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Equity Valuation Using Accounting Numbers:

Empirical Analysis on Different Valuation Methods Estimates and How Trimming Affects Explanatory Power

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Abstract

This dissertation aims to investigate the performance of the Dividend Discount Model (DDM), the Residual Income Valuation Model (RIVM), the Discounted Cash-Flow Model (DCFM), and the multiples-based models (MBM), specifically the Forward Price to Earnings (P/E), when analysing a large sample analysis of US-listed firms. First analysis on the results indicates MBM as the most accurate model. A sensitivity analysis exposed the RIVM as the model most sensitive to changes in assumptions. Further sensitivity was made on the sample selection process where trimming was tested and proved to be reliable. Additionally, the role of Research and Development (R&D) was analysed as a possible reason for the difference between the outputs on the different valuation models, and how low-high-intensive R&D companies provide accurate intrinsic values. The analysis based on smaller samples for low-high R&D intensive firms found that high-intensive firms provided more accurate estimates.

Further analysis on a small sample was conducted, where the investigation on the valuation methods used by analysts in equity valuation was compared with what literature suggests and with the large sample analysis results. The analysis on those reports indicated the MBM as the most essential for analysts on their valuations. After the multiples, DCFM was the model that comes up to be used more times in the reports. The analysis shows that the multiples model is the best model after both analyses of the large sample and analysts' reports.

Keywords: Valuation, Discounted Dividend Model, Discounted Cash Flow Model, Residual Income Valuation Model, Multiples Based Model, R&D Intensity, and Trimming

Resumo

A presente dissertação tem como principal objetivo avaliar o comportamento do *Dividend Discount Model (DDM)*, do *Residual Income Valuation Model (RIVM),* do *Discounted Cash-Flow Model (DCFM)* e também, do método de avaliação baseado em múltiplos, nomeadamente o *Forward Price to Earnings (P/E),* com base numa ampla amostra de todas as empresas listadas nos Estados Unidos entre 2005 e 2015. Resultados da primeira análise apontaram para o método dos múltiplos como o mais preciso. Uma análise de sensibilidade expôs o RIVM como o modelo mais sensível, no que concerne a alterações nas premissas. Adicionalmente, esta análise foi desenvolvida no processo de seleção da amostra em questão, em que o processo de *trimming* foi testado e provou ser superior. Ademais, o desempenho do *Research & Development (R&D)* foi analisado como possível razão para a diferença evidente entre os resultados dos diferentes modelos de avaliação e, para o facto das empresas de baixa-alta intensidade em *R&D,* concederem estimativas precisas ou não. A análise baseada em amostras menores para empresas baixa e alta intensidade de *R&D* concluiu que as empresas mais intensivas em *R&D* forneceram estimativas mais exatas.

Consecutivamente, foi conduzido um caso de estudo onde a investigação sobre os métodos de avaliação utilizados por analistas, na avaliação do valor de empresas, foi comparada com a sugestões literárias e com os resultados da análise da amostra. O estudo destes relatórios, indicam o *MBM* como essencial para os analistas e as suas avaliações. Após o modelo de múltiplos, o *DCFM* foi considerado o modelo mais utilizado nos relatórios. A análise revela que, o modelo de múltiplos é o modelo preferível, após ambas as investigações, tanto na referente à amostra geral dos dados como nos relatórios dos analistas financeiros.

Palavras-Chave: Avaliação Financeira, *Discounted Dividend Model, Discounted Cash Flow Model, Residual Income Valuation Model, Multiples Based Model, R&D Expenditures, and Trimming*

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List of Abbreviations

APE: Absolute prediction error

BVE: Book value of equity

BVEPS: Book value of equity per share

CA: Current Assets

CAPEX: Capital Expenditures

CAPM: Capital Asset Pricing Model

COE: Cost of Equity

CRSP: Centre for Research in Security Prices

D&A: Depreciation and amortization expense

DCF: Discounted Cash Flow

DCFM: Discounted Cash Flow Model

DDM: Discounted Dividend Model

DGM: Dividend Growth Model

DPS: Analyst consensus one year ahead forecasts of dividends per share

EBIT: Earnings before Interests and taxes

EBITDA: Earnings before Interest, Taxes, Depreciation, and Amortisation

EPS: Earnings per Share

FBM: Flows-based valuation model

FCFE: Free Cash Flow to Equity

FCFF: Free Cash Flow to the Firm

H0: Null Hypothesis

I/B/E/S: Institutional Brokers' Estimation System

IPO: Initial Public Offering

M&A: Mergers and Acquisitions

MBM: Multiple-based Valuation model

MRP: Market Risk Premium

NI: Net Income

P/E: Price to Earnings

P-value: Probability Value

R&D: Research and Development expense

RI: Residual Income

RIVM: Residual Income Valuation Model

ROA: Return on Assets

SVE: Signed Valuation Error

TA: Total Assets

WACC: Weighted Average Cost of Capital

WC: Working Capital

1. INTRODUCTION

"Valuation can be considered the heart of finance." (Damodaran, 2007, p.1)

As is known in today's world, equity valuation is for every investment professional an important tool in managing its investments, with the main goal to find investment opportunities that can bring profits, either in the short or in the long term. Therefore, the discovery of the intrinsic value is important for analysts in the first stages of investing, or for heads in the corporate management industry. As such, valuation is a must; where corporate finance players can use it to increase the value of a business through different investments and financing decisions (Damodaran, 2007).

When choosing a valuation method, the accounting-based models are mainly divided between flow-based models and multiples-based models (Damodaran, 2002). Ideally, at the end of a valuation – through using all the different models available – these should each attain similar results. Instead, discrepancies occur in the results from using these two approaches. Therefore, it is important to explore these differences within this study.

Accounting flow-based approaches are usually more precise as they involve modelling and estimating a firm's intrinsic value, by analysing and forecasting accounting numbers such as earnings, revenues, and expected growth (Palepu et al., 2013). Alternatively, there is a multiple-based approach that does not involve as many technicalities when evaluating a business (Palepu et. al, 1999). It is an approach that relies on comparable industries and firms, and with the use of simple multiples such as Price-to-Earnings and Price-to-Book ratio, it is possible to get an outcome that might be misleading when compared with a flow-based model.

Based on the idea that flow-based models and multiples-based models might differ across valuation purposes, this thesis will have as its main purpose to compare the results from these two different models. Further, the study will evaluate whether there are significant changes in pricing performance, through the test of bias, accuracy, and explanatory power. As a result of the differences expected from the use of different methods through a review of the literature (see

Chapter 2), we study the hypothesis that flow-based models outperform the multiples models, that RIVM is more accurate than DCFM, and more. Thus, this thesis intends to address some gaps within the literature.

The need to understand among all methods which one performs better and be able to rank all of them is the first point to address. During the period considered, from 2005 to 2015, the world experienced some distress moments from the 2008 crisis to the following years, where some countries struggled to survive bankruptcy. Therefore, the following chapters will aim to help fill these gaps as it is of most importance to analysts to have updated information as moments like the ones explained above could alter the performance of valuation methods.

Further, how sample selection impacts the performance of the models will also be an important question to address. After analysing the discrepancies in valuation methods using the large sample selection, further inferences will be made. One of these will be looking inside this big sample and considering only an accounting entry – Research and Development (R&D) specifically – where a similar analysis will be done on whether the different methods match each other. A division on the R&D sample will be made following Francis et al. (2000) study which aimed to understand where valuation estimates were more accurate; either on a low-intensive R&D industry or in a high-intensive. Following the analysis done in the present study, findings are expected to demonstrate how R&D entry directly affects the deviations in all methods.

After finding results on the large sample analysis, a shorter problem incision will be made. There will be some results to be proven, and a comparison with analyst reports will follow. With that, and after selecting a company, analysis on that business and a result comparison between analyst reports on which methods most favour its valuation, an insightful conclusion on the reliability of the equity valuation methods will be provided.

In sum, the main question I intend to answer is whether the reliability of the intrinsic value estimates derived from three flows-based models and a multiples-based model differ, as well as how performances are influenced by sample selection processes, mainly on the outliers.

2. LITERATURE REVIEW

Financial statements analysis is at the core of equity valuation, the value creation calculations adopt a long-term perspective, managing all cash flows across both the income statement and balance sheet to understand how to compare cash flows from different periods on a risk-adjusted basis (Copeland et al., 2000).

Accounting numbers are then, inevitably, a crucial player in this analysis as they can be read and provide useful information on a firm's businesses. Valuation relies on accounting information in doing firm valuation, but it is important to take into consideration that accounting numbers were not made with that purpose. Indeed, further skills apart from accounting, as finance, economics, marketing strategy, and corporate strategy must be fully incorporated (Lee, 1999). The chapter that follows will debate the roles of the different valuation models and the empirical findings on the models which will enable a full comparison between them, having an important role for the large sample assumptions.

2.1.Relation between accounting principles and valuation

The accounting information has its value and its failures. Since managers can manage earnings on their behalf and interest, they can take advantage of that power. For that reason, the existence of accounting standards is an important part of protecting the investors from these failures and potential distortions by managers (Palepu et al., 2004).

By including the accounting standards in the analysis is possible to look with less concern to the "bottom line" in financial statements, which is the Net Income (i.e., earnings). Authors such as Lev (1989) consider earnings as one of the most relevant pieces of information on the financial statements, reason behind this is the number of models that are on its calculations uses the earnings variable. Ball and Brown (1968) argue that the accounting numbers directly influence the valuation estimates since a strong correlation was found between market participants' reactions and earnings variations (i.e., higher earnings lead to higher share prices).

Thus, the use of reliable accounting information, not forgetting all the surroundings in valuation analysis, permits the estimation of a firm's value through those accounting numbers by discounting future forecasted accounting flows (Goedhart, Koller & Wessels (2005). For this to happen there are a few models that are used, with a clear distinction between flow-based models, where are included models as Dividend Discount Model (DDM), the Discounted Cash Flow Model (DCF), and the Residual Income Valuation Model (RIVM), and multiple-based models on a Relative Valuation, such as price-to-earnings (P/E) ratio and price-to-book (P/B) ratio (Damodaran, 2002). Also, Damodaran (2002) presents Return Based Approach and Contingent Claim Valuation as options for valuation.

