



A Research on Valuation Models in Private Equity Investment

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Abstract. This paper aims to study the valuation models and build a valuation model taking the macroeconomic variables into consideration to assess the value of the startups. This research method uses the Fisher equality and DCF three-stage model, then build a cluster model taking account of the inflation rate, based on the analysis of the trend represented with the inflation rate data in the past twenty year. At last the paper used the real data and build valuation models and pose a contrast between traditional DCF three-stage model and Fisher DCF three-stage model. The results show that the macroeconomic variables have an import effect on the value evaluation of startups, and the private equity will not suffer too much risk and cost of the capital, the startup will have an objective evaluation based on the free cash flow and macroeconomic environment. The research also provides an idea for startup valuation from another perspective. More consideration of macroeconomic variables that are relatively easy to evaluate and predict, and can not only improve the accuracy and stability of valuation, but also increase the probability of success for both parties to the transaction.

Keywords: Private Equity Funds · Valuation model · Discounted Cash Flow · Startup · M2

1 Introduction

Private Equity Funds (PE), which have existed for over a century in countries such as Europe and the United States, were first introduced in China in 2004 [1]. Private equity investment plays a vital role in the financial industry, particularly in terms of financing channels and venture capital. With the rapid development of the Chinese economy, PE funds in the investment market have experienced exponential growth. Private equity investment has gradually evolved from providing venture capital to small and medium-sized enterprises to enterprise restructuring and mergers and acquisitions, and eventually to IPO financing. Its impact on the national economy is becoming increasingly significant, and many well-known companies have grown stronger, while private equity investment has also gained substantial returns.

At the same time, when private equity investment firms were first established in China, they adopted various management and operational models from Europe and the United States. However, due to significant differences in thinking, market environment,

and political ecology, it became necessary to adjust the operating models [2]. The private equity industry has since transitioned from subjective judgment and past experience of investors to quantitative methods to assess the valuation of companies, making the study of reasonable company valuations an important focus. Valuation model of a startup's worth has thus become crucial in determining private equity investment success. However, past valuation models relied on traditional classic valuation theories and failed to provide in-depth and comprehensive attention and research on the macroeconomy, leading to implementation difficulties in China. This article focuses on studying the enterprise valuation model in private equity investment and addressing relevant issues concerning company valuation.

2 Literature Review

According to Almeida, firms that are highly sensitive to cash flow face fewer constraints [3]. Furthermore, some scholars argue that cash flows provide information about investment quality and investment quantity. Although stable cash flows can receive consistent investment, investors with different funding pressures and risk preferences conduct comprehensive valuations based on comparative methods after assessing cash flows [4]. Valuation models based on the discounted cash flow (DCF) are recommended by previous studies because of the importance of cash flows for the development of startups [5]. DCF has become the preferred option for startups with low income but high growth expectations, as it can be applied in such cases. However, some scholars argue that reasonable assumptions, expected future cash flows, and risk-adjusted interest rates are required when using DCF to judge enterprise valuation [6]. These variables often require subjective judgments based on experience from the private equity. However, the focus of this research is not to exclude these subjective judgments, but rather to add other variables or data based on existing data to improve the accuracy and precision of the valuation. Therefore, if macroeconomic variables are considered in the valuation model, the startup valuation will be more accurate, increasing the utilization of funds, lowering funding costs, increasing profits, and promoting social and economic development. Krishna et al. improved the accuracy of revenue forecasts for startups by simultaneously considering macro variables, demonstrating a significant correlation between expected revenue growth and macro data [7].

Currently, scholars' attention to the valuation of start-up companies is still insufficient. This is mainly because the valuation of start-up companies involves many difficulties, and there are also many shortcomings in the research of investment decision-making regarding company valuation by investors. Generally, investors consider multiple factors when evaluating the value of a company. First, the valuation of a start-up company depends not only on its cash flow, but also on the investor's risk preference. The valuation of a start-up company often comes from interested investors, which provides funding for faster development. At the same time, private equity is often not involved in company management, but focuses more on investment returns [8]. Private equity tends to focus on risk investment and risk control, pursuing high-risk benefits on one hand, and using IPOs as a funding exit channel in the future, while also paying more attention to macro-environmental changes, such as M2 growth rate, and the impact on its cost of funds, thus introducing risk bias to the valuation of the company.

There are generally four commonly used valuation models in start-up company evaluations: discounted cash flow model, profit multiplier model, net asset model, and venture capital model [9]. These methods all require the support of accounting data. For example, the DCF method requires company cash flow data, which is also highly valued by many private equity funds. The profit multiplier model, as well as the net asset model, often require a large amount of accounting data, financial data, and historical asset-liability data, which is somewhat difficult for start-up companies. Therefore, this article focuses on the cash flow-based valuation model, starting from the perspective of private equity and focusing on the impact of macroeconomic variables on cash flow valuation, thereby improving the optimization space of the valuation model.

