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Impact of Capital Structure and Its Changes on the Value of Companies Obtained Through the Discounted Cash Flow Formula

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Abstract

The thesis aims to address the issue of using improper weights of equity and debt in Weighted Average Cost of Capital in the Discounted Cash Flow to Firm valuation technique. In theoretical part I present the textbook derivations of the discussed method and algebraically show the necessity of using target market value of equity in Weighted Average Cost of Capital for this method to lead to unbiased results. Furthermore, I argue that in practice current market value of equity is more than often used instead of target value. In practical part I then try to quantify the biases which may stem from using improper weights for equity. I model resulting biases based on variables such as Return on Invested Capital and growth profiles. I find that in my modeling the level of relative bias gets ceteris paribus larger with lower Return on Invested Capital and larger relative difference between target value of equity and value of equity used in Weighted Average Cost of Capital.

Keywords

Metoda diskontovaných pěněžních toků, Vážený průměr nákladů kapitálu, Struktura kapitálu, Valuační metody, Výkonnost investovaného kapitálu, Vlastní jmění

Range of thesis: approximately 74 000 symbols

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

2. The author hereby declares that all the sources and literature used have been properly cited.

3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague … 13th July 2020 Jakub Chyba

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Bachelor thesis proposal

Bachelor's Thesis Proposal

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Research question and motivation

Well-functioning financial markets are crucial for healthy economy (Wurgler 2000). Therefore, it is essential for investors to value public companies as precisely as possible to create welfare for themselves and society as a whole. For determining the correct prices on the financial markets, the theory provides many methods and formulas (Kaplan and Ruback 1995). It follows that these methods should lead to the same result and the true intrinsic value. Yet in practice we usually observe that different methods lead to different results due to complexity of the task (Damodaran 2006).

In concurrent world the most used method for valuing companies is Discounted Cash Flow (DCF), using Free Cash Flow to Firm (FCFF) approach (Lundholm and O'Keefe 2001). This formula is derived from the DCF using Free Cash Flow to Equity (FCFE) (Koller, Goedhart and Wessels 2010). Yet for the two models to be equal and for the FCFF approach to lead to correct results two important assumptions must hold: i) target value of equity must be used in Weighted Average Cost of Capital (WACC), ii) capital structure must remain constant over time.

Indeed, if both assumptions are met, then both formulas should lead to the same results (Fernandez 2004). But in practice, these assumptions are often broken even by professionals, leading to incorrect results in valuation. (Steiger 2010). Indeed, this evidence of not-properly used formulas can be often seen in the research notes by investment analysts with rounded WACC discount rates.

My thesis aims to study this very phenomenon of the valuation through DCF using Free Cash Flow to Firm and its validity. I look into the capital structure changes at publicly listed companies and study how they influence target prices issued by covering analysts.

Contribution

There is a plenty of research on the Discounted Cash Flow and various valuation methods in general. Yet the research on the DCF using the Free Cash Flow to Firm as compared to the Free Cash Flow to

Equity is almost non-existent. I aim to study whether and to what extent the valuations by DCF using Free Cash flow to Firm are affected by capital structure and its changes. Consequently, my aspiration is to establish whether market participants should use rather the Free Cash Flow to Equity method instead.

The results should provide further insight into the functioning of valuation methods. If the hypothesis that changes in capital structure meaningfully influence target prices of publicly listed companies valued through DCF with FCFF approach would prove true, then the findings could lead to the shift in the preferences of valuation methods used by the wide investing community.

Methodology

I use Thomson Reuters Eikon to determine the capital structure of a group of publicly listed companies. I aim to match it with target prices issued by covering analysts for respective stocks. This enables me to make a regression for time series data to examine the influence of changes in the capital structure on the target prices over time.

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1. Introduction

To start broadly, I would argue that properly functioning capital markets are critical for well-functioning market based economy. It is so as they provide key macroeconomic functions such as allocation of resources and risk management. And indeed, if they do their job properly they play important part in achieving efficiency in the whole economy.

Yet, for the capital markets to perform their task well, adequate price discovery mechanism needs to be available. In that regard, over the time there has been done a meaningful work in the area of valuation methods, which should provide a way to value streams of cash flows spread over time and assign reasonable prices.

This situation is actually no small achievement as for meaningful period of time rather than fundamental value finding approaches various other drivers were moving the markets, which led to high volatility and significant differences between market and intrinsic values. This in turn had negative implications for overall economy.

Still, over the time various methods were developed with focus on finding intrinsic value in the underlying businesses and thus fundamental valuation approach took over the markets.

In this area many techniques were presented, among them Multiple based approaches, an idea of connecting company's performance metrics such as Sales or Earnings per share to its market value represented by for example by Enterprise value or Share price. The ratio of these two levels can be then used for very rough estimate of fundamental value in the stock. Yet as every company is different, it is not easy to use this approach well and one needs to take into account various other variables when looking at such multiples.

Other approaches centered around a notion of finding one right value for given stream of cash flows subject to some assumptions. Notable examples here include Economic Value Added, Discounted Cash Flow to Equity and Discounted Cash Flow to Firm. Among them Discounted Cash Flow to Firm method has been established as go to valuation technique in practice and is widely taught in Company Valuation classes in academia.

In the area of the more advanced valuation techniques meaningful amount of research has been published. Yet as these methods are often complex and difficult to use properly there is still a significant amount of issues, which should be properly discussed and addressed. Moreover, this task is not unimportant as this discussion could contribute to better pricing of instruments on capital markets, a phenomenon hopefully beneficial to efficiency in the overall economy.

In this thesis I aim to address one of the major points regarding the usage of Discounted Cash Flow to Firm. I intend to look into proper calculation of Weighted Average Cost of Capital (WACC), a variable, which plays instrumental part in Discounted Cash Flow to Firm method.

Particularly, I look into the issue of using proper weights for equity and debt in Weighted Average Cost of Capital formula. Notably, there has been some work done in the area by Mr. Fernández. Yet, as the issues in this field are meaningful I aim to build beyond his work and address one of the deeper issues remaining in the field.

The particular issue I tackle is the usage of current market values for equity instead of target market values in Weighted Average Cost of Capital formula. Indeed, I argue that this phenomenon is meaningful problem as practitioners often use improper weighting in Weighted Average Cost of Capital as pointed out by Bancel and Mittoo (2014)[1]. This in turn can lead to erroneous discount rates and biased results from the whole valuation process.

I consider the most important contribution of my thesis in its theoretical part. There I present textbook derivations of Terminal value of Discounted Cash Flow to Firm formula and algebraically show the necessity to use target market value of equity in Weighted Average Cost of Capital for it to lead to unbiased results.

To further explain myself, by target market value of equity I mean the amount, which is obtained as a result of the valuation process performed by Discounted Cash Flow to Firm approach. This might seem nonsensical as I effectively argue for the need to input variable during this process, which is obtained at the end of this process.

This is actually addressed in another part of this thesis. There I mention Solver function of Microsoft Excel, which is able to tackle this issue and I describe an example how to apply this function in valuation. Thus that part can be used as an advice for how to tackle this issue in practice.

In the practical part of this thesis I try to model possible amounts of resulting biases, stemming from the usage of improper weights in Weighted Average Cost of Capital. For this purpose I design set of financial models and perform their valuation through Discounted Cash Flow to Firm method both with and without target market values of equity used in Weighted Average Cost of Capital. Afterwards I look at resulting target values of equity and compute relative differences between results from models with and without target market values used in Weighted Average Cost of Capital. I present these results as relative biases stemming from usage of improper weights in WACC.

