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Valuation of Pre-profit Technology Companies Based on the Price-to-Sales Ratio and Black-Scholes Model: A Case Study of Beijing Phylisense Technology Co., Ltd.

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Abstract

With the rapid development of the digital economy, the valuation of pre-profit technology enterprises has become increasingly prominent. However, traditional valuation methods are difficult to adapt to the characteristics of high R&D investment, negative earnings, and asset-light operations. This paper focuses on the valuation challenges of pre-profit technology companies by using Beijing Phylisense as a case study and constructs a combined valuation model integrating the Price-to-Sales (P/S) ratio method with the Black-Scholes (B-S) real options model. The study first analyzes the applicability flaws of traditional absolute valuation methods as well as Price-to-Earnings (P/E) and Price-to-Book (P/B) ratios. Subsequently, it develops a combined model of the P/S method and the B-S real options method, utilizing the P/S ratio to evaluate the existing entity value of the firm. The results indicate that this combined model can more comprehensively reflect the value of pre-profit technology companies and effectively compensate for the deficiencies of single valuation methods. The research in this paper provides new insights and methodologies for the valuation of pre-profit technology enterprises. Furthermore, it offers decision-making references for investors, corporate managers, and regulatory agencies, holding practical significance for the improvement of valuation systems for pre-profit technology companies.

Keywords

pre-profit technology companies, corporate valuation, price-to-sales (P/S) method, black-scholes (B-S) model

1. Introduction

In the macro context of the deep integration between the current information-driven, intelligent economy and industrial development, a large number of technology companies have emerged. Driven by this era and policies such as the “14th Five-Year Plan” and the “Informatization Standard Action Construction,” China's informatization development has achieved remarkable results. By the end of 2024, a total of 302 generative artificial intelligence services in China had completed filing, the intelligent computing power scale reached 493 EFLOPS (FP16), and the industrial internet achieved full coverage across 41 major industrial categories. China's informatization process is advancing comprehensively and rapidly across all key sectors.

Simultaneously, as the degree of informatization continues to deepen, the valuation of technology companies providing information services has become a critical step for measuring corporate comprehensive strength, assisting in strategic decision-making, guiding investors toward correct investments, and expanding financing channels [1]. The effectiveness of traditional corporate valuation models faces challenges because technology companies possess characteristics such as long R&D cycles, high upfront investments, unstable initial cash flows, and a high proportion of intangible assets. In the early stages, since net profit has not yet been realized, there is no anchor for the Price-to-Earnings (P/E) model. Furthermore, when cash flows are negative, it is difficult to apply the Discounted Cash Flow (DCF) model for forecasting. At the same time, the core value of technology companies lies in technical patents and service quality, yet traditional models precisely lack the capacity to capture the potential value of pre-profit technology firms. This leads to the severe undervaluation of pre-profit technology companies, which misleads investors and limits the financing scale of these firms.

To address the aforementioned issues, this study takes Beijing Phylisense Technology Co., Ltd. as a case study. Based on an improvement of the Price-to-Sales (P/S) model, it incorporates the predicted potential value of the enterprise into the valuation process, including intellectual property value, operating cycles, market demand, and technical barriers. This research aims to improve the deficiencies of traditional valuation models at the theoretical level so they may be applied in more fields. At the practical level, it seeks to secure larger financing scales for technology companies and optimize the allocation of market resources.

2. Definition of Related Concepts and Applicability Analysis of Valuation Methods for Pre-profit Technology Companies

2.1 Definition of Concepts

Firstly, regarding “pre-profit,” this refers to enterprises whose net profit is negative according to the financial statements disclosed by listed companies. In this paper, pre-profit technology companies are defined as software and information technology service enterprises that experience continuous losses and negative net profits, yet maintain a high proportion of R&D investment, possess a large number of patents, utilize technology and data as core assets, and are in a high-growth stage.