Valuation Methods			
Discouted Cash-Flow Approach	*Relative Valuation*	*Return Based Approach*	*Contigent Claim Valuation*
Free-Cash Flow to the Firm (FCFF) Free-Cash Flow to the Equity (FCFE) Dividend Discount Model (DDM) Residual Income Model (RIM)	Price-to Earnings (P/E) Price-to-Book Value (P/B) EV/EBITDA EV/SALES	Economic Value Added	Option Pricing

Figure 1: Valuation Methods

Source: Damodaran (2002)

The methods presented above have been used to value companies through the years. For this literature review, a focus will be applied on the Discounted Cash-Flow Approach and the Relative Valuation.

2.2.Flow-Based Models

There are different value creation points in the equity valuation analysis as the Dividends, the Residual Income, or the Free-Cash-Flow. These methods will diverge as there will be different value drivers considered. Nevertheless, we should arrive at similar conclusions about the correspondent intrinsic value calculated throughout the use of different models, since all are theoretically driven from the DDM. A literature analysis will be made on flow-based models.

2.2.1. Dividend Discount Model

The dividend Discount Model will be the first flow-based model to be analysed, the reason behind it is the preponderant role of DDM in the spectrum of valuation models, being the basis of most of them (Barker, 2001). From an equity perspective, the DDM when evaluating a company computes the present value of the expected future dividends (Ross et al., 2008). Thus, assuming the dividends to be the cash that investors ultimately receive from investing in an equity share (i.e., all cash flows between shareholders and the firm), the market value of equity will be equal to those dividends' forecasts discounted to the present (Palepu et al., 2013). The most straightforward and probably easy DDM formula is known as the Gordon Growth Model (GGM) as follow:

$$V_t^e = \frac{E_t[\mathrm{DIV_{t+1}}]}{(R_e - g)}$$

Where,

V_t^e= the present value of all future dividends (value estimate)

$E_t[\mathrm{DIV_{t+1}}]$ = the dividend to be paid 1 year from now

R_e= the cost of equity

g = growth rate

This variation assumes that the dividends will grow to infinity at a constant growth rate (Gordon, 1961). The truth is that is unrealistic to forecast dividends for unlimited time life. One of the reasons for this is that less mature companies, usually smaller firms, are more susceptible to bankruptcy risk (Hovakimian et al., 2012). Therefore, not only the DDM but also other valuation models include a terminal value component. Terminal value is the calculation of the perpetuity value and can be interpreted as the value of the firm (equity perspective) for that forecasted period.

After the terminal value adjustment, the formula would be as follows, when including T-years of forecast periods:

$$V_t^e = \frac{E_t[\mathrm{DIV}_{\mathrm{t+T}}]}{(1+R_e)^{\mathrm{T}}} + \frac{E_t[\mathrm{DIV}_{\mathrm{t+T}} * (1+\mathrm{g})]}{(r_e - g)(1+R_e)^{\mathrm{T}}}$$

The Dividend Discount Model has been used widely in valuation analysis. One of the main reasons this model prospers is due to its simplicity, not requiring much complex analysis in its use (Brealey et. al 2005). Whenever simplicity comes to the surface many limitations are usually linked to it. Since the model assumes dividends as its centre of value creation a problem already starts from the square zero, as all valuation calculations can be at risk if a company does not pay dividends. Furthermore, even when a company pays dividends it can lead to a misleading equity valuation, as companies sometimes go under some financial distress problems and still pay dividends (Hillier, 2016).

The terminal value also constitutes a problem to this model as Olson et al. (2000) found within their research on high dependence of the terminal value in the DDM. Thus, changes in the growth rate and the discount rate can cause significant variations in the model results.

2.2.2. Residual Income Valuation Model

The Residual Income Valuation Model has been subject to continuous improvements over the years, with the first time being introduced by Preinreich (1938). Ohlson (1995) made this valuation model subject to more discussion in the equity valuation world. This model uses Residual Income as the centre of value. In broad terms, Residual Income (RI) refers to earnings with the deduction of the cost of the initial shareholder's investments (Feltham & Ohlson, 1995). Residual Income uses then, book value, and forecasted future earnings to back out dividends using the clean surplus relation (CSR) if using an equity perspective. It is also possible to adopt an entity perspective that uses the net operating profits after taxes, and a capital charge on the total capital used is deducted. Both perspectives can be represented as follows:

$$\mathrm{RI}_{\mathrm{t+1}} = NI_{t+1} - R_e * BVE_t$$

$$\mathrm{RI}_{\mathrm{t+1}} = NOPAT_{t+1} - WACC * NA_t$$

Where,

RI_{t+1}: is the residual income at time t +1,

BVE_t: is the book value at time t,

NI_{t+1}: is the net income for period t +1,

R_e: is the cost of equity capital,

$NOPAT_{t+1}$: Net operating profit after taxes in year t+1,

$WACC$: Weighted average cost of capital,

NA_t: Net Assets at time t.

This deduction can be referred to as the required equity and equals the initial Book value of equity times the discount rate. Given that we are referring to equity, the appropriate rate to use will be through the CAPM model.

In conformation with the Clean Surplus Relationship (CSR) and through the DDM formula we can reach the RIVM formula. This CS relationship states that earnings are equal to the change in book value of equity plus dividends net of capital (O'Hanlon, 2009). The relationship is stated as:

$$\mathrm{BVE_t} - \mathrm{BVE_{t\text{-}1}} = NI_t - DIV_t$$

The final RIVM formula follows as below (required rate of return assumed to be greater than growth rate):

$$\mathrm{V_t^e}{=}\mathrm{BVE_t} + \frac{E_t[RI_{t+\mathrm{T}}]}{(1+R_e)^{\mathrm{t}}} + \frac{E_t[RI_{t+\mathrm{T}}{}^{*}(1{+}\mathrm{g})]}{(\mathrm{R_e} - g) * (1+R_e)^{\mathrm{T}}}$$

If the model follows the Clean Surplus Relationship both methods, the DDM and the RIVM, should give similar results as they are theoretically based on the same formula from DDM. Despite this correlation between both models they might differ because when CSR does not hold (if all changes in assets and liabilities unrelated to dividends do not go through the income statement) it is expected to result in different intrinsic value estimates.

The RIVM is subject to critics on the reliability of the accounting policies and practices. The fact that accrual accounting is more prone to management manipulation is not enough for Francis et al. to discard the RIVM as one of the best models in equity valuation, as he states that "(…) neither accounting discretion nor accounting conservatism has a significant impact on the reliability of RIVM value estimates" (2000, p.47). Courteau (2006) also supports Francis et al. (2000) statement referring that more precise earnings forecasts and a larger proportion of intrinsic value are explained under the RIVM model when compared with the DDM and DCFM.

This is a model that is supported by some authors as stated in the above paragraph, but some main concerns must be addressed: the forecast of the RI, the estimation of the book value, the estimation of Terminal Value, and the estimation of the Cost of Equity Capital.

Residual Income estimation is the process of forecasting future earnings and depending on the companies it can be hard to estimate these values over more than two years. The I/B/E/S is one of the most common sources in getting this type of data. When this is not possible other theories can be adopted as some analysts provide forecasts on longer periods. Frankel and Lee (1998) conducted an analysis on the Dow index, that indicated the use of RIVM to be consistent in the sample period analysis when compared with other common multiples at that time, as the P/B and P/E. To their knowledge, it was "(…) the first study to develop a prediction model for long-run analyst forecast errors, and to trade profitably on that prediction" (Frankel and Lee, 1998, p.284)

The Book Values are not always available and thus analysts have to compute future book values forecasts. This is done through CSR, a concept explained above. Usually, a dividend pay-out ratio is used, a process that can complicate once earnings are negative. Solutions to the above are trimming negative observations and introducing a sample selection bias or replacing them with estimated long-run earnings performance (Lee 1999). An alternative solution when dividends are greater than earnings is to set pay-out = 1 (Liu, 2002). Regarding other negative value estimates Francis et al. (2000) states that negative value estimates should be set to zero.

Terminal Value estimation is another concern to consider, as after the forecasting period a terminal value is needed to be determined from the forecast period onwards. Francis et al. (2000), Kaplan and Ruback (1995), and Penman and Sougiannis (1998) have a comparable opinion on which growth rate to assume on the terminal value calculation and it is the average inflation rate (the authors adopt a 4% rate up to that time).

Cost of Equity Capital is another value that requires a proper estimation as it will be the model discount rate. Varying with the perspective adopted, equity perspective, or entity perspective, different rates will be used correspondingly the CAPM or the WACC. In this dissertation, once the equity perspective will be adopted the CAPM will be the one to take into consideration. CAPM estimation requires the measure of the risk-free rate, the Beta for the firm, and the Market risk premium. The risk-free rate is the target of different opinions regarding its time horizon, namely Pazarzi states that "(…) the risk-free rate derives from the annualized 3-month Treasury Bill discount rate" (2014, p.95) , while Liu et al. uses on his research "the 10-Year Treasury Bond Yield" (2002, p.147). The Beta measurement under Liu et al.'s analysis is said to be prone to error when calculated for an individual firm, so it is suggested to "(…) set firm beta equal to the median of all firms in the same beta decile" (2002, p.147). Lastly, the market premium, probably the one that is susceptible to more debate among researchers. Usually, a 5% risk premium is assumed and thereafter some sensitive analysis is made to test how results are different with different rates (Pazarzi, 2014).

Following the sensitive areas that the RIVM model incorporates there is no clarity in the advantages of the model among authors. Empirically findings of Lundholm and O'keefe (2001) and Dechow et al. (1999), indicate that the model might not be their favourite. Apart from the fact the RIVM be considerably like the DDM, these authors defend that the weight put on the analysts' forecasts is too high when compared to current earnings. This weight can have a big impact since the forecasts can be miscalculated. Furthermore, the accounting policies can be different among countries, leading to different use of accounting components in valuation.