Notably, I use set of financial models, which are not based on numbers from any real companies. My argument for using set of theoretical businesses instead of real ones would be following. First, as the valuation task concerns an appraisal of future cash flows, it might be impossible to determine what is the exact consensus for any given company and what the market is pricing in. Thus, by modeling real companies I would more than likely not be able to produce reliable results of resulting biases. Second, it would be uneasy to find companies with intended combinations of levels at underlying financial metrics and by modeling real companies I would likely limit the scope of applicability of my results. On the other hand, when I model theoretical businesses I can try to design them to be relevant to hopefully large number of real world companies.

Regarding the set of my theoretical companies I design nine different businesses based on variables such as Return On Invested Capital (ROIC) and growth, which could then be possibly representative of various business profiles from real world.

That being said I would mention my hypothesis that the usage of improper weights in Weighted Average Cost of Capital can often lead to larger than 10% biases in comparison to the unbiased target value of equity. Moreover, I would expect that in more extreme cases the bias can be even significantly larger than stated 10%.

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[1] Bancel, Franck, and Usha R. Mittoo. 2014. “The Gap between Theory and Practice of Firm Valuation: Survey of European Valuation Experts.”

Additionally, in the case that the value of equity used in valuation is lower than target value of equity (typical situation in my opinion) I would expect the resulting biases to be positive. The rational here would be that cost of equity is typically larger than cost of debt at given company. If one then uses lower value of equity in WACC compared to the value he should use, I would assume it leads to lower weight for equity in the formula and thus lower level of the whole WACC. That said, I would argue that lower than appropriate discount rate should then lead to positive biases in resulting target values.

To recapitulate, I aim to address one of the outstanding issues in valuation practice. I use both theoretical approach, where I algebraically show the necessity of using proper weights in Weighted Average Cost of Capital and argue that it is necessary to use target market values of equity and debt here for the Discounted Cash Flow to Firm method to lead to unbiased results. I follow with practical part, where I estimate the possible biases, which might stem from using other than target values of equity in Discounted Cash Flow to Firm valuation method.

The work in this area could contribute to more precise valuation and pricing of equity instruments on financial markets, which in turn could lead to greater efficiency in overall economy.

2. Literature review

2.1. State of knowledge

Over time, there have been invented many methods intended to derive absolute valuation of a firm, investment project, etc. Still it might seem that there is currently only one dominant method used by practitioners to value companies in concurrent world. This method is known as Discounted Cash Flow to Firm (DCFF) and taught at vast majority of core valuation courses at academia. Yet there are also other methods which can be sometimes seen in use such as Economic Value Added (EVA), Residual Income (RI), Discounted cash Flow to Equity (DCFE) and others.

In the academic literature and their theoretical derivations these methods should under certain assumptions lead to the same value, which should itself be the right evaluation of the investor's expectations for the given company. Yet as these methods are often at least time demanding and possibly complicated to use properly, it is common that in practice investors receive various results from various valuation methods as mentioned by Lundholm and O'Keefe (2001)[2].

This is the case as these methods usually require upholding certain assumptions, which can meaningfully complicate the valuation process. Plenborg (2002)[3] claims that when investors try to simplify these assumptions, they usually introduce a bias to the valuation method.

This phenomenon of improper valuation can be considered as unfortunate as it can increase inefficiencies present in the economy and have various spillover effects. Interestingly, there is a research paper by Dong, Hirshleifer, Richardson and Teoh (2006)[4] finding some evidence that misvaluation can be a factor in the takeover market for example, thus showing one undesired effect of this problem. This underscores the need for method(s) leading to unbiased target value for equities.

As some of the widely known absolute valuation methods are Discounted Cash Flow to Firm, Economic Value Added and Residual Income method, there exists various research showing that these methods should under given assumptions lead to the same values. Yet when investors in practice relax these assumptions, they receive different results.

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[2] Lundholm, Russell J., and Terry O'Keefe. 2001. "Reconciling Value Estimates from the Discounted Cash Flow Model and the Residual Income Model." Contemporary Accounting Research 18 (2): 311–35.

[3] Plenborg, Thomas. 2002. "Firm Valuation: Comparing the Residual Income and Discounted Cash Flow Approaches." Scandinavian Journal of Management 18 (3): 303–18.

[4] Dong, Ming, David A. Hirshleifer, Scott A. Richardson, and Siew Hong Teoh. 2006. "Does Investor Misvaluation Drive the Takeover Market." Journal of Finance 61 (2): 725–62.

As mentioned by Garvey and Milbourn (2000)[5] this with time led to discussion of which of these methods to use when valuing companies. Moreover, plenty of research has been written in situation of differing valuation estimates obtained by investors improperly using these methods. This research is often centered around showing that when used properly, under given assumptions, these methods should lead to the same value estimates and thus the errors were made at the side of investors. This way Discounted Cash Flow to Firm remains the go to valuation technique taught at universities and used in practice.

Notably there can be found a paper by Tham (2001)[6] analyzing the use of Residual Income method and showing its equivalence to Discounted Cash Flow when used correctly. Similarly there are papers written on the use Economic value added and Discounted Cash Flow. It is argued that the main reasoning whether to use one or the other should be centered around the value drivers used in each of the models and investors decision which one to focus on. This is valid reasoning as the estimated value assigned to the company to large extent follows the projections for the leading value drivers used in the valuation.

I might mention another method called Dividend discount model. This model and its limited use by concurrent practitioners highlight the importance of a close link between valuation method and the value driver used. As the Dividend Discount model derives the valuation target from the forecasted dividends, it has been considered inferior to Discounted Cash Flow to Firm, etc. as dividends are not considered a true value driver as they can be highly influenced by managers. Validity of this reasoning has gained strong support with time as US companies has been shifting to share buybacks instead of dividends for payouts to their shareholder thus introducing large problem for classic Dividend Discount model valuation.

Yet our interest lies in the comparison of usage of Discounted Cash Flow to Firm and Discounted Cash Flow to Equity. Although in theoretical background Discounted Cash Flow to Firm can be seen derived from Discounted Cash Flow to Equity method, in practice Discounted Cash Flow to Equity is typically seen less often and its usage is usually substituted by Discounted Cash Flow to Firm.

Interestingly, even though in its theoretical derivation Discounted Cash Flow to Firm should under some assumptions lead to the same results as Discounted Cash Flow to Equity, this can be overlooked even by researchers and there can be found a paper by Vlaović-Begović, Momčilović, and Jovin (2013)[7], which commits the error of improperly treating the discounting rate in Discounted Cash Flow to Firm and thus deriving biased estimate for the valued firm.

As this error of improperly treating discount rate in DCF to Firm can be seen even in the research, it is very common in practice as investors often use market value instead of

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[5] Garvey, Gerald T., and Todd T. Milbourn. 2000. "EVA versus Earnings: Does It Matter Which Is More Highly Correlated with Stock Returns?" Journal of Accounting Research 38: 209–45.

[6] Tham, Joseph. 2001. "Equivalence between Discounted Cash Flow (DCF) and Residual Income (RI)."

[7] Vlaović-Begović, Sanja, Mirela Momčilović, and Slobodanka Jovin. 2013. "Advantages and Limitations of the Discounted Cash Flow to Firm Valuation." Škola Biznisa 2013 (1): 38–47.

target value of equity in Weighted Average Cost of Capital (WACC) thus introducing bias into their models.