Secondly, there is no explicit definition for the identification of technology companies. This paper refers to the “Guidelines for the Industry Classification of Listed Companies” issued by the China Securities Regulatory Commission (CSRC) in the third quarter of 2021. Companies categorized under Industry Class Code 64 (Internet and Related Services) and Industry Class Code 65 (Software and Information Technology Services) are identified as technology companies. The evaluation dimensions include several key aspects. The first is R&D investment; technology companies typically allocate a significant portion of their expenditure to R&D for the development and implementation of technological products. The second is patent status; technology companies often possess a certain number of patented technologies that reflect their core competitiveness. Furthermore, the number of talented personnel is a crucial evaluation metric because the product development of technology firms is highly dependent on innovative talent. Finally, there is the degree of cutting-edge relevance; the main business areas of technology companies should be at the forefront of the era, characterized by innovation and forward-looking qualities [2].

Enterprise value is defined as the market evaluation of both the tangible and intangible value of a company, representing a comprehensive assessment of the firm's profitability and investor expectations. Technology companies are characterized by large upfront R&D investments, long monetization cycles, and high growth potential [3]. Their value should encompass both the existing business entity value and potential value such as technical patents, R&D pipelines, and growth opportunities. Therefore, it is necessary to utilize both the relative valuation method and the real options method for a comprehensive measurement [4]. This assessment approach facilitates a thorough understanding of the true value of the enterprise by the company’s management and investors, enabling them to make more informed decisions regarding the future direction and investments of the company.

2.2 Applicability Analysis of Valuation Methods for Pre-profit Technology Companies

The absolute valuation method primarily consists of the Free Cash Flow to Firm (FCFF) model, the Free Cash Flow to Equity (FCFE) model, and their respective variations. Its core principle is defining corporate value as the discounted value of expected future cash flows [5]. This method is suitable for enterprises with positive and relatively stable cash flows. For pre-profit technology companies, cash flows may be negative, and due to heavy upfront investments, these flows exhibit significant volatility; therefore, the absolute valuation method is not applicable.

The relative valuation method mainly includes the Price-to-Earnings (P/E) ratio and the Price-to-Book (P/B) ratio. The P/E ratio equals the stock price divided by earnings per share, reflecting the price investors pay for each unit of profit. This method is appropriate for enterprises with positive, steadily growing, and predictable earnings, making it unsuitable for pre-profit technology firms [6].

The P/B ratio equals the stock price divided by the net assets per share. This method is applicable to companies with substantial fixed assets whose book values are relatively accurate. Since technology companies are asset-light, their book net assets cannot accurately reflect the actual value of the firm. Consequently, applying this method would result in a severe undervaluation of technology companies [6].

2.3 Construction of the Valuation Model for Pre-profit Technology Companies

Based on the aforementioned applicability analysis of corporate valuation methods, this paper divides the value of pre-profit technology companies into two components. The first component is the **existing entity value** of the firm, which is assessed through the **Price-to-Sales (P/S) ratio method**. The second component is the **potential asset value**, valued using the **Black-Scholes (B-S) real options model** [7].

The P/S ratio method reflects the market's recognition of a firm's scale expansion, making it particularly suitable for companies that are currently pre-profit but experiencing rapid growth in sales revenue. By obtaining the P/S ratios of several comparable companies and calculating the average, the P/S ratio of the target company can be approximated. This, in turn, allows for the calculation of the target company's entity asset value [2].

Technology companies are characterized by a high proportion of intangible assets and unstable early-stage revenue. If an enterprise expects smooth product R&D and broad market applications in the future, it will increase investment in that sector. Conversely, if the enterprise predicts difficulties in product implementation or limited market development, it may scale back production or even terminate R&D. Therefore, utilizing the real options model to accurately estimate the potential value of an enterprise facilitates decision-making that maximizes the firm's interests.

3. Case Study: Valuation of Beijing Phylisense Technology Co., Ltd.

Beijing Phylisense Technology Co., Ltd. was established in 2002 and listed on the ChiNext Board of the Shenzhen Stock Exchange in 2012 under the stock code 300287. Phylisense is a leading domestic provider of comprehensive government informatization solutions, possessing multiple professional qualifications such as computer information system integration, building intelligence engineering, classified information system integration, and audio-video system integration. In recent years, Phylisense has gained recognition across various fields, including being selected for the "China Information Technology Application Innovation (ITAI) Top 500," ranking on the "Beijing Top 100 High-Precision, Sophisticated, and Advanced Enterprises," and receiving the 2024 Provincial Enterprise Technology Center certification. Currently, Phylisense has established a complete strategic layout and formed four major business sectors: Smart City, Intelligent Conferencing, Big Data, and Internet Education, providing customers with corresponding integrated solution services.