On the other hand, we have Francis et al. (2000) defending the model. Their reliability study of intrinsic value estimates found that RIVM value estimates are more accurate and explain greater variations in prices than DDM or DCM value estimates. Penman and Sougiannis (1998) did a similar analysis on whether this accrual-based method did perform better than the other options on equity valuation. As stated in these author conclusions "(…) equity valuations based on forecasting GAAP accrual earnings and book values have practical advantages over forecasting dividends and cash flows" (Penman & Sougiannis, 1998, p.376).

2.2.3. Discounted Free Cash Flow Model

Another method for the calculation of equity valuation is the Discounted Cash Flow Model that once more is a valuation method that derives from the DDM. The difference between both is related to the value driver, replacing the dividends for the free cash flows. With this change, the model tries to capture the cash flows that are available to distribute to shareholders and debtholders (Penman, 2007). In the case where the company does not pay dividends and has cash available, it still incorporates that value being an advantage compared to the DDM. That is, in some ways, this model tries to fulfil the DDM failure when companies do not pay dividends.

The model can be written in an equity perspective and a firm perspective as well as the other FBVM's. When focusing on the cash flows distributed to the shareholders, we adopt the equity form, calculating the Free Cash Flow to Equity (FCFE), using the CAPM as the discount rate. The other case is when we distribute the earnings not only to shareholders but also to debtholders. In this case, we calculate the Free Cash Flow to the Firm (FCFF) and use the WACC as the discount rate. For this dissertation the equity perspective is going to be adopted, so more focus will be directed to the FCFE. Independently, both free cash flows are going to be represented, respectively the FCFE and the FCFF (Francis et al., 2000):

$$\text{FCFE} = \text{NI}_t + \text{DEP}_t - \Delta\text{WC}_t - \text{CAPEX}_t + \text{Net borrowings}_t$$

$$\text{FCFF} = \text{NOPAT}_t + \text{DEP}_t - \Delta\text{WC}_t - \text{CAPEX}_t$$

Where,

NI_t : is the net income in year t,

$NOPAT_t$: Net operating profit after taxes in year t,

DEP_t : is the depreciation expense for year t,

ΔWC_t: is the change on working capital in year t,

$CAPEX_t$: is equivalent to capital expenditures in year t,

Net $borrowings_t$: is equal to the net debt issuance minus net debt repayments in year t.

Using the FCFE with the assumption of constant growth for perpetuity results in the following calculation of the intrinsic value of equity (Palepu et al., 2013):

$$V_{te} = \frac{E_t[FCFE_{t+1}]}{(R_e - g)}$$

Where,

V_{te} : Equity value at the time of the valuation

$E_t[FCFE_{T+1}]$: Expected free cash flows to equity at time t

R_e : Cost of equity

g : Growth rate

T: Time in years.

Similarly, the DDM model is unrealistic to look for the model as perpetuity. Thus, to complement the model, like in DDM, a value term must be added to turn the model into a finite-time valuation. Thus, assuming flat or continuous growth perpetuity, the intrinsic value of equity will be as follows:

$$V_{te} = \frac{E_t[FCFE_{t+\mathrm{T}}]}{(1+R_e)^{\mathrm{T}}} + \frac{E_t[FCFE_{t+\mathrm{T}} * (1+g)]}{(R_e - g) * (1+R_e)^{\mathrm{T}}}$$

The DCF is a model that compared with the Residual Income model, has an underlined advantage related to cash flow manipulation (Damodaran, 2007). Lev (1989) supports this opinion. The use of the cash flow statement for the DCF method is the key factor when compared with the Income Statement used in RIVM. The cash flow statement is nothing else than a conciliation of both, Income Statement and Statement of Financial Position, where it has as its main goal to record a firm's cash transactions in a given period (Securities and Exchange Commission, 2021). Using the RIVM, accrual accounting may create a problem as earnings manipulation is easier to be made by companies. In the DCF that will be eliminated, as cash flow statements will notice which revenues have or have not been collected. Thus, those accrual revenues will not be included in the FCF's. For this method to work, it is needed that this type of statement is included in the firm's report. FASB has a really important role in this aspect by incentivizing firms to provide financial information to help investors, creditors, and others assess the amounts, timing, and uncertainty of prospective net cash in flows to the related enterprise (Financial Accounting Standards Board, 1978).

Robichek and Myers (1966) advanced an objection to this model early in 1966, where they stated that cash flows suffer high uncertainty as to the time horizon increases. This is related to the study of Francis et al. (2000), where the terminal value is discussed to be difficult to measure since very sensitive analysis on the growth rate or the discount rate must be included. Another problem related to this model is aligned with the investment decision of the company, as sometimes negative cash flows can happen when the company invests in capital expenditures (Penman, 2013).

2.3.Multiple based models

The Multiple-based models' approach when compared with the flow-based models, has as the main difference: the unnecessary multiyear forecast (Palepu et al., 2000). Goedhart et al. (2005) state that companies focus too much on the discount flow models and that could threaten the valuation estimates. Goedhart et al. (2005) recommend four principles when using multiples:

1. Find similar companies in terms of growth and ROIC
2. Use forward-looking multiples, based on future earnings
3. Use enterprise-value multiples
4. Adjust the enterprise-value-to-EBITDA multiple for nonoperating items

According to Bhojraj and Lee (2002), multiple-based analysis is one of the most used methods in equity valuation. Damodaran (2002) found empirically that around 90% of equity research valuations used a combination of different multiples on their reports. The division of multiples was made following equity and enterprise perspectives as follows:

Relative Valuation	*Multiple*
Enterprise Value Multiples	EV/EBITDA EV/SALES EV/EBIT
Equity Value Multiples	Price-to Earnings (P/E) Price-to-Book Value (P/B) Price-to-Cash-Flow Ratio (PCF)

Figure 2: Multiples - Relative Valuation

Source: Damodaran (2006)

Also, a survey of the equity valuation practices of CFA Institute members regarding equity valuation done by Pinto et al. (2015) showed that 92.8% of the respondents confirmed to use market multiples in valuation, followed by DCFM with 78.8%. More studies over this preference were made by Asquith et al. (2005) finding almost 99% of equity research reports mentioned the use of multiples by analysts.

This popularity is mainly due to its simplicity in use, where comparable firms, usually firms in the same industry, but also with comparable risks, value drivers, and business model, are used to calculate an estimate of a firm equity capital intrinsic value (Fernandez, 2002). Multiple analysis in equity valuation is relevant, not only to financial players as investment bankers or asset management teams but also to academic researchers (Lie & Lie, 2002). Furthermore, the implementation of multiples can be helpful under Initial Price Offerings (IPO), leveraged buyout transactions, and other activities in association with merger and acquisition (M&A) (Ernst & Häcker, 2012).

Analytically, the multiple valuations will be given by the multiplication of a chosen value driver from the company by a calculated benchmark multiple concerning its industry. The expression is given as follows (Liu et al., 2002):

$$V_i = VD_i * \text{ BenchmarkMultiple}(\Phi_i)$$

Where,

V_i: The estimated intrinsic value of equity of firm i

VD_i: Value driver of firm i (VD>0)

Φ_i: Set of n comparable firms for firm i

Unfolding the Benchmark multiple, we get:

$$\text{BenchmarkMultiple}(\Phi_i) = \frac{P_j}{VD_j}$$

Where,

P_j: Observed price for the jth comparator firm

VD_j: Value driver of the jth comparable firm with j=1,2,…,n

The value driver of the firm should be always positive, since the estimated intrinsic value can be undefined when for example, we use earnings, and they are negative. Within the choice of the value drivers, there are two natures to adopt, an equity and enterprise perspective. Respectively in the case of equity, a value driver linked to shareholders like Net Income (NI) will be used while at the entity level the Net operating profit after taxes (NOPAT) will be used for the equity value (Penman, 2013).

When using the multiples for equity valuation purposes some implementation issues will directly affect the intrinsic value. Therefore, analysts or even academic researchers have a few choices to opt from. There are three main issues to address: (1) the choice of the value driver; (2) the choice of comparable firms; and (3) the choice of the calculation of the benchmark multiple (Baker & Ruback 1999).

2.3.1. The choice of the value driver

Regarding the choice of the value driver, there have been in the literature different thoughts among authors. A debate on whether accrual-based or cash flow-based is the most appropriate for the multiple valuations has been the centre of discussion (Liu et al., 2002). Accrual-based drivers are prone to be manipulated by managers, incurring then to that risk of misleading information. On the other hand, the cash flow-based model is not subject to that manipulation risk since the accruals are seen by the naked eye at the cash flow statement. Koller et al. (2010) consider that this disclosure makes the cash flow-based model a better model when compared to the RIVM.

Despite the claim that accrual-based might be considered misleading, Liu et al. (2002) found in a sample analysis in the US, that the accrual-based multiples outperformed the cash flow-based multiples. This opinion is backed with the meaning of earnings in an accrual-based. The accrual-based enables the investor to profit from a more incise knowledge about future profitability and value creation of a firm (Nichols & Wahlen, 2004).

Under the broad number of multiples available, Fernández (2001) concluded in his study on 1200 multiples from 175 companies that the Price-to-Earnings (P/E) and the Enterprise value over EBITDA (EV/EBITDA) were the most used. Fernández (2001) also concluded that depending on the industry, there were specific multiples that were more appropriate than others. The example of the Automotive industry where the Price-to-Sales seemed to be the most common while in the Technological sector the PER was the most used.

Liu, Nissim, and Thomas (2002) enter in on this discussion, on whether the industry affected the choice of the multiples. They concluded that independently of the industry earnings multiples, it did perform better in all industries, rejecting the idea of the study done by Fernández (2001).

In sum, there is no right answer when choosing the value drivers in different industries. Even though studies might state different results on the type of multiple over different industries, almost all conclude that in general accrual-based multiples are the most common and best option since they present more detailed information about a firm's profitability and wealth creation.