Regarding the Weighted Average Cost of Capital itself and its usage in Discounted Cash Flow to Firm method there has been written quite a lot. This is expected as WACC value is usually one of the two most important determinants in the Discounted Cash Flow to Firm valuation besides Free Cash Flow itself. This can be often implicitly acknowledged by analysts who provide so called sensitivity tables often including WACC levels.

Yet the existing research focuses mainly on the locations, sizes of the firms and effects of these phenomena on the Weighted Average Cost of Capital, on the information flow and analysts' coverage and other technicalities and their implications for the discount rate.

For example, there has been published research by Easley and O'hara (2004)[8] arguing that higher levels of private information can have effect on a return investors require on a given stocks. Moreover it is claimed that accounting methods can also influence the required rate of return. This is nicely summarized in another paper by Chen, Chen, and Wei (2011)[9], which looks into the whole matter of shareholder rights and finds that companies with higher level of shareholder rights have lower implied cost of equity. These findings seem reasonable as lower levels of corporate governance standards should ceteris paribus lead to higher risks to outside investors. They in turn are then expected to require higher return on their investment. It is also the case that in practice investors tend to require a premium for investing abroad, besides others the phenomenon of doubts about shareholder rights in various countries could be also a contributor for this state.

It has been also argued by Barclay and Smith (1995)[10] that companies with limited growth opportunities, often large, issue more long term debt compared others. This seems as reasonable as these firms should be considered less risky and thus investors could often offer attractive costs even at these long term securities. This in turn allows these companies to achieve more predictable capital structure.

Furthermore on capital structure, Degryse, de Goeij and Kappert (2012)[11] argue that also industry in which the given firm operates in can have effect on its capital structure. It follows that this then could have implications for WACC and the valuation itself.

Similar discussion is much thoroughly addressed in the work by Fama and French and their multi stage models. These methods then allow to account for variables such as size and others.

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[8] Easley, David, and Maureen O'hara. 2004. "Information and the Cost of Capital." Journal of Finance 59 (4): 1553–83.

[9] Chen, Kevin C. W., Zhihong Chen, and K. C. John Wei. 2011. "Agency Costs of Free Cash Flow and the Effect of Shareholder Rights on the Implied Cost of Equity Capital." Journal of Financial and Quantitative Analysis 46 (1): 171–207.

[10] Barclay, Michael J., and Clifford W. Smith. 1995. "The Maturity Structure of Corporate Debt." Journal of Finance 50 (2): 609–31.

[11] Degryse, Hans, Peter de Goeij, and Peter Kappert. 2012. "The Impact of Firm and Industry Characteristics on Small Firms' Capital Structure." Small Business Economics 38 (4): 431–47.

Furthermore, as there are at least two main views for discount rates widely taught at academia, namely traditional WACC approach and Modigliani and Miller approach, there has been published also significant amount of literature tackling the issues around these two methods.

There can be also found literature addressing the use of Weighted Average Cost of Capital compared to Adjusted Present Value method, example here might be Inselbag and Kaufold (1997)[12]. This discussion focuses on the future capital structure of the company, which stability is itself one of the assumptions used in the terminal value in Discounted Cash Flow to Firm.

Interestingly, there is a paper by Abor (2005)[13] finding a relationship between capital structure of the companies and the profitability of these firms. This result seems reasonable as the profitability of companies is often heavily influenced by the industry they operate in. For example profitability found at medtech, software, luxury fashion or fabless semiconductor companies is often meaningfully higher than the average of the market. At the same time these companies are often seen operating with quite different capital structure compared to some "average" or median company in the market.

Regarding the profitability, Free Cash Flow itself and other value drivers there can be found various research arguing, which of them is better to use, examples here may include Fernández (2002)[14] and Biddle, Bowen and Wallace (1997)[15]. As this discussion is connected to the whole issue of which valuation method to use, there has been published results of practical measurements of correlation between value drivers and stock market performance at given companies. It follows that as the Discounted Cash Flow to Firm remains the go to method for valuation in the field, the leading value driver in use is Free Cash Flow as has been the case for considerable time now.

Importantly there has been written a paper by Hirshleifer, Hou, Teoh and Zhang (2004)[16] looking into Net Operating Income and problems arising when investors look at this measure instead Free Cash Flow. It argues that systematically higher Net Operating Income than Free Cash Flow at a company can cause investors with limited attention to overvalue the company by their lack of focus on the core value driver of Free Cash Flow. Thus it argues that when investors' attention is limited increases in Net Operating Assets should have negative predictive effect on future stocks returns.

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[12] Inselbag, Isik, and Howard Kaufold. 1997. "TWO DCF APPROACHES FOR VALUING COMPANIES UNDER ALTERNATIVE FINANCING STRATEGIES (AND HOW TO CHOOSE BETWEEN THEM)." Journal of Applied Corporate Finance 10 (1): 114–22.

[13] Abor, Joshua. 2005. "The Effect of Capital Structure on Profitability: An Empirical Analysis of Listed Firms in Ghana." The Journal of Risk Finance 6 (5): 438–45.

[14]Fernández, Pablo. 2002. "EVA, Economic Profit and Cash Value Added Do NOT Measure Shareholder Value Creation." Valuation Methods and Shareholder Value Creation, 291–311.

[15] Biddle, Gary C., Robert M. Bowen, and James S. Wallace. 1997. "Does Eva Beat Earnings? Evidence on Associations with Stock Returns and Firm Values." Journal of Accounting and Economics 24 (3): 301–36.

[16] Hirshleifer, David, Kewei Hou, Siew Hong Teoh, and Yinglei Zhang. 2004. "Do Investors Overvalue Firms With Bloated Balance Sheets." The Finance.

This research effectively argues for proper use of changes in operating assets in valuation model and highlights the importance of accounting for the changes in the company's invested capital levels. Thus it addresses one of the basic parts of Discounted Cash Flow to Firm model build.

On the other hand, Dechow, Kothari and Watts (1998)[17] argue that earnings are better predictor of future cash flows than past cash flow. This could effectively lead investors to put weight to earnings when building their valuation models. Yet these arguments might not stand in contrary as one focuses on the proper analysis of the cash flow build and possible waterfall from earnings to cash flow in one period and second focuses on the changes in the free cash flow with time.

Interestingly there is a paper looking into the matter of accounting conservatism and its effects on valuation. Here Basu (1997)[18] argues that due to the asymmetry between accounting for good news and bad news under GAAP standards, positive earnings surprises should be more persistent than negative earnings surprises and empirically finds some evidence supporting this claim. This might also seem logical as managements often try to manage expectations for them to beat in each period and thus unless there is some negative surprise in the period the beats in the results could follow. On the other hand, negative surprises often have roots in some unexpected fundamental situations which tend to be rarer.

Besides the valuation models mentioned above there is whole other class of methods how to value or reason about valuation of some companies. These methods of Relative Valuation, usually known as Multiples are used extensively in the investment community. Common examples may include EV/Sales, EV/EBITDA, EV/EBIT, PE Ratio and their forward versions.

In that regard there is research evaluating performance of various of these indicators compared to each other. Notably Liu, Nissim and Thomas (2002)[19] claim some evidence of good performance of multiples derived from forward earnings, on the other hand they claim poor performance for multiples based on sales.

This seems interesting as forward PE multiples are some of the most widely used relative valuation methods. On the other hand not so good outcomes for sales based multiples seem interesting. Probably the most common of these multiples is EV/Revenue, which is often used, in its forward forms, for unprofitable growth stocks. As this method is demanding for proper use (it requires well picked group of comparables with similar characteristics), this might have been a factor in its bad performance. Still the results do not seem favorable for this method.

