The Application Differences of WACC in Firm Valuation: Technology Industry versus Manufacturing Industry

Xinhe Tian *

Dongbei University of Finance and Economics, Dalian, China

* Corresponding Author Email: vivian3978@outlook.com

Abstract. This paper reviews how the Weighted Average Cost of Capital (WACC) functions across different industries, focusing on a comparison between the technology and manufacturing sectors. It finds that several assumptions behind WACC often do not hold in the tech industry. These firms rely heavily on intangible assets, face higher unsystematic risks, and operate in more uncertain environments. By contrast, manufacturing companies tend to have more predictable cash flows and capital structures that better fit WACC-based models. In addition to highlighting these differences, the paper summarizes several methods proposed in the literature to adjust or improve WACC applications under uncertainty conditions. These include scenario-based forecasting, Monte Carlo simulation, and real options analysis. This paper shows that WACC is not equally applicable across all sectors and that valuation tools must be adapted to reflect the specific characteristics of each industry. this research offers industry-related guidance for financial analysts and valuation practitioners. Such adjustments may contribute to more accurate investment decisions.

Keywords: WACC; applicability differences; technology industry; manufacturing industry.

1. Introduction

Weighted Average Cost of Capital (WACC), has been a crucial indicator in evaluating the overall cost of capital for a firm [1]. Weighting the cost of equity and the cost of debt by their respective proportion in the capital structure, WACC can be utilized in further calculations, such as being the discount rate in Discounted Cash Flow Method (DCF) [1]. It has been commonly accepted by the firms' managers, especially when they use WACC as the hurdle rate for conducting feasibility analysis of projects, or exploring approaches to optimize the capital structure. Under these circumstances, the change of WACC would influence the overall valuation of a firm as an indispensable factor. Although WACC can also be used by external investors, it is primarily applied to internal financial decision making.

However, although WACC is clearly an indicator which has been widely accepted, its applicability may differ in various industries. Generally, WACC is calculated based on the same kind of financial data. According to Daskalakis et al., these financial data would result in distinct effects across various industries, because firm-specific capital structure is heavily related to its industries, corporate financing decisions should be made with industry classification considered [2]. Therefore, studying the various performance of the applicability of WACC in different industries could not only enrich the dimensions of the application of cost of capital, but also provides theoretical support for firms making financial decisions in different or unfamiliar sectors.

Nevertheless, given that most of the research targeting upon WACC focuses on its calculation methods or its theoretical value, there's a lack of systematic reviews concerning its practical applicability across different industries. This difference is extremely evident when comparing the manufacturing industry and the technology industry [2]. Firms in the manufacturing industry hold a high percentage of tangible assets and have a relatively stable annually income, ensuring them rather reasonable WACCs. In contrast, firms in the technology industry face a rather high uncertainty, resulting in an asset-light structure and a fluctuant equity beta. Research indicates that asset tangibility and profitability are essential indicators for financial evaluation in manufacturing sector, while in high-tech sectors, classic indicators are not as vital as growth expectations when it comes to making financing decisions [1]. Furthermore, the usage of WACC is unavoidable subjected to inherent assumptions, such as the market efficiency assumption and the constant capital structure assumptions, which might not hold or reflect the practical risk of high-tech sectors [3,4]. Despite having research on WACC in individual industries, cross-sector analyses, particularly on comparing its valuation applicability in the manufacturing industry and technology industry, are still limited, which this paper aims to address by systematically comparing the applicability and limitations of WACC-based valuation approaches in the technology and manufacturing sectors.

To systematically address the applicability differences of WACC between the manufacturing industry and the technology industry, this paper will examine the issue through four key perspectives. Firstly, the paper reviews the basic concept and the traditional method of calculating WACC, in order to demonstrate the current role and the limitation of WACC. Secondly, it shows the practical use of WACC in the manufacturing industry and the technology industry respectively, highlighting on the performance of WACC and the influence of industry-specific factors. Thirdly, it further discusses the border of the applicability of WACC through the comparison of the characteristics of capital structures, valuation logics, and related financial indicators. Finally, based on the representative conclusions and application scenarios from prior studies, the paper presents a discussion upon the WACC usage under different circumstances, and points out the current gaps as well as the potential directions for further studies, thus contributing to the literature by addressing the lack of cross-sectoral comparisons on the applicability of WACC, offering a structured perspective for both academic research and practical valuation.