2.3.2. The choice of comparable firms

The choice of comparable firms is a must in multiples valuation since many factors must be considered for its calculation regarding risks, business models, and the value drivers, with the stated literature review above representing an important role. When choosing comparable firms there are two paths to adopt: first to use a single comparable firm, or second to use a set of comparable firms.

The best path would be to find a single similar company that has similar business models, industry, risk relative to the firm's size, and earnings growth (Palepu et al., 2000). Although this would be the ideal way of doing it, it is difficult to find similar companies in such a way, for that reason a set of comparable companies are used instead. This approach brings advantages with it as well since the use of diversified companies within the industry will cancel out firm-specific risks. On the other hand, there is a disadvantage to be highlighted. The use of companies of the same industry can lead to misleading results in the multiples valuation since firms' have different objectives, strategies, and profitability (Liu et al., 2002).

2.3.3. The choice of the calculation of the benchmark multiple

The most common and simple approach when calculating the benchmark multiple is to use an arithmetic mean. However, this may not be the best alternative as sometimes there are some extremes on the sample analysis and it might produce skewed results (Agrrawal et al., 2010). The benchmark multiple has the following alternatives for its calculation:

$$Arithemetic\ mean = \frac{1}{n}\sum_{j=1}^{n}\frac{P_j}{VD_j}$$

$$Median = median(\frac{P_j}{VD_j})$$

$$Weithed\ Average = \frac{\sum_{j=1}^{n} P_j}{\sum_{j=1}^{n} VD_j}$$

$$Harmonic\ mean = \frac{1}{\frac{1}{n}\sum_{j=1}^{n} \frac{P_j}{VD_j}}$$

Where,

P_j: Observed price for the jth comparator firm

VD_j: Value driver of the j_{th} comparable firm with j=1, 2, …, n

n: Number of comparable firms

The biased results using arithmetic are stated by Baker and Ruback (1999) to lead to upwards valuation values. The authors also defend that use of the harmonic mean will lead to a better performance valuation as the mean will not consider the outliers leading to a more precise mean. In addition, Liu, Nissim, and Thomas (2002), and Damodaran (2016) defended that the use of the harmonic mean provides better estimates.

2.4.Hypothesis development

The literature review serves the purpose of finding specific subjects that can be addressed. The hypotheses development and the rationale behind it are going to be tested based on further sample analysis to check whether those hypotheses hold, or not. Primarily, the clash between flow-based models and multiple based models is the biggest topic to address, leading to the first hypothesis:

H1: Flow-based models provide more accurate and less biased equity valuations than Multiple-based models

In practice, it is seen that most professionals use Multiples-based models for their simplicity. For example, 92.8% of the respondents in Pinto et al.'s (2015) study as referred to above-used market multiples in equity valuation. Estimating multiple periods through the flow-based models is difficult, the high level of dependence in available information, the assumptions to be made on the discount rates, and the terminal growth, cause multiples to be in most cases the first choice in equity valuation (Barker, 1999). Despite all those technical limitations Imam et al. (2011) found that analysts using earnings multiples also used flow-based models as the DCF to support the analysis.

Although it seems that multiples are the first choice, we are evaluating whether they perform better. An empirical study by Courteau et al. (2006) used data from 1990 to 2000 of Value Line Investor Services and showed that flow-based models provided a higher return prediction power when compared to multiples, and thus a lower prediction error and less biased results. With more fresh data this dissertation will aim to back up the power of flow-based models or controversially argue the changes on the valuation's models predictability ranking.

Among flow-based models the discussion over the cash valuation model versus the accrual model leads to the next hypothesis, which will also provide ranking information within flow-based models:

H2: The accrual-based valuation model (RIVM) is more accurate than the cash flow-based model (DCFM)

The accuracy of RIVM over the other flow-based models (the DDM and DCFM), seems to have a big gap difference as seen within Francis et al.'s (2000) research. The absolute prediction error of RIVM was 30%, whilst the DCFM was 41% and the DDM was 69% in his study. Also, Penman and Sougiannis (1998) provided empirical analysis that the RIVM outperforms the DCFM and the DDM.

Recently, researchers are providing evidence that the accrual-based problems are creating challenges on the approach to choose, as earnings might not be as accurate and not sufficient to value a business (Hui et al., 2013). Hui et al. state that "industry-wide cash flows is the most persistent component of earnings while (…) firm-specific accruals are the least persistent" (2013, p.186). This is supported also by Call et al. (2009), where he defends that the complexity when valuing a company through the cash flow approach will lead to more accurate results, as there will be a deeper understanding of the financial statements that will lead to a wider understanding about the company outlook, and thus its valuation. Despite empirical analysis stating the opposite, recent research shows a turnaround on the model chosen, so this hypothesis will provide useful information on that matter.

It seems market participants rely on themselves in the use of multiples more and more, despite all the flaws it incorporates. Imam et al. (2011) consider that the use of flow-based and multiple-based models together leads to lower valuation errors. Thus, tests on the performance of the two models that seem to provide more accurate valuation estimates in the literature, MBM (Barker, 1999) and RIVM (Courteau et al., 2006), will be made regarding the explanatory power of both models together.

H3: The use of RIVM and MBM together leads to the higher explanatory power of price variance

This hypothesis intends to compare the univariate regressions of RIVM and MBM on the stock price to the multivariate regression of both models. The results are going to support whether the use of both decreases or not estimated valuation errors.

The required analysis on the different models requires a sample selection that able results to be as best as possible according to the data provided. The outliers are one important selection and can be segmented in two ways, through trimming, where the outliers are removed, or through winsorization, where outliers are substituted by the 1st and 99th percentile values.

Lusk et al. (2011) argue that the loss of observations in trimming did compensate because the decrease in the variance of the estimates overweight's the sample size reduction. The reduction of the sample could be on the other side a constrain to the estimation analysis. In this scenario, it is argued that the winsorization process will englobe the observations that cause variance to increase but, in some parts, modelled to provide more reliable estimates. Nicklin and Plonsky in a recent study investigated how measurement errors should be cleaned where it was "(…) recommended winsorizing as opposed to trimming in order to avoid the elimination of legitimate data" (2020, p.51). The importance of choosing the right sample process led to the following hypothesis:

H4: Trimming outliers leads to more accurate and higher explainability on value estimates than the use of Winsorization

The debate between trimming and winsorization in valuation analysis has not been in-depth investigated, thus the need to incorporate this hypothesis. The recent studies on these seem to be increasing but not specific to the calculation of valuation estimates, the case of Nicklin and Plonsky (2020) where it was related to wages and salaries.

Following the study conducted by Francis et al. (2000), the accuracy and the explanatory power between different groups and industries will be tested, in this case, according to the R&D financial data of each firm. The hypothesis tries to understand how different industries estimates respond to the different valuation methods.

H5: Low-intensive R&D firms provide more accurate, less biased, and higher explanation power on equity estimates than High-Intensive firms

Amir and Lev (1996) conducted a study on the same subject testing the accuracy between the two samples of high and low intensive R&D firms. The conclusions of Amir and Lev's (1996) study showed higher explanatory power on lower R&D intensive firms. The reasons behind this are related to the highest manipulation on financial statements when having more R&D components in a firm, and thus leading to less precise valuation analysis.

3. LARGE SAMPLE ANALYSIS

3.1.Methodology

Following the analysis of the literature review on the three flow-based models and the multiples-based models, it is time to apply them to real data–specifically to a large sample of US public firms with data available. In the case of the multiple valuation approach, the value driver to be used will be the forward price to earnings succeeding Liu et al. (2002). The descriptive information and financial statements will be collected from Compustat, CRSP, and I/B/E/S.

Following this, a comparison of the performance and reliability of the value estimates is made with the market prices. The performance will be evaluated by comparing how accurate the value estimates are when compared with market prices, in other words, valuation errors percentage will be calculated as follows:

$$Valuation\ Error = \frac{VE_t - P_t}{P_t}$$

In line with Francis et al. (2000), further analysis on the reliability of the RIVM model and the Flow-based models is going to be scrutinized. The results of the study were that the RIVM was the most reliable when examining the accounting component of R&D expenditure. The impact on the valuation estimates will be investigated on the sample analysis by comparing all the valuation models in terms of high and low R&D investment.

3.1.1. Sample Selection

The data observation period starts in 2005 and ends in 2015. The dataset includes all observations of U.S. public firms over this period from Compustat, CRSP, and I/B/E/S. For this analysis, there will be a total of 37,106 initial firm observations. Afterward, a data selection will be made under the following criteria, first, use all U.S. firms publicly traded with its data available on the platforms referred, and then check the total assets from Compustat, analyst one and two year ahead EPS forecasts from I/B/E/S and see if the price four months after the fiscal year-end are not missing.

In a bigger outlook, this large sample will include firms from different industries, where it has some of the following firm information: firm general descriptions as name, accounting data information as earnings, assets or shareholders' equity, analysts' forecasts, and marketing prices as stock prices. Specifically, general descriptive firm information will be collected from Compustat, analysts' forecasts will be available on the I/B/E/S, and information as the stock prices will be retrieved from the CRSP.

From the initial 37,106 observations, some companies had to be removed to provide more clear and trustworthy results. On the selection process, duplicated companies on the data set were the first to be eliminated. In line with Lie and Lie (2002), specific industry groups have more regulations or different accounting statements due to their capital structures, thus these companies would negatively affect our sample. Removing the financial and the utility companies was the solution. Damodaran (2009) supports this as he states that it is hard to estimate Free Cash Flows to Equity (FCFE) and compute Net Capital Expenditures and non-cash Working Capital in the banking industry.

Furthermore, observations where specific accounting lines (described further) had negative values, were missing or were equal to zero and which were needed for the different models' calculations were removed. The incomplete data set involved the following data, the one and two-year forecasts of earnings per share (EPS1 and EPS2), the dividends per share (DPS1 and DPS2), stock price four months after the fiscal year ends (Prc4), Beta, BVE per share (BVEPS), and one as well as two years ahead calculated FCFE per share (FCFEPS1 and FCFEPS2). In the multiple model valuation, to guarantee that there was a minimum of comparable firms in each industry it was set a minimum of 10 observations.