Regarding the proper selection of group of comparables for valuation, Holthausen and Zmijewski (2012)[20] argue that even metrics such as cost structure and working capital

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[17] Dechow, Patricia M., S.P. Kothari, and Ross L. Watts. 1998. "The Relation Between Earnings and Cash Flows." Journal of Accounting and Economics 25 (2): 133–68.
[18] Basu, Sudipta. 1997. "The Conservatism Principle and the Asymmetric Timeliness of Earnings." Journal of Accounting and Economics 24 (1): 3–37.
[19] Liu, Jing, Doron Nissim, and Jacob K. Thomas. 2002. "Equity Valuation Using Multiples." Journal of Accounting Research 40 (1): 135–72.
[20] Holthausen, Robert W., and Mark E. Zmijewski. 2012. "Valuation with Market Multiples: How to Avoid Pitfalls When Identifying and Using Comparable Companies." Journal of Applied Corporate Finance 24 (3): 26–38.

should be taken into account and thus it follows that investors should pick the comparable group with care. Moreover it is nicely pointed out that different multiple methods could have higher or lower sensitivity to these metrics as they use different denominators. Example here might be that EBIT and EBITDA based multiples can be expected to fail to account for different tax rates as corporate taxes are below the line for these metrics.

The issue of whether to use Discounted Cash Flow models or some Relative Valuation technique or both is itself often a topic in the investment community. Interestingly in academic research there can be found a paper by Berkman, Bradbury and Ferguson (2000)[21] claiming similar performance for both multiples and Discounted Cash Flow models.

These findings are certainly interesting as they could suggest that the valuation models are only as good as the underlying analysis and possible forecast for the company. Furthermore, they could point investors to higher focus on underlying business analysis over the valuation complexities themselves.

As the focus of this thesis lies in the Discounted Cash Flow to Equity and Discounted Cash Flow to Firm and their use in practice there is some although likely not that plenty of research to be cited in this area. There are papers showing theoretical equivalence of these methods and the derivations leading from Discounted Cash Flow to Equity to Discounted Cash Flow to Firm can be found in the textbook from which the author of this thesis draws as well. There is also research addressing the proper treatment of the tax shield (Fernández 2007)[22]. Also there can be found some work addressing the proper use of weights for equity and debt in the Weighted Average Cost of Capital and implications of this issue for valuation through Discounted Cash Flow.

One of the writings most relevant to this thesis what I have managed to find is a broad survey of European practitioners by Bancel and Mittoo (2014)[23] broadly addressing various issues in practical valuation. Here among other topics it is pointed out by the survey question that proper treatment of weights in Weighted Average Cost of Capital is an issue in practice, but the topic is not studied meaningfully further there.

Besides this paper there can be found a writing by (Fernández 2020)[24], which acknowledges the issue of using improper weights in Weighted Average Cost of Capital in valuation and addresses specific case of certain investment bank using the book values instead of target market values there.

2.2. My contribution

As it may seem that this topic is not that rich on academic research and Fernández is one of the authors dedicated to this area the most, I aim to further build on the common

[21] Berkman, Henk, Michael E. Bradbury, and Jason Ferguson. 2000. "The Accuracy of Price-Earnings and Discounted Cash Flow Methods of IPO Equity Valuation." Journal of International Financial Management and Accounting 11 (2): 71–83.
[22] Fernandez, Pablo. 2007. "Equivalence of the Different Discounted Cash Flow Valuation Methods: Different Alternatives for Determining the Discounted Value of Tax Shields and Their Implications for the Valuation." IESE Research Papers.
[23] Bancel, Franck, and Usha R. Mittoo. 2014. "The Gap between Theory and Practice of Firm Valuation: Survey of European Valuation Experts."
[24] Fernandez, Pablo. 2020. "The Most Common Error in Valuations using WACC."

state of knowledge to which he has meaningfully contributed. It is my ambition to look into the topic of using current market based values instead of target market values in Weighted Average Cost of Capital as the next step in the academic debate after the topic of book values instead of target market values. Moreover, I intend to present deeper insight in the theory behind the discussed methods with additional work around practical findings in this area.

It is my aim to address the issue of proper treatment of weights in Weighted Cost of Capital in this thesis. I would like to present the theory behind the derivations of the Discounted Cash Flow to Firm method and point out the assumptions it requires for it to achieve the same results as Discounted Cash Flow to Equity method from which it is derived in the textbook I work with. Furthermore, I would like to present an argumentation showing the necessity to use target market values in WACC for this method to lead to valid results.

In this part, I aim to highlight the complexities of the proper treatment of weights for equity and debt in Weighted Average Cost of Capital and argue that simplifications often made by analysts in practice can lead to bias in the discount rate and erroneous results from their Discounted Cash Flow to Firm models. Particularly, I want to focus on the issue of using current market values instead of target market values in Weighted Cost of Capital as I consider this as the major problem of this topic leading to biases in weights in WACC, discount rates and results from DCFF models.

Moreover, in the next part I aim to design Discounted Cash Flow models of some predefined companies based on variables such as ROIC levels. Then, I aim to perform their valuations using both the valid method with target values in WACC weights and the erroneous method with hypothetical current market values based on the upside to target price of the company's equity. As a result of this effort I aim to present matrices showing relative biases resulting from the improper use of weights in Weighted Average Cost of Capital based on the variables such as ROIC.

3. Theory

In this part I aim to go through the theoretical derivation of Terminal Value of Discounted Cash Flow to Firm formula and point out various assumptions it uses for it to lead to unbiased results. Furthermore, I aim to highlight the complexity of these assumption and issues with them in practice and show the necessity to use target market values and not current market values for equity in the formula.

In the textbook I work with (Koller, Goedhart, Wessels 2010)[25] the derivation of Discounted Cash Flow to Firm formula is as follows.

"...To simplify the analysis, we assume cash flows to equity are growing at a constant rate, g. This way we can use growth perpetuities to analyze the relationship between methods.[1]

ENTERPRISE DISCOUNTED CASH FLOW

By definition, enterprise value equals the market value of debt plus the market value of equity:

$$V = D + E \qquad (1)$$

To examine the components of enterprise value, multiply the right side of the equation by a complex fraction equivalent to 1 (the numerator equals the denominator, an algebraic trick we will use many times):

$$V = (D + E)\left(\frac{D(1 - T_m)k_d + CF_e - D(g)}{D(1 - T_m)k_d + CF_e - D(g)}\right) \qquad (C.1), (2)$$

where T_m = *marginal tax rate*

k_d = *cost of debt*

CF_e = *cash flow to equity holders*

g = *growth in cash flow to equity holders*

Over the next few steps, the fraction's numerator will be converted to free cash flow (FCF).We will show later that the denominator equals the weighted average cost of capital. Start by defining FCF:

$$FCF = D(1 - T_m)k_d + CF_e - D(g) \qquad (3)$$

If the market value of debt equals the face value of debt, the cost of debt will equal the coupon rate, and D times k_d *will equal the company's interest expense. Therefore,*

$$FCF = Interest(1 - T_m) + CF_e - D(g) \qquad (4)$$

By definition, cash flow to equity (CF_e*) equals earnings before interest and taxes (EBIT) minus interest minus taxes minus net investment plus the increase in debt. Assuming the ratio of debt to equity is constant, the annual increase in debt will equal D(g). Why? Since cash flows to equity are growing at g, the value of equity also grows at g. Since the ratio of debt to equity remains constant (a key assumption), the value of debt must*