2. Application

2.1. The Application of WACC in Technology Industry

According to Tsanacas, technology firms, especially those start-up companies, not only have high growth potential and uncertainty, but also rely heavily on intangible assets, such as data and software, which make them choose a different approach for valuation from other industries [5]. This indicates that numerous technology firms begin with negative earnings, thus lacking a stable and predictable near-term cash flow. Damodaran further points out that these companies should determine their WACC based on their mature stage, rather than based on their current financial data [6]. Under this circumstance, companies are advised to use adjusted WACC, or calculating WACC based on their target leverage [5]. These research shows that in technology sector, what WACC truly estimates is a firm’s future maturity-stage cost of capital, rather than its current financing reality. As a result, WACC is frequently used for IPO valuation of startups, investment decisions in tech-related projects, and the discounting of intangible assets such as patents or user base value [5].

Furthermore, Mattia’s comparative analysis between technology startups and traditional industries suggests that in practice, WACC also functions as a relative benchmark whose meaning [7]. This indicates that when comparing WACC across industries, a different standard should be provided for technology firms.

2.2. The Application of WACC in Manufacturing Industry

Manufacturing firms are generally asset-intensive operations, with a majority of fixed investments, and relatively stable cash flows. These firms are more capable of financing through banks, resulting in more stable capital structures and lower financial risks. This results in the convenience of manufacturing firms to determine the market value directly through the market or their own financial data [2]. In practice, WACC is regarded as one of the most realistic rates, and has been widely used as a discount rate in the DCF method. To be more specific, WACC is normally treated as a firm’s true cost of capital, thus being applied in various circumstances, including equipment acquisition, capacity expansion, mergers and acquisitions, and asset valuation, which reflects its well-established role in manufacturing industries [8].

3. Analysis

3.1. The Background of the Applicability Differences of WACC

WACC was originally established as an overall discount rate for all kinds of firms for capital budgeting, investment appraisal, and corporate valuation decisions [1]. Its fundamental logic is based on the optimal composition of capital structure, balancing the costs of debt and equity financing to reflect the firm's overall cost of capital [1]. However, with the development of technology, the separation on capital structure, approaches on estimation, and the types of risks companies are facing gradually becomes more and more evident by sectors, which questions the overall applicability of WACC. Numerous researchers point out that the differences between industries might influence this. For example, Daskalakis et al. highlight that the determinants of capital structure vary significantly across industries, and industry characteristics have a long-term and fundamental influence on the composition of a firm's WACC [2]. In conclusion, it is industry characteristics which determine the application differences between technology industry and manufacturing industry from the very beginning.

3.2. Key Drivers of WACC Applicability Differences across Indutries

3.2.1. Capital composition difference

In technology industry, intangible assets account for the majority part of assets, while in manufacturing industry, tangible assets account for most of the firm's total capital [2,4,7]. This means that even if a technology company has considerable market value of total capital, its collateral is often limited, thus reducing its access to debt financing, eventually resulting in a higher proportion of equity in the capital structure (i.e., a higher E/V ratio). In short, when calculating WACC, technology companies rely more on E/V ratio, while manufacturing companies rely more on D/V ratio.

Moreover, according to Choi et al., although modern market does recognize the value of intangible assets, it consistently assigns a lower valuation per dollar to them compared to tangible assets, reflecting their greater uncertainty in generating future economic benefits [9]. This finding shows that for firms with a high proportion of intangibles, such as those in the technology sector, estimating risk parameters, such as β_E and r_E, is more challenging.

The research above indicates that in firms with a high proportion of intangibles, the parameters related to assets in WACC may not only be inaccurate, but also make WACC itself depends more on a volatile component ($r_E \times E/V$). Consequently, WACC becomes less reliable and less representative in the valuation of technology firms, especially when compared to the relatively stable capital and risk structure observed in manufacturing industries.

3.2.2. Risk structure difference

In WACC, r_E is calculated through capital asset pricing model (CAPM), and β_E is a crucial element in the formula for measuring risk facing by a firm [1].

However, this method is questioned nowadays, especially in technology sector, given that the underlying hypothesis, which is the dominant risk in every firm should be systematic risk and thus measuring by β_E, is inaccurate. The research of Singh and Bhatia shows that most of the IT companies share an evident characteristic, which is unsystematic risk accounts for a significantly larger proportion than systematic risk [10]. In other words, what risk technology companies face majorly is their very own firm-specific one, which could not be measured by β_E. To be more specific, unmeasured potential result in a lower β_E, leading to a downward bias in the cost of equity (r_E) and eventually an underestimated WACC. This could lead to numerous problems. On one hand, a low WACC makes the firm to appear less risky or more attractive to investors than it actually is, which is an illusion by calculation. On the other hand, it could mislead the firm to assume that equity financing is relatively inexpensive, thus causing capital structure imbalance. As a result, WACC is less reasonable in technology sector.