Another important problem to consider on the data is the outliers. Those extreme observations require either trimming or winsorization. Lusk et al. (2011) argue that the loss of observations in trimming did compensate, as the reduction in sample size was responsible for a decrease in variance that overweight's the sample size reduction. Also, Dixon and Yuen (1974) concluded trimming was the best option when having observations with long-tailed distributions. On the sample analysis, the affected data presented values of high skewness, meaning the presence of long-tailed distributions and thus, a trimming approach was adopted for the remaining large sample analysis. The adjustments for the sample selection are as follow:

Table I

Summary of Sample Selection

Description	Delete	Total
Observations of U.S. public firms between 2005 and 2015		37,106
Duplicated Observations	145	36,961
Models Calculations		36,961
Removal of financial companies	7,905	29,056
Removal of utility companies	1,351	27,705
Removal of industry groups with less than 10 observations	1,787	25,918
Removal of missing variables[1]	10,293	15,625
Removal of negative variables	12,878	2,747
Removal of missing model's estimates[2]	123	2,624
Removal of missing variables of R&D sample	32	2,592
Trimming Observations[3]		2,592
Removal of variables below 1st percentile	228	2,364
Removal of variables over 99th percentile	268	2,096
Final Sample		**2,096**
R&D Sample Division		
Low-Intensive R&D Firms[4]		939
High-Intensive R&D Firms[5]		524

[1]The missing variables include the earnings per share for 2-periods-ahead (EPS1, EPS2), dividends per share 2-periods-ahead (DPS1, DPS2), stock price four-month after the fiscal year ends (Prc4), the BVE per share (BVEPS), and the calculated Free-Cash-Flow to equity per share for the 2 -periods -ahead (FCFEPS1, FCFEPS2). The same applies to the negative variables.

[2]The models' estimates include the estimates for RIVM, DDM, DCFM, and MBM.

[3]The above variables in note 1 plus all the absolute valuation errors and all the model's final estimates above the 99th percentile and below the 1st percentile were trimmed.

[4]The low-intensive R&D sample includes all firms with zero or Immaterial R&D.

[5]The high-intensive R&D sample includes the firms with the 25% R&D expenditures total assets.

3.1.2. Data Specification

The Large Sample analysis will include four valuation models, three flow-based valuation models, and a multiple-based (as stated above). Following the discussion on the models that fit the valuation purposes on the FBMV the DDM, RIVM and the DCFM are going to be used. For some models to provide trustworthy results some observations had to be removed, the specific case of financial companies that would lead to misleading results in the DCFM as the calculations of the FCFE would be difficult to made (Damodaran, 2009). The multiple-choice was based on Liu et al. (2002), where the forward earnings were considered to provide more accuracy as a value driver and then the use of Price-to-Earnings multiple consequently. The sample selection ends up leading the observations to be financial stable firms, as firms with uncertain variables were removed.

3.2. The Flow-based Model Valuation

The different flow models involved a set of implementation issues to the current analysis on the valuation approaches performances. Thus, it is important to consider and expose the implementations adopted in respect to forecast horizon, cost of equity, growth rates, dividend pay-outs, and all other computations, shown as follows.

First, the time horizon adopted for all three methods was the two-year ahead forecasts followed by the terminal value calculations. The debate was between two and three years where Sougiannis and Yaekura (2000) argue that a three-year period was better to overcome different accounting policies, as an example in the R&D rubric. On the other side, Frankel and Lee (1998) set a two-years forecast as enough, which due to the lack of observations that a time horizon increase would create made sense to adopt. In the sensitivity analysis, a three-year forecast will also be adopted to check the differences.

The Cost of Equity (COE) calculations was based on the equity perspective; therefore, the discount rate was calculate based on the Capital Asset Pricing Calculation:

Cost of Equity (RE) = $Risk\ Free\ Rate\ (rf) + Beta\ (\beta) * (Market\ Risk\ Premium\ (rM - rf))$

Still within the COE, the risk-free rate followed Parazzi's (2014) study, where it was adopted the annualized 3-month Treasury Bill discount rate. The beta already involved more concerns as negative betas in some observations were giving misleading discount rates. For that reason, under Ross et al. (2009), an average industry beta was used for each industry. The market risk premium under Copeland et al. (1994) study is going to be 6%.

The Growth Rate used for terminal value calculations in the model's valuation is going to be 4%, a similar growth rate used in Penman and Sougiannis (1998). Also, in Francis et al. (2000) the 4% growth rate was used, as well the 0%, which will be used for sensitivity tests.

The Dividend Pay-out Ratio, the dividends divided by the earnings, to be sustainable have incorporated two restrictions, when above 1 or when with negative values. The ratio above one is not sustainable for the firm in the long-term as it is paid more dividends than the cash available, thus when the ratio>1 we set the ratio =1. In addition, observations with negative values were removed throw sample selection.

Apart from these assumptions, some models required variables that are not available in current platforms (Compustat and I/B/E/S), and, thus, they needed to be calculated to proceed with the analysis. For the RIVM, BVEPS at the beginning of the forecast period was one of those variables:

$$BVEPS_i = \frac{Total\ ordinary\ equity_i}{Common\ shares\ outstanding_i * adjustment\ factor_i}$$

Also, for FCFE calculations for the DCFM model, variables as the working capital, net borrowing debt, and book-value of equity were calculated as well.

The formulas for these requirements are as follows:

$$FCFEPS_i = \frac{FCFE_i}{Common\ shares\ outstanding_i * adjustment\ factor_i}$$

$$\Delta WC_T = WC_t - WC_{\ t+1}$$

$$WC_t = CA_t - (CL_t - debt\ in\ CL_t)$$

$$\Delta BVD_T = BVD_t - BVD_{t-1}$$

$$BVD_t = TA_t - BVE_t - CL_t + debt\ in\ CL_t$$

Where,

ΔWC_T: Change in working capital during period T

WC_t: Working capital at time t

CA_t: Current assets at time t

CL_t: Current liabilities at time t

ΔBVD_T: Change in book value of debt during period T

BVD_t: Book value of debt at time t

TA_t: Total assets at time t

BVE_t: Book value of equity at time t

Gathering all the assumptions, all the new variables calculated and all literature review with each model specifications, the intrinsic value calculations of each flow-based model is stated as follow:

Dividend Discount Valuation Model:

$$V_t^e = \frac{E_t[\mathrm{DIV}_{t+1}]}{(1+R_e)} + \frac{E_t[\mathrm{DIV}_{t+2}]}{(1+R_e)^2} + \frac{E_t[\mathrm{DIV}_{t+2} * (1+g)]}{(r_e - g)(1+R_e)^2}$$

Residual Income Valuation Model:

$$V_t^e = \mathrm{BVE}_0 + \frac{E_t[RI_{t+1}]}{(1+R_e)} + \frac{E_t[RI_{t+2}]}{(1+R_e)^2} + \frac{E_t[RI_{t+2} * (1+g)]}{(R_e - g) * (1+R_e)^2}$$

Discount Cash-Flow Valuation Model:

$$V_{te} = \frac{E_t[FCFE_{t+1}]}{(1+R_e)} + \frac{E_t[FCFE_{t+2}]}{(1+R_e)^2} + \frac{E_t[FCFE_{t+2} * (1+g)]}{(R_e - g) * (1+R_e)^2}$$

Where:

V_t^e: Equity value at the time of the valuation

BVE_0: Current book value of equity

$E_t[RI_t]$: Expected residual income in period t

$E_t[\text{FCFE}_t]$: Expected free cash flows to equity in period t

$E_t[\text{Div}_t]$: Expected dividends in period t

R_e: Cost of equity

g: Growth rate

3.3. The Multiple-based Model

The MBM adopted was the Price-to-earnings (P/E), therefore forecasted earnings were used following Liu et al. (2002). During sample selection, negative values of earnings were removed to prevent negative value drivers. The value drive used was as follows:

$$Value\ Driver = \frac{\text{Analyst forecast of EPS (Year t + 1)}}{\text{Stock price 4 months after fiscal year\_end}}$$

According to Baker and Ruback (1999), harmonic mean displays better, accordingly o the benchmark multiple, since it provides less biased results. Also, Kim and Ritter (1999), argue that a harmonic mean provides less deflated values. Furthermore, the choice of comparable companies was necessary, according to Alford (1992), the selection of 3-Digit SIC Code to industry comparable was the best choice. Conjugating all assumptions, we get the following expression for MBM using earnings as a value driver, accordingly to the above authors:

Multiple-Based Model:

$$V_i^{PE1} = \frac{1}{\frac{1}{n}\sum_{j=1}^{n}\frac{EPS_j}{Prc4_j}}$$

Where,

n: Set of n comparable firms for firm i

V_i^{PE1}: The estimated intrinsic value of equity of firm i

EPS_j: Analyst forecast of EPS j periods ahead

$PRC4_j$: The observed share price of the i comparable firm four months after the fiscal year ends

3.4. Descriptive Statistics

The summary of descriptive statistics for the relevant variables used in the large sample analysis will be the starting point on models' inferences, where the valuation models' and the price statistical properties are going to be presented first. All differences between descriptive statistics for valuation models' output variables are going to be presented, through analyses on prediction errors and regressions giving an overview for further statistical tests in the large sample analysis.

Next, a first overview is given in Table 2, where is possible to observe an average share price of all companies of $47.92 and the median share price as $43.43. The sample reduction helped the results to be more concentrated and reduce the skewness. Further, the output indicates a right-tailed distribution for PRC4 and to all valuation models (mean>median).