[25] Koller, Tim, Marc Goedhart, David Wessels, and McKINSEY & COMPANY. 2010. Valuation: Measuring and Managing the Value of Companies. 5th ed., n.d.

also grow at g. Substitute the definition of cash flow to equity into the preceding equation:

$$FCF = Interest(1 - T_m) + EBIT - Interest - Taxes - Net\ Investment + D(g) - D(g) \quad (5)$$

Next, distribute the after-tax interest expression into its two components, and cancel D(g):

$$FCF = Interest - T_m(Interest) + EBIT - Interest - Taxes - Net\ Investment \quad (6)$$

Simplify by cancelling the interest terms and rearranging the remaining terms:

$$FCF = EBIT - [Taxes + T_m(Interest)] - Net\ Investment \quad (7)$$

In Chapter 6, we define operating taxes as the taxes a company would pay if the company were financed entirely with equity. Operating taxes therefore equal reported taxes plus the interest tax shield (as interest is eliminated, taxes would rise by the interest tax shield). This leads to the definition of free cash flow we use throughout the book:

$$FCF = EBIT - Opertaing\ Taxes - Net\ Investment \quad (8)$$

Next, we focus on the denominator. To derive the weighted average cost of capital (WACC), start with equation C.1, and multiply CF_e by $k_e - g$ divided by $k_e - g$ (which equals 1):

$$V = (D + E)\left(\frac{FCF}{D(1 - T_m)k_d + \frac{CF_e}{k_e - g}(k_e - g) - D(g)}\right) \quad (9)$$

where k_e = cost of equity

If equity cash flows are growing at a constant rate, the value of equity equals CF_e divided by (k_e – g). Therefore, the growing perpetuity in the denominator can be replaced by the value of equity (E) and distributed:

$$V = (D + E)\left(\frac{FCF}{D(1 - T_m)k_d + E(k_e) - E(g) - D(g)}\right) \quad (10)$$

In the denominator, collapse E(g) and D(g) into a single term:

$$V = (D + E)\left(\frac{FCF}{D(1 - T_m)k_d + E(k_e) - (D + E)g}\right) \quad (11)$$

To complete the derivation of WACC in the denominator, divide the numerator and denominator by (D+E). This will eliminate the (D+E) expression on the left and place it in the denominator as a divisor. Distributing the term across the denominator, the result is the following equation:

$$V = \frac{FCF}{\frac{D}{D + E}k_d(1 - T_m) + \frac{E}{D + E}k_e - \frac{D + E}{D + E}(g)} \quad (12)$$

The expression in the denominator is the weighted average cost of capital (WACC) minus the growth in cash flow (g). Therefore, equation C.1 can be rewritten as

$$V = \frac{FCF}{WACC - g} \qquad (13)$$

such that

$$WACC = \frac{D}{D+E}(k_d)(1 - T_m) + \frac{E}{D+E}k_e \qquad (14)$$

Note how the after-tax cost of debt and the cost of equity are weighted by each security's market weight to enterprise value. This is why market-based values, and not book values, should be used to build the cost of capital. This is also why free cash flow should be discounted at the weighted average cost of capital to determine enterprise value. Remember, however, that you can use a constant WACC over time only when leverage is expected to remain constant (i.e., debt grows as the business grows).[2]

1 For an analysis that applies to more complex situations (i.e., when cash flows can follow any pattern), see J. A. Miles and J. R. Ezzell, "The Weighted Average Cost of Capital, Perfect Capital Markets, and Project Life: A Clarification," Journal of Financial and Quantitative Analysis 15 (1980): 719–730 (for a discussion of enterprise DCF and WACC); and S. C. Myers, "Interactions of Corporate Financing and Investment Decisions: Implications for Capital Budgeting," Journal of Finance 29 (1974): 1–25 (for a discussion of adjusted present value).

2 To see this restriction applied in a more general setting, see Miles and Ezzell, "Weighted Average Cost of Capital."..."[25]

As the textbook derivations have been presented above (formula numbers assigned by me), I will continue with presenting my arguments about the assumptions used by authors there and their implications.

One of the first assumptions used in the derivation of Free Cash Flow term itself (4) is that market value of debt equals book value of debt. Moreover, from the argumentation I lay later it seems that the necessary assumption here is debt target market value must equal debt book value and cost of debt is derived from these variables.

This assumption itself leads to some potential issues, for one it disallows to use Discounted Cash Flow to Firm for companies for which we plan default. The usage here would more than likely lead to bias as debt target market value should not equal debt book value here. Second it is obviously not possible to use it for valuation of debt. As this particular assumption is not the main topic of this thesis I will leave it here.

Another assumption used is that the ratio of equity and debt remains constant (5), this is rather technical assumption as in continuing value we assume constant profile for many variables and it seems logical this one should belong to them. The situation would get more complicated in the case of usage of explicit forecasting period (which investors do overwhelmingly), here we would either have to also plan constant equity to debt ratio or introduce changes into the WACC levels between the years the ratio changes. This way, if we would not assume constant equity to debt ratio throughout this period, we would have to deal with additional complexity in the valuation task which could both further complicate the process and make it more time consuming. Again as this assumption is not the main topic of this thesis I will leave this matter here.

In my opinion, the key assumption required for Discounted Cash Flow to Firm to be unbiased is the use of correct weights in Weighted Average Cost of Capital. In the derivations above this is acknowledged by mentioning that the weighting must be done by using market values. Yet it is quite odd that the textbook does not state which market values. Here I would like to lay argument that for the discussed valuation method to be unbiased it is necessary to use Target market values (the values for equity and debt we receive at the end of valuation process) as opposed to Current market values (values at which the securities are currently trading at, e.g. current market cap) throughout the whole valuation process including WACC weighting (unless Target market value equals Current market value).

I would like to start with an argument that in the line (1), where the derivations begin, we are trying to derive the formula for Target market value, thus the *V* in

$$V = D + E$$

stands for Target Enterprise value. It follows from the equation that *D* and *E* stand here for debt target market value and equity target market value respectively.

As in the line (2) the left side of the equation is multiplied by a fraction equaling to 1, the $(D + E)$ part remains at the beginning of the left side of the equation throughout the lines (2) and (9)-(11) with the equation in the

$$V = (D + E)\frac{x_i}{y_i}$$

form, where x_i and y_i stand for appropriate numerators and denominators. In the line (12) the $(D + E)$ gets incorporated into the large fraction there

$$V = \frac{\mathrm{FCF}}{\frac{D}{D+E}k_d(1 - T_m) + \frac{E}{D+E}k_e - \frac{D+E}{D+E}(g)}$$

moving to the denominators of the denominator of this fraction and can be found in denominators again the line (14). As these are the same variables throughout the whole algebraic process, in every part they should stand for the debt target market value and equity target market value as they do in the line (1). This way we know that in the line (14) where we find WACC formula

$$\mathrm{WACC} = \frac{\mathrm{D}}{\mathrm{D+E}}(\mathrm{k_d})(1 - \mathrm{T_m}) + \frac{\mathrm{E}}{\mathrm{D+E}}\mathrm{k_e}$$

the $\mathrm{D} + \mathrm{E}$ in denominators stand for target market weights.

Moving to the second part of this argumentation, in the line (9) we find an expression

$$\frac{CF_e}{k_e - g}(k_e - g)$$

which in the next line (10) gets converted to:

$$E(k_e) - E(g)$$

As the $\frac{CF_e}{k_e - g}$ is the known formula for Continuing Value of Discounted Cash Flow to Equity model, it follows that E in $E(k_e) - E(g)$ should stand for equity target market

value. This way all the appropriate E terms, which have roots in the $\frac{CF_e}{k_e-g}$ should stand for equity target market values. These are all the E terms remaining in the lines (10)-(12) and (14) not covered by the first part of the argumentation.

