspectives to improve competitiveness and profitability to support industrial upgrading.

2. Research Design and Modeling

2.1 AHP Approach

This work utilizes the Analytic Hierarchy Process (AHP) to calculate the base net present value of data assets. It starts by subtracting the projected free cash flow from the total value of on-balance sheet assets, calculating their contribution value, and then multiplying it by excess earnings. The third stage calculates the base net present value by discounting their contribution value to a specific valuation point in time. The formula is as stated:

$$Vt=FCFt-Lt-Ft-It \quad (1)$$

$$P=\sum_{t=1}^{T}\frac{kV_t}{(1+r_s)^t} \quad (2)$$

Lt - value contributed by the current assets during period t

V_t- excess earnings generated by the enterprise during period t

k - revenue sharing rate of the data asset

r_s- discount rate of the data asset

T - data asset's revenue period
It - contribution value of intangible assets during the specified period "t"
P - data asset's underlying NPV at the time of valuation

2.2 Binomial Option Pricing Model

Options and internet data assets exhibit similar traits of volatility and unpredictability, which could contribute to their value[10]. In order to accurately assess the value, this paper utilizes a binomial tree option pricing model to quantify and subsequently examine it. In this model, we consider the data asset as the primary asset and start from the expiration date, gradually moving forward to calculate the value of each node in order to preserve the implied option holding. Concurrently, comparing the value of the early exercise and keep-and-hold alternatives is necessary. If the value derived by exercising the preceding option is greater, then the option's value at that juncture is determined by early exercise; otherwise, the option's value is computed based on the option to retain and maintain[10,11]. This procedure entails revisiting the valuation date to compute the option's original price.

2.3 ARIMA Time Series Forecasting Model

The Autoregressive Integrated Moving Average (ARIMA) model was popularized by Box and Jenkins in the 1970s[12]. It is a widely used statistical technique for time series forecasting. The methodology emphasizes the iterative process of model identification, parameter estimation, and diagnostic checking to ensure an adequate model fit[12-13]. Our work use the model to pursue predicted data for target company.

The process of calculation is intricate and burdensome when done manually. Thus, this research uses the Python programming language to carry out computations. Figure 2 illustrates the paper's valuation process in detail.

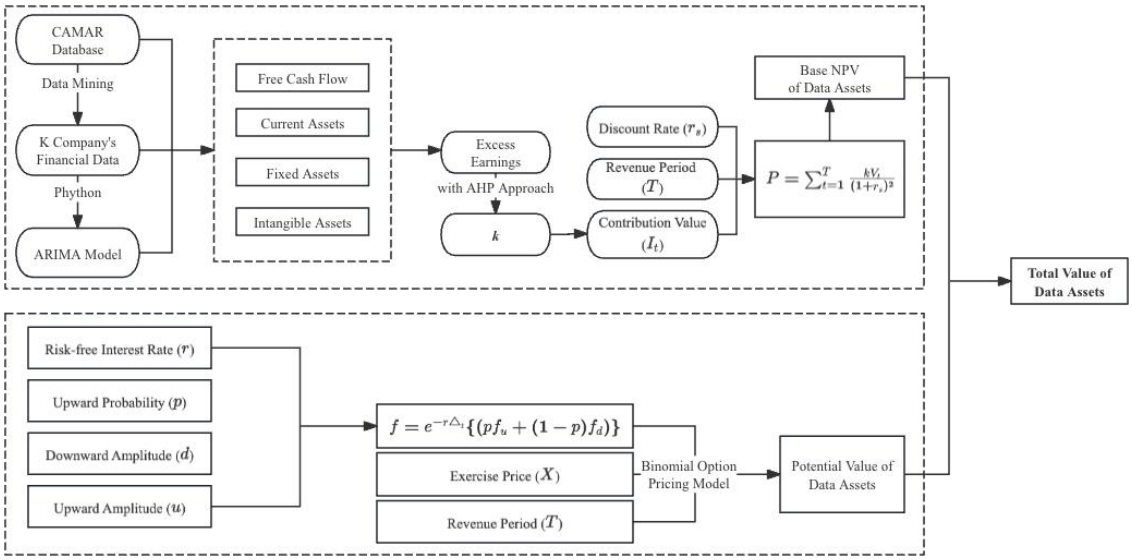

Fig. 2 Internet Data Asset Valuation Method

3. 3. Case Study on K Company

3.1 Background of K Company

K company is a prominent Internet software company that specializes in providing innovative sales and promotional services for a variety of office products. The company offers collaborative tools and language-learning programs that are compatible with popular operating systems. It has earned the trust and support of customers by consistently innovating and providing reliable network

services, it has earned customer's trust and support. In 2022, the company demonstrated robust competitiveness in the conventional licensing sector and remarkable expansion in the subscription sector, achieving a 43.45% year-on-year revenue growth. The subscription business accounted for 71% of the company's total revenue.

The study evaluates K Company as an example in the digital transformation process. We collects financial data from K Company's yearly financial statements for the years 2019 to 2023, which have been publicly accessible since its stock went public and set December 31st, 2023 as the starting point for assessment.

3.2 Calculation of Excess Return and k

3.2.1 Excess Return

Due to the limited financial data available since K Company's initial public offering on November 18, 2019, a prediction has been generated using the ARIMA temporal prediction model. The selected data spans a time frame of three months, aligning with the financial statements of each quarter. We input collected data into the ARIMA time series prediction model to generate forecasting. Table 1 presents the condensed data.