3 Methodology

It is well known that private equity (PE) firms tend to prefer established companies with a certain scale and stable cash flow. PE investments also have a relatively long horizon, typically lasting for more than three years, and are less liquid. PE firms do not get involved in ownership disputes of the companies they invest in; they only act as financial investors. Therefore, cash flow becomes a crucial factor in their investment decisions. Under the principle of cash flow, the value of a company today is determined by the present value of expected cash inflows and outflows over the entire remaining life of the equity assets, using an appropriate discount rate.

The discounted cash flow (DCF) method involves projecting the future free cash flow of a startup and estimating a rate of return on investment, known as the discount rate [10]. Due to the high risk associated with investing in startups, a high discount rate is typically applied. These future free cash flows are then discounted to their present value described in Eq. (1).

$$V = \sum \frac{CF}{(1+r)^t} \quad (1)$$

where V refers to the company value, CF refers to the expected cash flow, and r is the discount rate, known as the weighted average cost of capital, t is the number of years into the future which the cash flows are expected.

Take into consideration the growth rate of the cash flow, and the formula of the perpetual grow model is described following:

$$TV = \frac{FCF_1}{r-g} \quad (2)$$

where TV refers to the terminal value of startup after $t - 1$ years, and FCF_1 is the free cash flow next year, just known as the cash flow in the specific year. And r is the weighted average cost of capital, and g refers to the perpetual growth rate. However, it's difficult for a company to keep grow forever, and the formula should be used carefully.

However, perpetual growth is not realistic. In many cases, a company begins with an expansion and super-growth phase, but then enters a stable growth phase. Therefore, the

Eq. (3) illustrates that a two-stage growth method can be used to calculate the enterprise value:

$$V = \sum_{t=1}^{t=n} \frac{FCF_t}{(1+r)^t} + \frac{FCF_{n+1}}{(r-g)(1+r)^n} \quad (3)$$

where FCF_t is the cash flow in year t , and g refers to the perpetual growth rate, r is the weighted average cost of capital.

If we consider the reality of decreasing growth rates after a certain stage, the formula will be Eq. (4) described below:

$$V = \sum_{t=1}^{t=n} \frac{FCF_t}{(1+r)^t} + \sum_{t=n+1}^{t=n+m} \frac{FCF_t}{(1+r)^t} + \frac{FCF_{n+m+1}}{(r-g)(1+r)^{n+m}} \quad (4)$$

where n is the years of first phrase, and m is the years of second phrase, the last part is the terminal value after $n + m$ years.

In summary, current models have little consideration for the impact of macro factors, and many models use variables like “ r ” to crudely summarize macro variables that can be predicted or estimated more accurately. Additionally, current cost of capital calculations depends more on the market value of equity and debt, as well as the tax rate, without taking into account macro variables such as inflation rate and M2 growth rate. In the future, we will introduce macro data variables and construct a three-stage DCF valuation model based on macroeconomic factors to make the valuation model more accurate in its predictions.

4 Fisher Discounted Cash Flow Valuation Model

Based on the more general DCF model, macroeconomic variables are taken into consideration. In order to measure inflation, M2 growth rate, and other pricing factors, we use the Fisher Equation [11], which represents the quantitative relationship between national income level, price level, and money supply, to optimize the model. The Fisher equation is a commonly used method to evaluate macroeconomic data, which was proposed by Irving Fisher, and focuses on estimating changes in the price level based on the total amount of money in circulation and the speed at which it circulates [12]. The Eq. (5) is as follows:

$$M * V = P * T \quad (5)$$

where M represents the supply of money, V represents the velocity of money, P represents the price level, and T refers to the volume of transactions in one country.

In other words, if the supply of money increase by 10% year over year, the velocity of money keeps the same as before, and the volume of transactions keep growing by 5% annually, and we can calculate the price level, which will grow by about 4.7% increase annually. And the variable M is relatively easier to predict than the growth of cash flow and cost of capital in a startup. So that, we collect the growth rate of broad supply of

money and inflation rate in the past twenty years from China to analyze the trend and changes.

According to the data in the Table 1, draw a line chart. From the chart, as Fig. 1, we can see that no matter how the money supply changes over the years, the government will take actions to control and manage the inflation rate [14], keeping it within a small range of fluctuation. Therefore, taking the inflation rate into account in the DCF three-stage model will greatly improve the accuracy and predictability of the model’s valuation.

Then we take the inflation rate into DCF three-stage model, and constructing a DCF three-stage model based on the Fisher Equation, also called FDCF model. The formula of the model is shown as Eq. (6):

$$V = \sum_{t=1}^{t=n} \frac{FCF_t}{(1+r-i)^t} + \sum_{t=n+1}^{t=n+m} \frac{FCF_t}{(1+r-i)^t} + \frac{FCF_{n+m+1}}{(r-g)(1+r-i)^{n+m}} \quad (6)$$

where *i* represents the inflation rate. If there are different inflation rate in every year, the variable *i* will be different.