This way we know that the equity part, $\frac{\mathrm{E}}{\mathrm{D+E}}\mathrm{k_e}$, in the WACC formula

$$\mathrm{WACC} = \frac{\mathrm{D}}{\mathrm{D+E}}(\mathrm{k_d})(1-\mathrm{T_m}) + \frac{\mathrm{E}}{\mathrm{D+E}}\mathrm{k_e}$$

must be computed from target market values.

In the third part of this argumentation I will start from the line (12) where we find following equation.

$$V = \frac{\mathrm{FCF}}{\frac{D}{D+E}k_d(1-T_m) + \frac{E}{D+E}k_e - \frac{D+E}{D+E}(g)}$$

Interestingly, if we were to use the proof by contradiction this is the part we would use to finish our argument. We can notice $\frac{D+E}{D+E}(g)$ expression in the denominator where the fraction gets cancelled out in the next step, moreover we already know that the E in the numerator of this expression must stand for equity target market value as it is derived from $\frac{CF_e}{k_e-g}$ formula. This way if we would try to use current market values instead of target market values for $D+E$ in the denominator of this expression the cancelling out would not be possible and we would get our contradiction.

Yet as I aim to show that all the D and E terms in the textbook derivations must stand for target market values I will continue. I will use the $\frac{D+E}{D+E}(g)$ expression to argue that D in the numerator here must stand for debt target market value for the fraction to be cancelled out (which it is in the next step) as all the other terms in the fraction stand for target market values (as we have already shown).

This D then can be traced back to the line (2)

$$V = (D+E)\left(\frac{D(1-T_m)k_d + CF_e - D(g)}{D(1-T_m)k_d + CF_e - D(g)}\right)$$

to the $-D(g)$ term in the denominator, which equals the $-D(g)$ in the numerator.

This numerator $-D(g)$ can be followed to the line (5)

$$\mathrm{FCF} = \mathrm{Interest}(1-\mathrm{T_m}) + \mathrm{EBIT} - \mathrm{Interest} - \mathrm{Taxes} - \mathrm{Net\ Investment} + \mathrm{D(g)} - \mathrm{D(g)}$$

where it is in the next step canceled out with the $+D(g)$ term. Thus all these D terms need to stand for target market value of debt. Yet also, this $+D(g)$ is derived from the CF_e in the previous step which is itself accounting term and thus this $+D(g)$ stands also for debt book value. Here we then need and use the assumption that debt book value equals debt target market value, for this cancelling out to be possible.

Since the $\mathrm{D}(1-\mathrm{T_m})\mathrm{k_d}$ term introduced in the line (2) and unchanged in the line (3)

$$\mathrm{FCF} = \mathrm{D}(1-\mathrm{T_m})\mathrm{k_d} + \mathrm{CF_e} - \mathrm{D(g)}$$

requires D to stand for debt book value for it to be transformed to Interest term in the line (4)

$$\mathrm{FCF} = \mathrm{Interest}(1 - \mathrm{T_m}) + \mathrm{CF_e} - \mathrm{D(g)}$$

by multiplying it with k_d, this D then also equals debt target market value as we already assume that debt target market value equals debt book value.

Moreover, all the remaining D terms in the textbook derivations, which I have not addressed already can be traced to either $\mathrm{D}(1 - \mathrm{T_m})\mathrm{k_d}$ or $-D(g)$ terms in the line (2)

$$V = (D + E)\left(\frac{D(1 - T_m)k_d + CF_e - D(g)}{D(1 - T_m)k_d + CF_e - D(g)}\right)$$

and the D terms here are equal to both debt book value and debt target market value as it follows from argumentation above. This way all the remaining D terms need to equal to debt target market value and the D in the numerator in the debt weight $\frac{D}{D+E}$ in WACC formula

$$\mathrm{WACC} = \frac{\mathrm{D}}{\mathrm{D} + \mathrm{E}}(\mathrm{k_d})(1 - \mathrm{T_m}) + \frac{\mathrm{E}}{\mathrm{D} + \mathrm{E}}\mathrm{k_e}$$

need to stand for debt target market value, equaling debt book value, as well.

This way, all the D and E terms in WACC need to stand for their respective target market values.

Now it seems to me that the intended argumentation is done and we have shown the necessity to use target market values in the whole WACC. Moreover, I will argue that it is important to use proper WACC levels in valuation as even smaller differences in Weighted Average Cost of Capital values can have meaningful implications for the target values derived from Discounted Cash Flow to Firm valuation method. This way I argue that it is necessary condition to use target market values instead of current market values in WACC for the Discounted Cash Flow to Firm formula to lead to unbiased results.

4. Methodology

In the practical part of my thesis I aim to design financial models of several companies. Next I perform their valuation through Discounted Cash Flow to Firm method. It is my intent to perform more than one appraisal of a specific financial model (company).

In the first such appraisal I use target market values in WACC and this way I aim for unbiased estimate of target value for the company and its equity. In the next rounds instead of using target market values I use assumed current market values in WACC for the valuation task. I define assumed current market value for this purpose as a percentage of unbiased target market value. For explanation one can turn this around and consider current market value to be some percentage lower than unbiased target market value. This percentage can be then thought of as an upside to target price or just upside, term widely used in practice, although here it is upside to unbiased target market value not to the biased target value received from models with wrong weights in WACC.

The aim here is to perform the valuation with predefined set of upsides and thus different values of equity in WACC. Regarding upsides I decided to use set of 10%, 25% and 50% and thus undergo four appraisals for each company including the one with unbiased target market value in WACC. The objective of this whole procedure is then to receive biased target market values from appraisals with nonzero upsides and compare quantified levels of biases (in relative terms) based on metrics such as the size of upside or profitability of the underlying financial model (company).

Importantly I do not use real companies in my set of financial models. It is a nature of real world that every company there is different with its own profile of growth, profitability, risk, etc. Moreover opinions about future values of these metrics differ. On the contrary in my work I intend to estimate the biases based on predefined levels of specific metrics as each then should serve for hopefully large number of real world (at least somehow) comparable companies. As it is not easily possible to find real world company with the exact profile I would want, and it might be impossible to find out what exactly are market expectations for future underlying metrics of each company, I rather design financial statements for a set of theoretical companies. This way in the set of my financial models I can design the specific financial metrics exactly as I want. The models should not then suffer from many real world complexities and be more user friendly for anyone who would want to look into these findings.

The variables I use to differentiate each financial model are ROIC and growth profile. As in practice investors usually differ among themselves with value or growth leaning strategies I assume these two metrics should at least somehow account for the variability in investment profiles of specific companies.

I model three levels for each of these two metrics, low ROIC, medium ROIC, high ROIC and accordingly low growth, medium growth and high growth. By combining these profiles one should arrive to nine distinct financial models with combinations as follows.

Table 1: Financial profiles matrix

		Growth		
		low	medium	high
ROIC	low			
	medium			
	high			

Regarding the profitability metric, ROIC, I assume it to be stable in all forecasted periods. This assumption itself is not very realistic, at least for large portion of real world companies, still I consider this as more friendly method compared to introducing time development into ROIC variable and thus further complexity into my modeling leading to additional financial models.