Table II

Price and Valuation Models Descriptive Statistics

Variables	Observations	Mean	Std. Dev	Q1	Median	Q2
PRC4	2,092	47.92	25.54	29.25	43.43	62.21
RIVM	2,092	30.03	24.09	13.43	22.83	39.49
DDM	2,092	9.69	12.75	0.46	5.56	13.42
DCFM	2,092	47.20	70.29	3.16	22.39	58.89
MBM	2,092	46.47	28.65	25.80	40.84	61.09

[1]Descriptive statistics of stock price and valuation models from 2005 to 2015 with the number of observations, standard deviation, first quartile, median, and third quartile.

For more accurate analysis, median results are considered rather than means. DFCFM results are a clear example, where there is a large dispersion between mean and median values, mostly caused by missing or negative estimates. Other problems urge on DDM when compared to PRC4, where either its mean or median present low estimates, meaning this model underestimates the market. Also due to sample selection. MBM seems to generate similarly and the most accurate value estimates regarding mean and median.

To evaluate the estimates in more detail, signed valuation errors (SVEs) and absolute prediction errors (APEs) will provide results for models bias and accuracy.

3.5. Valuation Errors

The valuation errors provide useful value differences between the current price and models' intrinsic values to comment on. Signed Prediction errors and absolute prediction errors are the two methods used to observe those differences. The closest the SVE is to zero, the less biased the model is. In contrast, the closest APE is to zero the more accurate is the model. Both are presented as follows:

$$SVE\ for\ Bias\ = \frac{Equity\ Value\ Per\ Share - Market\ Price}{Market\ Price}$$

$$APE\ for\ Accuracy = \frac{|Equity\ Value\ Per\ Share - Market\ Price|}{Market\ Price}$$

The SVE, when negative (positive) explicates that the firm in cause might be undervalued (overvalued) compared with the market price. To evaluate if value estimates are biased and accurate, SVE and APE are tested on whether the mean/median error equals zero:

$$H0: Mean/Median\ = 0 \qquad\qquad H1: Mean/Median\ \neq 0$$

The absolute and signed valuation errors are tested with a t-test for mean purposes and with the Wilcoxon test for median inference. For both error types, statistical significance is at a 95% confidence level.

As seen from table 3, all absolute and signed valuation errors are statistically significant from zero (p-value<0.05) except for the mean SVE of the MBM and DCFM when using a t-test. Thus, with a p-value of 0.6575 and 0.2362 respectively, the null hypothesis cannot be rejected at any significance level, meaning the SVE mean value is zero. This result indicates that the MBM and DCFM performs similar mean results to the market price as there is no evidence against the H0.

Regarding the median signed errors, all models have negative values, meaning they are undervalued compared to the market price, specifically DDM and DCFM with large deviations when compared with the RIVM and MBM, which seem to provide the best value estimates. Following absolute errors for accuracy, MBM also performs best, followed by RIVM, DCFCM, and DDM.

Table III

Bias and Accuracy of value estimates

Statistics		Mean	Median	Mean		Median	
Variables	Errors			t-value	p-value	z-value	p-value
RIVM	Absolute	0.47	0.45	83.46	0,0000	39.62	0,0000
	Signed	-0.34	-0.41	-36.46	0,0000	-29.22	0,0000
DDM	Absolute	0.8	0.87	163.2	0,0000	39.62	0,0000
	Signed	-0.77	-0.86	-1.3	0,0000	-38.52	0,0000
DCFM	Absolute	0.95	0.77	38.06	0,0000	39.62	0,0000
	Signed	0.04	-0.44	1.19	0.2362	-10.33	0.0256
MBM	Absolute	0.3	0.23	51.58	0,0000	39.62	0,0000
	Signed	-0.004	-0.07	-0.44	0.6575	-4.97	0,0000

[1]Table 3 reports mean and median Absolute and Signed Valuation Errors with the respective p-values of t-tests for means and Wilcoxon signed-rank tests for medians comparing the signed valuation errors to zero.

The results of Table 3 are key to produce an evaluation of the first hypothesis, as results on accuracy and bias are being provided in this output. Also, using a paired t-test will be useful for comparing models and to guide to support the second hypothesis. For Table 3 a fixed number of 2,092 observations was used.

3.5.1. H1: Flow-based models vs Multiple-based models

Hypothesis 1 Analysis:

The findings of Courteau et al. (2001) and Frankel and Lee (1998) in that the FBM's were more accurate than MBM's was used as the basis to create this hypothesis. Over the last few years, as the MBM has experienced an increase in its use (Barker, 1999), this hypothesis was deemed relevant to analyse, since one of the reasons for this could be that better results were achieved through MBM's.

The mean and median data of Table 3 were selected as a sub-sample for comment purposes. Looking to mean and median values it is observable that MBM performs better in terms of accuracy. As described in Table 3 the mean signed error for the MBM was not significant at the 5% level and thus the valuation error is inferred to be equal to zero, same with DCFM. For that reason, among all models, MBM provides less biased results followed by DCFM.

Table IV

Bias and Accuracy of value estimates (sub-sample)

Valuation Variables	Valuation Errors	Observations	Mean	Median
RIVM	Absolute	2,092	0.47	0.45
	Signed	2,092	-0.34	-0.41
DDM	Absolute	2,092	0.80	0.87
	Signed	2,092	-0.77	-0.86
DCFM	Absolute	2,092	0.95	0.77
	Signed	2,092	0.04	-0.44
MBM	Absolute	2,092	0.30	0.23
	Signed	2,092	-0.00	-0.07

[1] Table 4 Is a sub-sample of table 3 including the mean and median of Absolute and Signed valuation errors.

In terms of accuracy, MBM comes upfront with the best results as well, where its median is the lowest. The median absolute errors of MBM with a 23% markets price deviation and 32% of the RIVM were the lowest errors and thus the best models. Overall MBM outperforms all flow-based models presented in terms of accuracy and biasedness, results that contest the hypothesis. The FBMs assumptions as the fixed growth rate assumed, the cost of equity used and as well all the sample selection process made flow-based valuations more uncertain. The MBM outperformance will be also supported, or not, by univariate regressions in the following chapters. All in all, hypothesis 1 does not hold, with the potential implications behind it the difficulty in estimating FBMs variables, as well as to have all variables available without any inherent constrains.

Paired t-test

Using the absolute and signed errors it is possible to perform a paired t-test that facilitates the comparison between models. The paired t-test will check if the methods in question have similar absolute errors, or how much they differ between them. For this statistical analysis, the hypotheses are as follows:

$$H0: APE\ Mean/Median\ of\ model\ i\ =\ APE\ Mean/Median\ of\ model\ j$$

$$H0: APE\ Mean/Median\ of\ model\ i\ \neq\ APE\ Mean/Median\ of\ model\ j$$

For all results in Table 5, the p-values are equal to zero, thus the null hypothesis can be rejected at a 5% significance level, meaning a difference between errors exists. The results focused on accuracy, provide a clear ranking of models where MBM is better than all flow-based models. The RIVM outperforms DDM and DCF, and lastly, DDM is more accurate than DCFM. These results best explain the accuracy estimations in Table 2, reinforcing the power of MBM.

Table V

Paired t-Tests between RIVM, DDM, DCFM, and MBM

Variables	Absolute Valuation Error			
	Observations	**Mean**	**Difference**	**P-value**
RIVM DDM	2,092	0.48 0.80	-0.32	0.0000
RIVM DCFM	2,092	0.48 0.95	-0.47	0.0000
RIVM MBM	2,092	0.48 0.30	0.18	0.0000
DDM DCFM	2,092	0.80 0.95	-0.15	0.0000
DDM MBM	2,092	0.80 0.30	0.50	0.0000
DCFM MBM	2,092	0.95 0.30	0.65	0.0000

[1]The paired t-test shows how models perform against others whereby all values are significant. The MBM is better in terms of accuracy in the respective tests than the comparison methods, followed by RIVM, DDM, DCFM.

3.5.2. H2: Accrual-based vs Cash-Flow-Based Valuation

<u>Hypothesis 2 Analysis:</u>

The arguments provided by some authors that the RIVM was subject to earnings manipulation did not seem to be proven with the tests conducted. Through analysis of Table 5, it is observable that RIVM outperforms in terms of accuracy DCFM by a large difference of 47%.

The sample selection and the assumptions assumed took a key role in these discrepancies between models. Positively for the RIVM, the valuation model was based on the BVE which is not susceptible to assumptions. Where the BVE was taken from the balance sheet, the same could not be done with DCFM, because mainly forecasted assumptions were used. Additionally, DCFM tended to have less predictable cash-flows as there are not much investment data included in such a short time. Shroff (1998) states that earnings have lower variance and higher return correlation than cash flows supporting the RIVM performance.

This confirms the results of Francis et al. (2000), who state that the RIVM performs better than the DCFM but contradicts the opinion of Courteau et al. (2001), who assume that both perform almost equally well. All in all, hypothesis 2 holds, which is a strong indication that RIVM provides the most accurate estimates among all the flow-based models.

3.6. Regression Analysis

Further analysis on the model's performance was made, now for explanatory power. An OLS regression analysis was conducted that aimed to explain the relationship between the intrinsic value estimates and the market price. Univariate regressions were conducted first, where the independent variables were the four valuation models estimates for each firm. With market share price as the dependent variable for each company, the general univariate regression formula is as follows:

$$P_t = \alpha + \beta Value\ Estimate_t + \varepsilon$$

Where,

α: Constant,

P_t: is the stock price 4 months after fiscal year-end in period t,

$Value\ Estimate_t$: valuation estimate provided by each model at period t

ε: the error term.

The first analysis in Table 6 below is to check whether the independent variables directly affect the stock price. The p-values are less than the 5%

significance level, which confirms that all coefficients can explain in some part share price fluctuations.