3.1 Valuation of Existing Assets Using the Price-to-Sales Method

This report sets December 31, 2024, as the valuation date. Based on the industry characteristics of technology companies described previously and the overview of Phylisense's corporate situation, three listed companies with primary business operations similar to Phylisense were selected as comparable companies:

Beijing eGOVA Co., Ltd. (300075), DHC Software Co., Ltd. (002065), and BizConf Telecom Co., Ltd. (300578). As of December 31, 2024, the average Price-to-Sales (P/S) ratio of these three companies was 7.17. In 2024, the operating revenue of Phylisense was 584,979,506.5 RMB. According to the P/S ratio method, the valuation of Phylisense's existing assets in 2024 is determined to be 4.196 billion RMB.

3.2 Evaluating Potential Value Using the B-S Real Options Model

First, the required parameters must be determined.

1. **Value of the Underlying Asset (S):** In this paper, the book value of operating assets is used to measure the value of the underlying asset. Based on annual report data, this is calculated as 1.982 billion RMB.
2. **Exercise Price (X):** When evaluating the potential value of an enterprise, interest-bearing liabilities are treated as the option's exercise price. Accordingly, interest-bearing liabilities include short-term borrowings, long-term borrowings, bonds payable, non-current liabilities due within one year, and lease liabilities [2]. Based on this, the exercise price for this real option is calculated as 22 million RMB.
3. **Time to Expiration (T-t):** Based on the nature of the company and Phylisense's R&D cycles and patent protection periods, this is set at 5 years.
4. **Risk-free Interest Rate (r):** This paper selects the yield to maturity of government bonds with a matching term as a proxy, which is 2.5% [8].
5. **Volatility of Asset Returns (σ):** The closing stock price data for a total of 242 trading days from January 2, 2024, to December 31, 2024, are presented in Table 1.

Table 1: Stock Closing Price Data

Date	Closing Price (RMB)	Daily Return
2024-01-02	3.97	-0.0124
2024-01-03	3.98	0.0025
2024-01-04	3.97	-0.0025
2024-01-05	3.88	-0.0227
2024-01-08	3.83	-0.0129
2024-01-09	3.83	0
2024-01-10	3.75	-0.0209
2024-01-11	3.87	0.032
2024-01-12	3.80	-0.0181
2024-01-15	3.76	-0.0105
…	…	…
2024-12-20	5.79	0.0566
2024-12-23	5.38	-0.0708
2024-12-24	5.21	-0.0316
2024-12-25	4.80	-0.0787
2024-12-26	4.91	0.0229
2024-12-27	4.76	-0.0305
2024-12-30	4.48	-0.0588
2024-12-31	4.20	-0.0625

Data Source: RESSET Database.

The standard deviation of daily returns is used to represent the standard deviation of stock returns [9]. The calculated daily volatility of Phylisense is approximately 0.0564. The annual standard deviation of Phylisense's stock returns σ for 2024 is Daily Volatility$\times\sqrt{242}\approx$87.74%. Consequently, the potential value of Phylisense as of December 31, 2024, is calculated to be 1.9632 billion RMB.

This paper utilizes the B-S real options method to estimate the potential value of Phylisense in 2024 at 1.963 billion RMB. This result possesses strong theoretical reference value and explanatory power, serving as a complementary contrast to the company's market capitalization and P/S ratio valuation. From a valuation logic perspective, the real option value reflects the intrinsic value of the enterprise's existing core business and the conservative value of future growth opportunities, excluding factors such as market sentiment, liquidity

premiums, and thematic expectations. In contrast, the market capitalization of 4.704 billion RMB and the P/S valuation of 4.196 billion RMB reflect secondary market trading prices, which include investor expectations, industry trends, and short-term emotional premiums. The discrepancy between these figures suggests that a significant proportion of Phylisense's current market value stems from market expectations and liquidity premiums, whereas the real options valuation aligns more closely with the true intrinsic value of the company's fundamentals. Therefore, the result of 1.963 billion RMB effectively identifies the baseline support for corporate value. When compared with the P/S method and market capitalization, it forms a complete valuation system with robust explanatory power and practical significance for reference.