The situation is entirely different in manufacturing industry. Compared to technology industry, manufacturing firms need to constantly purchase raw materials, which is tightly connected to systematic risk. As Puspitaningtyas points out, systematic risk arises from macro-level conditions and affects many companies across the market, making it a central metric for evaluating investment risk in manufacturing firms [11]. This indicates that manufacturing firms' risk structure combines more closely with the logic of CAPM-based β estimation, thereby making WACC more applicable and stable in this sector.

3.2.3. Model applicability difference

In practice of utilizing WACC, substantial differences in model applicability exist across industries. Traditional valuation models, such as DCF, have been widely and effectively applied in the manufacturing sector. However, in the technology industry, these models often face systematic challenges, including parameter estimation difficulties and model logic breakdowns, indicating limited applicability in this sector.

Damodaran points out that WACC is one of the four fundamental logic elements when applying DCF, but he also implies that DCF itself might be unreliable due to the characteristics of technology sector [6]. According to Damodaran, most of the technology companies do not have enough public market data for calculating β [6]. Furthermore, due to the volatile cash flows of technology firms, computing future cash flow by WACC is unrealistic [6]. Hence, under these common circumstances of technology firms, WACC ceases to be a reliable benchmark and becomes a source of strategic error [6].

Tsanacas further points out that the approach of growth of technology companies is different from traditional hypothesis [5]. While manufacturing industry and other industries generally have linear growth patterns just as the classic assumption of WACC, platform-based technology firms exhibit nonlinear growth patterns [5]. In such cases for the technology firms, the assumption of a constant capital structure, which is a base for WACC, is no longer valid.

The regression-based comparison of Tobin's Q and debt-to-equity (D/E) ratios across sectors conducted by Mattia shows that in traditional industries, such as manufacturing industry, firm value is positively correlated with leverage, implying that the use of debt in reasonable in WACC; in contrast, in technology firms, this correlation is either negative or statistically insignificant, suggesting that lowering WACC does not improve firm value [7]. This finding challenges the applicability of WACC-based valuation frameworks in the technology sector and underscores the need for more adaptive modeling approaches.

3.3. Strategic Responses to the Applicability Differences of WACC

3.3.1. Enhancing capital structure estimation

In the technology firms which are dominated by intangible assets, they often face challenges as listed above in estimating capital structure. To address these issues, several researchers have proposed alternative strategies.

Klobucnik and Sievers introduce the Schwartz-Moon model, an approach of evaluation only based on key accounting financial statements variables such as revenues, expenses, and capital investment [4]. This shift away from market inputs reduces the dependence on highly volatile equity values, which often are shown as E/V ratios in technology firms. The model itself is also dynamic, which depicts a more realistic status quo of technology firms. Moreover, by introducing convergence toward industry-level financial norms, the model ensures that the construction of synthetic capital structure ratios, even when debt or equity market values are unreliable.

Li et al. further emphasize that a multi-valuation approach should be introduced when evaluating. They combine relative valuation metrics (such as P/E, P/B, and PEG) with absolute valuation models (e.g., DCF) to triangulate firm value in contexts where debt or equity market values are unreliable [8]. This strategy helps smooth volatility and offers a solution when direct observations of capital structure components are unavailable or unstable.

3.3.2. Adjusting risk estimation

A crucial problem in tradition WACC formula is that r_E cannot measure unsystematic risk. This problem is especially significant in technology firms, where their dominant risk is firm-specific one, such as innovation failure, regulatory uncertainty, and business model volatility.

To address this problem, several methods have been proposed. One recommended approach is utilizing multi-factor asset pricing models, such as the Fama-French three-factor. By taking factors such as firm size, book-to-market ratio, profitability, and investment activity into consideration, these models handle the risk of the firms more comprehensively than CAPM [12]. Li and Duan's research data indicates that such models improve explanatory power in volatile or crisis conditions, which resemble the uncertainty often presents in the technology sector [12]. Thus, replacing CAPM with multi-factor models can enhance the robustness of r_E estimation in firms exposed to high unsystematic risk.

Another approach can be using adjusted or total β value, which adjust traditional beta coefficients to reflect investor perspective. Given that this approach adjusts the β to a firm-specific level, it is more suitable not only for start-up technology firms, but also for private manufacturing firms, according to Damodaran [6]. This is the approach which can theorotically evaluates all kinds of risk a firm could be facing, thus eliminating the problem of excluding unsystematic risk.

3.3.3. Adapting other discounting methods

For addressing the problem that traditional DCF method often fail when valuing technology comapnies, Damodaran and Tsanacas propose several methodological refinements that improve the adaptability of discounting frameworks.