Table 1. Predicted Net Assets

Year	2024	2025	2026	2027	2028
Free Cash Flow	122,7.9	120,2.5	132,2	144,1.4	156,0.9
Current Assets	109,95	116,98	125,08	133,18	141,28
Fixed Assets	56.27	67.204	60.652	66.649	67.32
Intangible Assets	153.6	200.96	199.55	188.14	219.56

unit:CNY(millions)

The table provides a concise overview of the projected free cash flows, current assets, fixed assets, and intangible assets of the company for the upcoming five years. These projections are based on the ARIMA time-series forecasting model implementation. It lays the groundwork for future evaluations of the fundamental net present value.

The data is used to forecast the company's future profits, thereby enhancing the accuracy of the valuation model. To calculate the excess earnings of the company, we first determine the duration of future earnings. Then, we assess the difference between the available cash flow and the estimated value of tangible assets, current assets, and intangible assets during that specific period. We then multiply this difference by the relevant contribution rate to determine the surplus profits of the company. The value of fixed assets is determined by multiplying their contribution margin by their expected value, while the valuation of current assets is calculated by multiplying their contribution margin by their anticipated value. Intangible assets are valued by calculating their contribution margin and multiplying it by their predicted value.

3.2.2 Determination of k

Technology, management systems, and customer relations are determined as major drivers of value enhancement for Internet enterprises. Key drivers include market expansion, technological innovation, revenue increase, and operational efficiency improvement. Table 2 presents the revenue sharing proportion for every off-balance sheet asset.

Table 2.

	Data Asset	Human Capital	Consumer Relation	Mangement	Technology
k	25.16%	11.17%	14.73%	18.45%	30.5%

k

Meanwhile, The contribution rate for current assets is determined by the one-year bank loan interest rate of 3.45% as of December 31, 2023. The five-year bank loan interest rate of 4.20%, based on the evaluation date, can substitute the contribution rates for the evaluation of intangible

assets and fixed assets.According to the analysis provided, we acknowledge that the firm's data assets will not indefinitely retain their economic benefits and have a specific duration of validity. Based on this premise, we assumed that K Company's data assets have an effective income period of five years. Table 3 displays the precise results, yielding an NPV of data assets of $942.59 million.

Table 3. K Company's NPV of Data Asset

Item	2019	2020	2021	2022	2023
Free Cash Flow *(FCF$_t$)*	1227.90	1202.50	1322.00	1441.40	1560.90
Current Asset	10995.00	11698.00	12508.00	13318.00	14128.00
Contribution Rate of Current Asset	3.45%	3.45%	3.45%	3.45%	3.45%
Contribution Value of Current Asset	379.33	403.58	431.53	459.47	487.42
Fixed Asset	56.27	67.20	60.65	66.65	67.32
Contribution Rate of Fixed Asset	4.20%	4.20%	4.20%	4.20%	4.20%
Contribution Value of Fixed Asset	2.36	2.82	2.55	2.80	2.83
Intangible Asset	153.60	200.96	199.55	188.14	219.56
Contribution Rate of Intangible Asset	4.20%	4.20%	4.20%	4.20%	4.20%
Contribution Value of Intangible Asset	6.45	8.44	8.38	7.90	9.22
Excess Earnings *(Vt)*	839.76	787.66	879.55	971.23	1061.44
Revenue sharing rate of data assets *(k)*	25.16%	25.16%	25.16%	25.16%	25.16%
Contribution value of data assets	211.28	198.17	221.29	244.36	267.06
Discount Rate	4.48%	4.48%	4.48%	4.48%	4.48%
Discount Value	202.22	181.54	194.03	205.07	214.51
NPV of Data Assets			942.59		

unit: CNY (millions)

3.3 Data Asset Evaluation by Binomial Option Pricing Model

From the calculation, the cost of capital expenditure by 2023 amounts to $41.73 million. Meanwhile, we ascertain the risk-free interest rate r to be 2.40% and the duration of yield period T to be 5 years. We can calculate the yield volatility of K company's shares in 2023 using formula 24-26, which yields a value of $56.54. Once we have determined all the essential parameters, we proceed to calculate the following parameters: After inputting the values P=942.59, X=41.73, r=2.40%, σ（earnings volatility）=56.54%, and T=5 into Python programming, a result of $905.99 million was generated, indicating the potential worth of K company's data assets. Therefore, the overall value of the data assets is $1848.58 million.

4. Conclusion

This paper investigates the prospective value of data assets, emphasizing the supplementary value that is latent due to uncertainty. We determine the potential value of data assets using the binomial tree option pricing model, which enhances objectivity and flexibility. The model effectively accounts for uncertainties in the value of Internet enterprises' data assets, including market volatility, technological advancements, and data application scenarios.

Additionally, it facilitates dynamic valuation, which enables the ongoing assessment of the value of data assets. In addition to serving as a strategic decision-making support system and valuation instrument, the model assists managers in comprehending the risk and reward characteristics of data investments and optimizing resource allocation. The model has broad cross-domain application potential, rendering it applicable to other industries that rely significantly on data assets, such as fintech, healthcare, and intelligent manufacturing.

Future research should focus on optimizing model parameters, integrating multi-dimensional assessment indicators, responding to regulatory challenges, and conducting empirical research and

case studies. The binomial tree option pricing model demonstrates significant theoretical and practical potential for evaluating the value of data assets for Internet enterprises.

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