4. Recommendations

Optimize the Valuation Methodology System for Pre-profit Technology Enterprises. Enterprises should establish a combined valuation model integrating the Price-to-Sales (P/S) ratio method and the real options method to separately calculate existing business value and potential growth value. When selecting comparable companies, priority should be given to firms with similar business structures, R&D investments, and growth stages to avoid blind comparisons across different industries or scales. Simultaneously, key parameters such as volatility and risk-free interest rates should be updated regularly to enhance valuation accuracy.

Strengthen the Synergistic Management of R&D and Revenue. While increasing R&D investment, pre-profit technology enterprises should accelerate the transformation of technological achievements and promote the rapid conversion of patents and technologies into stable revenue to narrow the gap between valuation and actual market value [10]. Companies need to establish a tracking mechanism for R&D investment and revenue growth to reasonably control the R&D expense ratio, thereby avoiding inflated valuations caused by excessive investment and achieving a steady increase in corporate value.

Improve Information Disclosure and Valuation Regulatory Mechanisms. At the regulatory level, information disclosure requirements regarding the R&D progress, patent counts, customer structures, and core technical barriers of pre-profit technology enterprises should be refined to reduce valuation information asymmetry. Enterprises should proactively disclose their valuation methodologies, parameter selections, and underlying assumptions. This transparency facilitates reasonable value judgments by investors and institutions, reducing valuation deviations and investment risks caused by a lack of information.

5. Conclusion

Technology companies occupy an increasingly vital position in China's development blueprint. Simultaneously, due to their high growth potential and unstable early-stage development, many of these firms have yet to achieve profitability. Consequently, the valuation of pre-profit technology companies has become particularly essential. Addressing the current issues in corporate valuation, this paper provides a comprehensive analysis of the difficulties in valuing pre-profit technology firms and an in-depth examination of the limitations of existing valuation methods. To evaluate corporate value, a combined approach integrating the Price-to-Sales (P/S) ratio method and the Black-Scholes (B-S) real options model was selected. This study reaches the following conclusions.

First, the value of pre-profit technology companies is characterized by high growth potential, high volatility, and high latency. These enterprises generally feature high upfront R&D investment and long cycles; transforming professional qualifications into commercial products requires significant time. Market competition and technological iterations further exacerbate the volatility of their corporate value. At the same time, non-physical assets such as core technologies, talent teams, and R&D pipelines are difficult to reflect in financial statements. Therefore, corporate value should not be treated as a simple summation of assets but must be considered comprehensively.

Second, the combination of the P/S ratio method and the B-S model is better suited for the valuation of pre-profit technology companies. The B-S model breaks away from traditional valuation methods centered on cash flow or earnings by focusing more on the potential value of the enterprise. Combined with the P/S ratio method, this approach aligns more closely with the true value of the firm than traditional single-method valuation models.

Finally, the combination of the P/S method and the B-S model possesses practical feasibility. This paper verifies the model using Beijing Phylisense Technology Co., Ltd. as a case study. The valuation results from the P/S method show an error of approximately 15% compared to the annual market capitalization, proving the rationality and reliability of the model.

This paper constructs a combined P/S and B-S real options model, providing a more scientific valuation methodology for pre-profit technology companies. This helps investors make rational decisions and enables corporate leadership to maintain a correct understanding of enterprise development. With the continuous influx of companies in fields such as biopharmaceuticals, large AI models, and semiconductors, this combined model has broad application prospects. Future research could apply this model to more enterprises to evaluate error margins and further optimize relevant parameters. Dynamic adjustments could be made by incorporating factors such as industry life cycles, technological maturity, and R&D conversion rates to adapt to changes in related fields. Additionally, machine learning could be introduced to optimize the variable calculations of the B-S model, enhancing its ability to handle complex valuations and market risks.

Overall, valuation institutions should strengthen their assessment of non-financial indicators for technology enterprises, emphasizing core technologies, talent teams, and management quality. Multi-dimensional evaluation standards adapted for pre-profit technology firms should be established. Meanwhile, technology enterprises should strengthen their core business capabilities, prioritize technological innovation, and proactively manage risks to achieve comprehensive value appreciation.

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The authors declare no conflict of interest.

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