The R-Squared is then the most relevant statistic, as it can explain how much of the dependent variable variance can be explained by the independent variable selected. Results are shown as follows:

Table VI

Price Univariate Regressions on Valuation Models

Valuation Model	RIVM		DDM		DCFM		MBM	
Variables	Constant	βRIVM	Constant	βDDM	Constant	βDCFM	Constant	βMBM
OLS Coefficient	30.99	0.56	43.3	0.48	42.85	0.11	15.93	0.69
Robust Standard Error	0.80	0.03	0.68	0.05	0.63	0.01	0.73	0.02
t-value	38.96	21.53	64.15	9.92	67.93	11.59	21.85	38.96
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
95% Confidence Interval	29.43	0.51	41.98	0.38	41.61	0.09	14.5	0.65
	32.55	0.62	44.63	0.57	44.08	0.13	17.36	0.72
Observations	2,092		2,092		2,092		2,092	
F-statistic	463.69		98.42		134.29		1517.77	
P-value	0.0000		0.0000		0.0000		0.0000	
R-Squared	0.28		0.06		0.09		0.60	
Root MSE	21.64		24.82		24.41		16.24	

[1] Table 6 includes the univariate regression results for the reported share price against the independent variables, specifically the estimates of the valuation models, all values are statistical significance using t-tests, whereby; MBM Is the model with higher explanatory power.

From Table 6, the R^2 of MBM with 60% is the highest value, meaning that 60% of the variance of the stock price can be explained by MBM variance estimates. These results are aligned with previous analysis in bias and accuracy estimates, indicating MBM outperforms flow-based models. Also, RIVM among the FBMs has the highest explanatory percentage with 28% of the stock price variance explained by the RIVM, whether the DCFM and the DDM only explain 9% and 6% respectively.

Additional to R-Squared analysis, the univariate regressions also provide estimates for the constant (alpha) and the independent variables. If models were to provide accurate explanation power of the stock price, alpha should equal zero. Analysing the constants of the different models, it is observable that all have high values, meaning there is a lot of the price variance that is not explained by the univariate regressions. For that reason, multivariate regressions should be considered as a solution to improve explanatory power, leading to the third hypothesis.

3.6.1. H3: Multivariate Regression and Explainability Increase

Hypothesis 3 Analysis:

The evaluation of a firm and the respective calculations of intrinsic values are very important for decision-making in the financial world. Therefore, financial players should always consider the best model. However, sometimes leaning on one model only might not be enough. As such, this hypothesis will try to explain if a model is enough or if two provide better explanatory power. The results are as follow:

Table VII

Price Multivariate Regressions on RIVM and MBM

Variables	Constant	βRIVM	βMBM
OLS Coefficient	14.06	0.19	0.61
Robust Standard Error	0.71	0.02	0.02
t-value	19.76	9.99	31.35
P-value	0.0000	0.0000	0.0000
95% Confidence Interval	12.67	0.15	0.57
	15.46	0.23	0.64
Observations		2,092	
F-statistic		880.31	
P-value		0.0000	
R-Squared		0.62	
Root MSE		15.76	

[1] Table 7 includes the multivariate regression results for the reported share price against the independent variables RIVM and MBM, all values are statistical significance using t-tests.

The results in Table 7 indicate that both methods together end up explaining more of the price variances. Whilst the univariate regressions in Table 6 show the MBM had an R-Squared of 60%, now with RIVM included, the explanatory power increases around 2%. Similarly, the constant went from 15,93 on the MBM univariate regression to 14,06. Results show that when adding RIVM variable, little is added to the price explanatory power. However, it still helps to confirm other models' results, and depending on firm-specific characteristics, it can even increase explanatory power more. All in all, hypothesis 3 holds, which is a strong indication that multivariate regressions tend to provide more price variances explained by the independent variables considered.

3.7. Sensitivity Analysis

A sensitivity analysis on the large sample analysis is deemed useful to understand how the different assumptions impact the results. Since many of the assumptions are subject to debate within different research, those different specifications that were not previously used are now going to take place for sensitivity purposes. This analysis is going to be focused on the flow-based models as those are more likely to be influenced by growth rates, cost of equity, among other indicators. For the analysis, the absolute valuation errors and univariate regression on price were considered. Also, the Trimming versus Winsorization sample modelling will be considered on this section.

3.7.1. Growth Rate

The growth rate is a key variable in the calculations of intrinsic value as the terminal value component in the model's calculations holds weight in the final estimates. Thus, following Francis et al. (2000) and Penman and Sougiannis (1998), a 0% growth rate, apart from the initial 4% on the large sample analysis, was adopted. Also, considering that the authors defended the inflation rate as the best growth estimate, the 4% is not up to date to the sample analysis period, thus in line with an article published by Hillier (2016), a 2% average growth rate was considered.

In Table 8 (in page below), the accuracy of the models seems to be consistent among different growth rates, whereby looking at the median, RIVM and DDM present lower valuation errors with 4% growth, whilst DCFM presents more accurate estimates with 0%. Looking at the explanatory power of the different models on the price variances, all present consistent results on the 0% growth rate as best. The results indicate that a 0% growth increases explainability and this might be due to the firms being less susceptible to earnings, dividends, or cash-flows variations over the years. In sum, these results are aligned with the sample selection, where firms are financially stable with little variable changes, and thus the negative impact of growth in valuation estimates.

Table VIII

Sensitivity Analysis on Growth Rate

Valuation		Absolute Valuation Error					Univariate Regressions		
Variables	Growth Rate	Observations	Mean	p-value	Median	p-value	R-Squared	Constant	Coefficient
RIVM	g=0%	2,100	0.48	0.0000	0.48	0.0000	0.40	23.70	0.99
	g=2%	2,104	0.46	0.0000	0.46	0.0000	0.37	26.51	0.81
	g=4%	2,096	0.47	0.0000	0.45	0.0000	0.28	30.99	0.56
DDM	g=0%	2,100	0.86	0.0000	0.90	0.0000	0.09	41.16	1.12
	g=2%	2,104	0.84	0.0000	0.89	0.0000	0.08	41.97	0.83
	g=4%	2,096	0.80	0.0000	0.87	0.0000	0.06	43.30	0.48
DCFM	g=0%	2,100	0.73	0.0000	0.70	0.0000	0.12	41.45	0.22
	g=2%	2,104	0.80	0.0000	0.72	0.0000	0.11	42.19	0.16
	g=4%	2,096	0.95	0.0000	0.77	0.0000	0.09	42.85	0.11

[1] Table 8 reports the mean and median absolute prediction errors and the univariate regressions for different growth rates of 0%, 2%, and 4% on the RIVM, DDM, and DCFM models.

3.7.2. Forecast Horizon

The forecast horizon is also a point subject to discussion as some authors argue that a 2-year period is the way to go and others a 3-year. For that reason, tests were conducted to see how different time horizons impact the valuation estimates. Clearing the data, the same way as in the large sample, observations were cut down to 1,226. One of the reasons for this was there were not many analysts' forecasts available for the 3 years.

Data presented in Table 9 indicates overall a tendency of the 2-year forecast period to outperform the 3-year forecast. First, in terms of accuracy, all three models despite not presenting big differences have lower absolute errors in median analysis for the 2-year forecast. Second, by looking at R-Squared, it can also be concluded that all models have more explanatory power on the stock price variance when including it in its calculations only two years ahead. Adding 1-year forecast to the sample seems not to improve value estimates. These results could be caused by the large sample reduction that eliminates many explanatory observations. For the RIVM the results were more expected since the model is based on accruals, and thus, a short-term valuation is enough.

Table IX

Sensitivity Analysis on Forecasted Years

Valuation		Absolute Valuation Error					Univariate Regressions		
Variables	Forecast Period	Observations	Mean	p-value	Median	p-value	R-Squared	Constant	Coefficient
RIVM	2 years	2,096	0.47	0.0000	0.45	0.0000	0.28	30.99	0.56
	3 years	1,226	0.5	0.0000	0.48	0.0000	0.21	34.71	0.42
DDM	2 years	2,096	0.8	0.0000	0.87	0.0000	0.06	43.3	0.48
	3 years	1,226	0.79	0.0000	0.88	0.0000	0.03	44.93	0.28
DCFM	2 years	2,096	0.95	0.0000	0.77	0.0000	0.09	42.85	0.11
	3 years	1,226	0.97	0.0000	0.84	0.0000	0.08	42.95	0.11

[1] Table 9 reports the mean and median absolute prediction errors using a three-year forecast horizon and a two-year forecast. All values are statistically significant. The sample size was reduced in the 3-year forecast as not all variables could be predicted to that time frame, specifically the 3 years ahead FCFEPS.

3.7.3. Risk Premium

As part of sensitivity analysis in the cost of equity, the market risk premium was considered. Research done by KPMG (2020) has shown that over the 2010-2015 period, rates wide-ranging between 5% and 7%, hence it was adopted apart from the 6% in previous chapters an MRP of 5% and 6%. The results of the conducted analysis are as follows:

Table X

Sensitivity Analysis on Risk Premium

Valuation		Absolute Valuation Error					Univariate Regressions		
Variables	MRP	Observations	Mean	p-value	Median	p-value	R-Squared	Constant	Coefficient
RIVM	5%	2,080	0.51	0.0000	0.46	0.0000	0.21	35.08	0.38
	6%	2,096	0.47	0.0000	0.45	0.0000	0.28	30.99	0.56
	7%	2,087	0.46	0.0000	0.46	0.0000	0.32	28.37	0.71
DDM	5%	2,080	0.79	0.0000	0.86	0.0000	0.04	44.32	0.31
	6%	2,096	0.80	0.0000	0.87	0.0000	0.06	43.30	0.48
	7%	2,087	0.82	0.0000	0.88	0.0000	0.07	42.72	0.65
DCFM	5%	2,080	1.13	0.0000	0.84	0.0000	0.07	43.69	0.08
	6%	2,096	0.95	0.0000	0.77	0.0000	0.09	42.85	0.11
	7%	2,087	0.85	0.0000	0.73	0.0000	0.09	42.79	0.13

[1]Table 10 reports mean and median absolute prediction errors and univariate regressions results using a ten-year US-treasury bond yield as a risk-free rate and different market risk premium of 5%,6%, and 7%. All values are statistically significant.