As low ROIC I use 10% level for this metric in all periods as discussed above. I consider 10% level to be slightly above usual WACC levels and thus allow these companies to produce some economic profit. I assume this level could decently account for example for companies from ugly sectors with often high levels of Invested capital such as utilities or some industrial companies.

I apply 20% level as medium ROIC. I assume 20% to be decent level of profitability, which could be used for large variety of companies with some reasonable level of differentiation. These companies could span industries such as consumer discretionary, consumer staples or even industrials.

I use 40% ROIC level as high value of this metric. Although the variance at the higher end of ROIC spectrum gets likely larger, I consider 40% level as reasonable level to account for companies with some kind of strong competitive advantage. The companies which should be able to achieve such strong profitability (or even stronger) could often come from sectors such as technology or luxury fashion.

Regarding to growth metric I apply fifteen years long explicit forecasting period with terminal growth rate afterwards. Importantly, as I do not forecast financials for real companies I do not plan any revenue build or even Revenue line itself. I start at Operating Income level and go down to Net Income line. Notably I apply the same growth rate to Interest expense as to the profit lines. This way I let the growth of value of equity to be (hopefully) equal to growth of value of debt and thus avoid tackling additional complexity of dealing with changing weights of equity and debt in WACC between separate years as this could be considered as separate issue itself. I also plan stable tax rate.

As the low level of growth metric I apply following combinations of growth for the given years.

Table 2: Low growth profile, part 1

1	2	3	4	5	6	7	8
5%	5%	5%	4%	4%	4%	3%	3%

Table 3: Low growth profile, part 2

9	10	11	12	13	14	15	t
3%	2%	2%	2%	2%	2%	2%	2%

For the medium level of growth I use following rates.

Table 4: Medium growth profile, part 1

1	2	3	4	5	6	7	8
10%	10%	9%	9%	8%	8%	7%	7%

Table 5: Medium growth profile, part 2

9	10	11	12	13	14	15	t
6%	6%	5%	5%	4%	4%	3%	3%

As the high level of this metric I plan this combination.

Table 6: High growth profile, part 1

1	2	3	4	5	6	7	8
30%	27%	24%	21%	18%	15%	12%	10%

Table 7: High growth profile, part 2

9	10	11	12	13	14	15	t
8%	6%	5%	4%	4%	3%	3%	3%

The low growth profile as planned above could represent some more mature companies from, say, consumer staples or industrial sectors. The medium growth profile then could be representative of some companies from consumer discretionary industry, which could be exposed to some form of more durable growth story. The high growth profile, which I design, could then serve as representative for possibly some companies from technology sector.

Besides the ROIC and growth profiles there are also other metrics which need to be assigned their respective values. Notably there remain cost of equity, cost of debt and amount of net debt. Among various options, one way would be to introduce their own profiles for these metrics and thus significantly increase the number of modeled companies. Second way is to assign these values based on the already developed financial profiles.

As I considered growth profile of the company to have typically significant influence on the level of these metrics I assigned each growth profile its own level of cost of equity, cost of debt and amount of net debt.

For low growth companies I use 6% as cost of equity, 2% as cost of debt and 3 as the ratio of net debt/EBIT.

For medium growth companies I use 7% as cost of equity, 2.5% as cost of debt and 2.5 as the ratio of net debt /EBIT.

For high growth companies I use 8% as cost of equity, 3% as cost of debt and 2 as the ratio of net debt/EBIT.

To conclude this part I use 20% tax rate and begin with nominal amount of 1000 at Operating Income as the starting point of financial models. The nominal number here is obviously not important, but for example one can think of it as 1000 million, which I would argue leads (at least for me) to quite realistic view of the company. The rest of the models is computed from the inputs discussed above.

This way I derive NOPAT with following formula.

$$\text{NOPAT} = \text{EBIT}(1 - \text{tax rate})$$

Eventually I let excel compute Free Cash Flow in each year with formula as follows.

$$\text{FCF} = \text{NOPAT} - \Delta \text{ Invested Capital}$$

And I employ classic Gordon formula for the valuation of terminal period cash flows.

The valuation itself is performed in Microsoft Excel via Discounted Cash Flow to Firm method. For this purpose I use "Solver" function in excel ("Řešitel" in Czech) with methodology as follows. I write a number in cell A which stands for company's value of equity in WACC formula and let excel compute the WACC value for a given company. At this point the WACC value is not the right one but this will be addressed in a few steps. Next I use this value to discount appropriate cash flows and sum these cash flows to a cell B. I then subtract value of debt and receive value of equity in a cell C.

At this point the values of equity in cell A and cell C differ and thus both of them are wrong. This is actually a case of bias arising from not using proper weights in WACC, which I discuss in this thesis. Yet here I follow with subtracting the number in cell A from the number in cell C and let excel write it in a cell D. In cell D I then apply the Solver function with gradient method requiring it to find a value in cell A, which makes the value in cell D equal to zero. This should eliminate the difference between cells A and C and we arrive to the same value of equity in both cells, which should be our unbiased target market value of equity.

As a next step of this task I copy valuation model of each company to three new excel sheets thus receiving four same valuation models at this point. I leave the first model as it is as this should be the one with unbiased results.

In a second sheet I write in the cell A value equaling to $\frac{10}{11}$ of unbiased target market value of equity in cell A of the first sheet. Thus I apply 10% upside to unbiased target market price. As the formulas get recalculated I receive biased target market value of equity in cell C resulting from using improper weights in WACC in this sheet.

In third and fourth sheet I apply the same procedure with the exception of using $\frac{4}{5}$ of unbiased target market value of equity in the third sheet and $\frac{2}{3}$ in the fourth sheet. This way I model the cases with 25% and 50% upsides respectively.

Regarding the sizes of upsides I used I argue that approximately 10% could be found at Hold or even some Outperform research ratings. Approximately 25% could represent some decent Outperform rating (Buy in some research). Values around 50% then could represent either some strong conviction Buy rating (Strong Buy in some research then) or possibly some cases when investors would invest according to their own valuations.

After the modeling in excels is done I proceed with calculating the biases. At this stage I have three variables (Upside, ROIC and growth) each with three possible profiles. This together leads to 27 combinations. I aim to present all 27 data points in three tables, one for each level of upside. Every table then should contain 9 values for every combination of my chosen ROIC and growth profiles.

The intended data points should each represent relative value of bias in target market value of equity derived when using improper weights in WACC. The formula used for their calculation is as follows.

$$\frac{\text{biased target market value of equity} - \text{unbiased target market value of equity}}{\text{unbiased target market value of equity}}$$

Afterwards I intend to proceed with a discussion stemming from obtained results.

5. Results & Conclusion

To recapitulate, in theoretical part of this thesis I algebraically show the necessity to use target market values in Weighted Average Cost of Capital. Furthermore, I argue that when weighting in WACC does not reflect target market values it leads to bias.

In practical part I then try to design financial models based on different growth profiles and ROIC levels. The aim here is to perform Discounted Cash Flow to Firm valuation for these models and estimate the level of bias stemming from using improper weights in WACC with respect to the metrics mentioned above and different upside levels.

After designing appropriate excel models I proceed with the valuation task through Discounted Cash Flow to Firm method. I receive results ranging from around 20 000 to around 45 000 at unbiased target value of equity. Although I would possibly expect even higher ratio of the highest and the lowest results, these numbers seem reasonable when compared to my starting point of 1000 at Operating Income.

Next I present the obtained results of biases at equity value resulting from using improper weights in WACC.

First I present results for models with 10% upside to target equity value.