Damodaran recommends scenario-based valuation methods [6]. Instead of adjusting the discount rate directly, these approaches estimate a firm's possible success and failure separately, and then combine them probabilistically [6]. This method allows firms to assign probability distributions to critical variables, simulate alternative performance paths, and estimate the expected value under different circumstances, which presents a new path for technology companies to estimate their future cash flows.

While Damodaran focuses on adjusting WACC via survival-adjusted probabilities, Tsanacas further argues that maybe utilizing adjusted WACC or other models may be insufficient for capturing qualitative advantages in platform-based tech firms [5]. He suggests that qualitative scorecards that evaluate switching costs, brand equity, and network effects should be introduced to test whether the valuation output aligns with observed competitive positioning.

4. Conclusion

4.1. Summary of Key Findings

This paper conducts a literature review on the application differences of Weighted Average Cost of Capital between technology industry and manufacturing industry by comparing its performance. Through an analysis of capital structure difference, risk characteristics, and related model applicability by synthesizing theoretical and empirical studies, this paper identifies several distinctions:

In capital composition aspect, technology firms, which are dominated by intangible assets in general, often lack debt financing, contributing to the fluctuation of WACC, while manufacturing firms have more consistent and leverage-driven structures.

In risk characteristics aspect, technology firms prone to encounter firm-specific and unsystematic risks, which cannot be measured through WACC, while the major risk manufacturing firms face is systematic one, which can be measured comprehensively through WACC.

In model applicability aspect, the characteristics of technology sector led to several basic assumptions of WACC ceasing to be valid, while the manufacturing sector generally aligns well with these assumptions.

In addition to identifying these limitations, the paper also summarizes several possible adjustments to enhance WACC applicability in technology industry.

4.2. Theorotical and Practical Implications

From the theoretical perspective, this paper summaries the aspect of differences when utilizing WACC in technology industry and manufacturing industry, which offers a reference framework grounded in industry-specific differences for future developments in valuation theory. From the practical perspective, this research offers industry-related guidance for financial analysts and valuation practitioners. Such adjustments may contribute to more accurate investment decisions.

4.3. Limitations and Future Research Directions

This paper is based on a structured literature review and focuses on two representative industries: technology and manufacturing. Hence, the paper lacks directly empirical testing with firm-level data, such as testing the applicability of WACC in technology companies like Apple or Samsung.

Future research may broaden this scope to other industries, given that some problems discussed in this paper are not solely encountered in technology sector. There may also be other constraints that could influence the applicability of WACC in other fields.

References

[1] Farber, A., Gillet, R. L., Szafarz, A. A general formula for the WACC. International Journal of Business, 2006, 11(2).

[2] Daskalakis, N., Kakavas, A., Missiakoulis, S. Do industry differences affect firm-specific capital structure determinants? The European Journal of Finance, 2023, 29: 1705–1715.

[3] Carluccio, J., Mazet-Sonilhac, C., Mésonnier, J.-S. Private firms, corporate investment and the WACC: evidence from France. The European Journal of Finance, 2023, 29: 86–110.

[4] Klobucnik, J., Sievers, S. Valuing high technology growth firms. Journal of Business Economics, 2013, 83(9): 947–984.

[5] Tsanacas, D. Valuation challenges in high tech platform-based corporations. International Journal of Economics and Business Administration, 2022, 10(1): 89-100.

[6] Damodaran, A. Valuing young, start-up and growth companies: estimation issues and valuation challenges. SSRN Working Paper, 2009.

[7] Mattia, A. Capital structure optimization and firm value: a comparative analysis of technology startups and traditional industries. International Journal of Commercial Research and Development, 2024.

[8] Li Zirou, Tan Kaijie, Yang Xi. Valuation of the IoT industry based on relative and absolute valuation method. Proceedings of the 7th International Conference on Economics, Management and Green Development, 2023.

[9] Choi, W. W., Kwon, S. S., Lobo, G. J. Market valuation of intangible assets. Journal of Business Research, 2000, 49: 35–45.

[10] Singh, S. P., Bhatia, R. Beta factor, systematic risk and unsystematic risk: a study of prominent companies of IT and banking sector. Management Dynamics, 2014, 14(1): 16–29.

[11] Puspitaningtyas, Z. Estimating systematic risk for the best investment decisions on manufacturing company in Indonesia. Investment Management and Financial Innovations, 2017, 14(1): 46–54.

[12] Li Kanlong, Duan, Yanjun. Research on the application of Fama and French three-factor and five-factor models in American industry. Journal of Physics: Conference Series, 2021, 1865: 042105.