Table 1. Cost comparison

Year	M2 Growth Rate (%)	Inflation Rate (%)
2002	13.14	-0.73
2003	19.24	1.13
2004	14.89	3.82
2005	16.74	1.78
2006	22.12	1.65
2007	16.74	4.82
2008	17.78	5.93
2009	28.42	-0.73
2010	18.95	3.18
2011	17.32	5.55
2012	14.39	2.62
2013	13.59	2.62
2014	11.01	1.92
2015	13.34	1.44
2016	11.33	2.00
2017	8.11	1.59
2018	6.99	2.07
2019	8.88	2.90
2020	10.01	2.42

Source: www.stats.gov.cn [13]

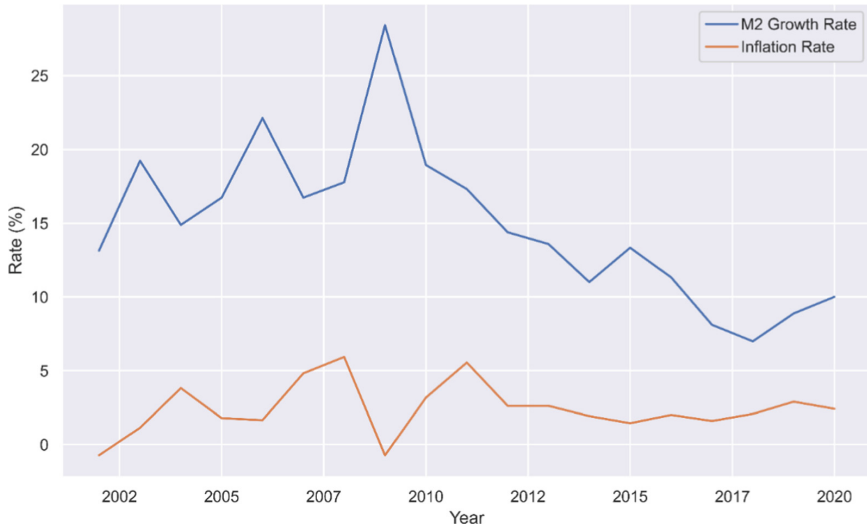


Fig. 1. Inflation Rate and M2 Growth Rate plot

5 Results and Discussion

We combine the existing data and select the cash flow situation of A Company in China from 2015 to 2022 to perform valuation calculations using the model. We used 2015 as the base year for enterprise valuation calculations. At the end of 2015, the company had approximately 10 million yuan in free cash flow, and in the following three years, the free cash flow maintained a growth rate of 15% per year. However, between 2019 and 2020, the growth rate of free cash flow slowed down to 10% for two years. In 2021 and 2022, the annual growth rate remained at 2% according to the estimated prediction from the company’s management, as the Chinese economy gradually moved from a high-growth model to a stable-growth model. According to relevant calculations, the company’s cost of capital discount rate has remained around 10% over the years from 2015 to 2022, and the Chinese inflation rate has fluctuated around 2.5%. Based on the above company data, we constructed an FDCF model.

Values in bold show the total value of startup; Unit: million RMB.

Table 2. Value evaluation models comparison

Value	DCF(3-stage)	FDCF(3-stage)
Present value(1-stage)	32.81	32.87
Present value(2-stage)	22.85	22.92
Present value(3-stage)	145.68	142.54
Value of startup	201.35	198.35

From this result shown in Table 2, we can see that after introducing the inflation rate, the enterprise valuation is lower compared to the traditional three-stage method, but this valuation is more precise, and investors' cost of capital can be more effectively utilized. Here, we only used a relatively stable inflation rate for valuation. If there are changes in the economic environment and a higher inflation rate occurs, the enterprise valuation will differ significantly. Therefore, it is necessary for investors to pay more attention to the introduction of macro variables into the valuation model.

6 Conclusion

Overall, this study aims to research the enterprise valuation model based on free cash flow, and builds a three-stage DCF model that incorporates macroeconomic variables to evaluate enterprise value, providing new ideas in the field of enterprise valuation. The paper systematically reviews the classic valuation methods for startups, discusses cash flow valuation, analyzes several influencing factors, focuses on the changes in macroeconomic variables during the enterprise development process, and refers to the Fisher equation's impact on commodity value. The paper conducts trend analysis on the easily estimable and predictable macro variable, inflation rate, and introduces DCF model to construct a FDCF valuation model based on the Fisher equation. Finally, using the company's cash flow data and the inflation rate at that time, valuation calculations are carried out, and the differences between the two valuation models before and after introducing inflation rate are compared. It can be found that macroeconomic variables are easier to estimate compared to microeconomic cash flow data and macroeconomic environment will have an impact on the cash flow and valuation of enterprises. In the future, we need to focus on the impact of macroeconomic variables on cash flow and the impact of other macro variables on enterprise valuation models, in order to optimize and expand the valuation model, provide more accurate solutions for enterprise valuation, and provide equal communication for investors and companies.

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