Table 8: 10% upside results

		Growth		
		low	medium	high
ROIC	low	2,00%	2,08%	1,83%
	medium	1,68%	1,40%	0,81%
	high	1,55%	1,20%	0,62%

I follow with biases resulting from application of 25% upside.

Table 9: 25% upside results

		Growth		
		low	medium	high
ROIC	low	5,01%	5,23%	4,58%
	medium	4,21%	3,52%	2,04%
	high	3,89%	3,01%	1,54%

Here I present results for discounting with 50% upside to target equity value.

Table 10: 50% upside results

		Growth		
		low	medium	high
ROIC	low	10,07%	10,56%	9,20%
	medium	8,45%	7,10%	4,09%
	high	7,82%	6,06%	3,09%

Generally, the obtained levels of bias range from under 1% to slightly higher than 10%. To state the obvious we can see that ceteris paribus biases are lower for lower levels of upside. This makes sense as with higher upside, the weights in Weighted Average Cost of Capital get more distorted, which leads to larger biases at resulting values.

Next, I would point out that biases get larger as ROIC values get lower. I must admit that I expected (wrongly) the correlation to go the other way before seeing the results. Yet this way makes sense and seems reasonable as with lower ROIC the amount of Invested Capital gets larger, which pushes part of cash flows to more distant future where the impact of distorted WACC values is higher.

Probably the most complicated part to argue about is the influence of growth levels on the resulting biases. Here we can see the highest impact at medium or low growth level depending on ROIC values with high growth level having the lowest impact.

This indeed does not feel very natural. I would argue that this situation stems from my decision to assign values for cost of equity, cost of debt and indebtedness based on growth profile. Furthermore, I would argue that different levels for cost of equity could be major variable here.

To explain, I would argue that significant part of the value in employed financial models is situated in terminal value derived from Gordon formula. This formula uses two important variables, terminal growth and WACC level, where cost of equity is the main driver of given value of Weighted Average Cost of Capital. As terminal growth is subtracted from WACC level and the result is used in denominator, this difference indeed has very meaningful impact on resulting terminal value.

The situation is that I use 2% terminal growth and 6% cost of equity for low growth companies. For medium growth companies I use 3% terminal growth and 7% cost of equity. Yet, for high growth models I use 8% cost of equity, but only 3% terminal growth rate, the same as for medium growth companies. To explain further the difference between cost of equity and terminal growth rate for low growth companies is 4%, for medium growth companies is 4%, and for high growth companies is 5%. I would expect then the differences between WACC levels and terminal growth rates for given profiles to be similar as these above.

My reasoning for raising the cost of equity for high growth companies while letting their terminal growth stay at 3% is that I intended to plan the medium growth profile as representative for companies for example from consumer discretionary sector, which often enjoy very durable growth trends (luxury fashion, restaurants). On the other hand high growth profile was intended as representative for companies for example from technology sector and while these companies often enjoy very strong growth rates at first, after they mature their growth often comes down significantly.

Yet this still does not explain the situation between low and medium growth profiles. Here I would present following argumentation. First, as the difference between cost of equity and terminal growth stays the same (suggesting similar difference between WACC and terminal growth) for these two profiles, it suggests similar multiple for both terminal values. This is indeed questionable situation as one might argue that the market tends to assign higher multiples for higher growth companies. Next, other assigned metrics such as higher indebtedness and lower cost of debt for low growth profile compared to medium growth can also have their effect.

Combination of all these characteristics with different ROIC profiles (and thus different changes in Invested Capital levels) then might lead to the situation presented above.

Regarding the total amounts of relative biases I must admit that obtained values are lower than I expected. Still I would argue that the biases are not insignificant and should represent a message to investors using Discounted Cash Flow to Firm as their core

valuation method. Furthermore, I would argue that if I were to use higher upside levels (which might be more representative of situations where investors do invest) the biases would get even larger.

Second thing I should admit is that once a person figures out how to deal with Solver function in excel for this particular situation the valuation is not that much more complicated as I assumed it could be.

Still, in conclusion I would argue that proper Discounted Cash Flow to Firm method leads to additional complexities compared to Discounted Cash Flow to Equity approach. Moreover, I would argue that if an investor is not careful or does not know about this issue Discounted Cash Flow to Firm might lead him/her to biased valuation. On the other hand, Discounted Cash Flow to Equity should offer proper valuation and should lead to unbiased results as well as valid Discounted Cash Flow to Firm. Furthermore, I would argue that Discounted Cash Flow to Equity is less complicated to use and thus, in summary, recommend Discounted Cash Flow to Equity as a go to valuation method instead of Discounted Cash Flow to Firm.

This is supported by the claim that in valuation time is valuable and the time, which is not used on tackling proper application of discounting method can be used for better understanding of underlying business and possibly to more valuable cash flow forecast and results.

As one additional argument I would like to point out connection between the discussed valuation techniques and American and Continental view of the company. I would argue that in the United States the consensus is that a company should serve the interest of its equity owners. On the other hand in Europe the view is often that company should serve interest of various stakeholders such as owners, but also bondholders and society. While the discussion there might be a task for another paper I would argue that economically speaking American concept of a company shows itself as more successful in history.

Now I would like to move to the link to discounting methods. With its focus on equity holders I would claim the Discounted Cash Flow to Equity as more representative of American view, while I would argue that Discounted Cash Flow to Firm is closer to European concept with taking into account both investors and creditors. I would present this then as one additional argument in favor of Discounted Cash Flow to Equity.

To summarize, in theoretical part of my thesis I algebraically show the necessity to use target market values of equity in Weighted Average Cost of Capital for Discounted Cash Flow to Firm method to lead to unbiased results. In practical part I then try to estimate the relative level of the possible biases resulting from this issue on the set of financial models. I present the results above in this section and find out that ceteris paribus lower levels of ROIC lead to higher levels of biases, while the situation is more complicated in regard to the metrics connected with my growth profiles. I also show that level of bias gets ceteris paribus higher with higher level of relative upside to target price.

I will also mention the thanks to my supervisor for this thesis, prof. Mejstřík. While for some time I had issues with use of Discounted Cash Flow to Firm in practice in the form it is often used today (biased), I did not have the right argumentation to address this situation and it was actually prof. Mejstřík who told me to look the method up in the textbook, where I set my opinion on the topic clear and found the reason for the issue.

Thus I need to credit him with big thanks for this and also for the supervision over the whole thesis then.

5.1. Topics for further study

Here I should admit my failure in trying to find a proof of the discussed valuation bias on the data with a regression. I would state that I have not managed to build a regression, which would not suffer from at least one side effect of the drivers in the market and thus I was not able to present valid results.

Although I think that financial world has many complexities making this very uneasy job I still put up in the air the task of trying to design and present a regression which would be able to address this issue.

As another topic I propose looking into a matter of changing weights in WACC between separate years in explicit forecasted period. In this thesis I only mention this matter and focus on different subject, but I would argue that separate study into this topic could be very beneficial.

Finally, to present another controversial idea, in the recent years the yields on bonds in many developed countries went significantly downwards, probably pushing investors' expectation of required rate of return on these instruments. As I would argue that bonds are one of the two main asset classes with equity on public markets, to me this situation raises question about what rates of required return should be used on equity markets in this situation.

Thus, I would argue that this topic would use some attention and possible research of historical relationship between required rates of return on bonds and equity could be very useful. Indeed, it could have implications not only for general level of "the range where equity class should trade", but also for equities among themselves as the values in various companies are exposed differently to changes in discount rate (different spread of cash flows in time).

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