Within Table 10 it is noticeable that valuation errors for RIVM and DDM do not vary much as the MRPs are altered. DCFM already presents more concise results as the median absolute errors decreased from 84% to 73%. The R-Squared confirms this reduction as the three methods improve explanatory power when MRP increases. Overall, the increase in the MRP leads to an increase in the discount rate, meaning higher discount rates are providing more accurate value estimates. The reason for this could be that the use of the 6% was too optimistic, leading to overvalued estimates of the stock price.

3.7.4. H4: Trimming vs Winsorization

Hypothesis 4 Analysis:

Considering the sample selected as the first step on large sample analysis, it was deemed important that this topic was studied to check whether the right process was providing a trustworthy analysis of the statistical results. Even though literature does not provide much information, Lusk et al. (2011) and Dixon and Yuen (1974) show the loss of variance in the respective variables in trimming seemed to outperform the winsorization process, and thus the formulation of the hypothesis where trimming outperforms winsorization.

Table XI

Trimming vs Winsorization

Valuation		**Absolute Valuation Error**					**Univariate Regressions**		
Variables	**Selection Method**	**Observ.**	**Mean**	**p-value**	**Median**	**p-value**	**R-Squared**	**Constant**	**Coefficient**
RIVM	Trimming	2,096	0.47	0.0000	0.45	0.0000	0.28	30.99	0.56
	Winsorization	2588	0.50	0.0000	0.46	0.0000	0.32	29.84	0.58
DDM	Trimming	2,096	0.80	0.0000	0.87	0.0000	0.06	43.30	0.48
	Winsorization	2588	0.80	0.0000	0.87	0.0000	0.06	43.08	0.46
DCFM	Trimming	2,096	0.95	0.0000	0.77	0.0000	0.09	42.85	0.11
	Winsorization	2588	1.15	0.0000	0.81	0.0000	0.12	42.20	0.11
MBM	Trimming	2,096	0.30	0.0000	0.23	0.0000	0.60	15.93	0.69
	Winsorization	2588	0.33	0.0000	0.24	0.0000	0.62	15.38	0.69

[1]Table 11 reports the results of the mean and median absolute valuation errors and the univariate regressions for the different sample selection processes, Trimming and Winsorization, on the RIVM, DDM, DCFM, and MBM. All values are statistically significant. R^2, Constant, and coefficient to models explanatory power inference are also presented.

The analysis in Table 11 provides ambiguous results for the hypothesis analysis since accuracy and explanatory power appear to contradict each other. The mean and the median values of all models have more accuracy in the trimming process as they represent fewer valuation errors. The DCFM had the highest impact where the mean error was reduced from 115% to 95% and the median from 81% to 77%. When looking at the univariate regressions all models see an increase in the R-Squared, except DDM that remains constant.

Overall results can be contradictory, where the sample selection intends to reduce valuation errors in each other to increase the explanatory power. Here, the valuation errors are indeed decreasing but not increasing the explanatory power. All in all, this hypothesis needs more research and configurations, even though, there is a small indication that trimming leads to lower valuation errors compared to winsorization.

3.7.5. Sensitivity Analysis Summary

The sensitivity analysis provides important remarks as it indicates how assumptions could be changed to provide more accurate results. Thus, this investigation is useful for further studies in this topic by creating new hypotheses under new and better assumptions. From, the original assumptions only the 2-year forecast period appear to provide the most accurate estimates. On the other side, the 0% growth rate outperforms the initial 4% used and the 7% MRP outperforms the 6% used. From all methods the RIVM is the one that is most susceptible to this sensitivity analysis, meaning that for the model to perform well it should have the closest assumption from reality as possible.

A final point on the outliers modelling is that valuation errors provide similar results with both methods, whereas in the regression analysis the winsorization provides a small amount higher explanatory power. However, there is no clear better method.

3.8. R&D Sample Analysis

The R&D expenditures have been discussed in literature over the years by authors such as Amir and Lev (1996), Penman and Sougiannis (1998), and Francis et al. (2000). The discussion on how R&D intensity affects equity valuations is the main topic approached. The following study on R&D aims to evaluate the models' performance and to validate or not large sample analysis' results. Furthermore, it will help analysts which models to use according to R&D intensity.

3.8.1. Descriptive statistics

The large sample analysis was divided between high and low R&D intensive groups by adopting Francis et al. (2000) study assumptions. For the low-intensive groups, observations with zero or immaterial amounts of R&D were chosen that led to 939 observations. And for the high R&D sample were chosen the 25% of companies with the highest intensity, calculated through the following ratio:

$$RD\ Intensity_j = \frac{R\&D\ Expenditures}{Total\ Assets}$$

A previous study done by Schreiner and Spremann (2007) stated that highly intensive firms were penalized in equity stock prices. The same cannot be concluded from Table 12 analysis, where either in mean values or in median values the high sample presents much higher equity value estimates.

Table XII

Descriptive Statistics of R&D sample

LOW R&D SAMPLE						
Variables	**Observations**	**Mean**	**Std. Dev**	**Q1**	**Median**	**Q2**
PRC4	939	43.93	24.01	26.71	40.37	56.84
RIVM	939	27.12	21.46	12.25	20.85	36.02
DDM	939	9.41	13.19	0.51	5.28	12.65
DCFM	939	46.48	69.43	3.65	21.67	58.48
MBM	939	42.77	27.64	22.43	37.22	56.19
HIGH R&D SAMPLE						
Variables	**Observations**	**Mean**	**Std. Dev**	**Q1**	**Median**	**Q2**
PRC4	524	52.54	24.75	34.98	48.59	66.14
RIVM	524	36.46	23.75	18.62	30.16	48.89
DDM	524	11.82	11.62	1.49	8.68	19.34
DCFM	524	66.39	85.82	10.54	38.5	81.91
MBM	524	50.39	28.57	29.11	44.42	64.79

[1]Descriptive statistics for Low and High-Intensive R&D firms of the stock price and the valuation models, RIVM, DDM DCFM, and MBM, from 2005 to 2015 with the number of observations, standard deviation, first quartile, median, and third quartile.

Looking at the differences between mean and medians, and the stock price from Table 12, MBM is the model that provides more close estimates in both low and high samples. Surprisingly, the results of the DDCFM outperform the RIVM in low and high-intensive R&D, contradicting the previous analysis in the large sample analysis. This analysis is not enough, as no meaningful conclusions can be taken, thus further analysis will be made by analysing the accuracy and explanatory power within the two samples.

3.8.2. Valuation Errors

The analysis on the valuation errors will follow the same structure as in Francis et al. (2000) by adopting two different growth rates. The growth rates used were the 4% from the original sample and the 0%, that according to the sensitivity analysis was the growth rate that provided more accurate estimates.

All the models are statistically significant at a 5% significance level, except for the MBM mean signed valuation for both growth rates in low-intensive R&D firms and high-intensive for the mean in the 0% growth rate and the median in the 4%. This means there were no significant valuation errors with the model, and thus, the multiple models are less biased. Once more, MBM's outperformance in this research is aligned and supporting the large sample results. Testing both growth rates in the two samples (low and high intensive), there were not large disparities that confirmed lower valuation errors in one growth rate compared to another. On the other hand, there is a finding that contradicts the expectation of the low-intensive R&D firms to provide more accurate results, as the high-intensive R&D firms provide fewer valuation errors.

The analysis on the valuation errors is important to complement the descriptive statistics because as seen above the DCFM seemed to outperform the RIVM, but now looking at the statistics in all growths and industry intensities it is observable that the RIVM has lower errors when compared to the cash-flow model. Overall, the research results of Francis et al. (2000) are contradicted on this sample analysis as different bias and accuracy performances are stating that high-intensive R&D firms have lower valuation errors.

Panel A and panel B from Table 13 provide the statistics for this evaluation, where the MBM presents the best results in terms of bias and accuracy, and the high-Intensive firms outperform the low-intensive firms in R&D expenditures.

Table XIII

Bias and Accuracy of value estimates on R&D samples

	Panel A: Low R&D Sample								
	Variables	**RIVM**		**DDM**		**DCFM**		**MBM**	
	Valuation Error	**Absolute**	**Signed**	**Absolute**	**Signed**	**Absolute**	**Signed**	**Absolute**	**Signed**
Growth = 4%	Observations	939	939	939	939	939	939	939	939
	Mean	0.47	-0.35	0.80	-0.76	1.02	0.13	0.31	-0.0002
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0159	0.0000	0.9878
	Median	0.45	-0.41	0.87	-0.86	0.79	-0.41	0.24	-0.06
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0040
Growth = 0%	Observations	947	947	947	947	947	947	947	947
	Mean	0.47	-0.45	0.86	-0.84	0.76	-0.27	0.31	0.01
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6072
	Median	0.47	-0.46	0.90	-0.90	0.71	-0.56	0.24	-0.06
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0208
	Panel B: High R&D Sample								
	Variables	**RIVM**		**DDM**		**DCFM**		**MBM**	
	Valuation Error	**Absolute**	**Signed**	**Absolute**	**Signed**	**Absolute**	**Signed**	**Absolute**	**Signed**
Growth = 4%	Observations	524	524	524	524	524	524	524	524
	Mean	0.37	-0.29	0.76	-0.76	0.96	0.28	0.28	-0.02
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.1486
	Median	0.31	-0.28	0.81	-0.81	0.70	-0.15	0.21	-0.10
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.4505	0.0000	0.0000
Growth = 0%	Observations	521	521	521	521	521	521	521	521
	Mean	0.46	-0.43	0.84	-0.84	0.71	-0.37	0.30	0.06
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005
	Median	0.46	-0.46	0.86	-0.86	0.67	-0.58	0.22	0.00
	p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1518

[1]Both Panels, A and B report mean and median Absolute and Signed valuation errors with the respective p-values of t-tests for means, and Wilcoxon signed-rank tests for medians, comparing the signed valuation errors to zero. The analysis is performed for a 0% growth rate and a 4% growth rate following Francis et al. (2000) study.

3.8.3. Regression Analysis

The results from the following regression analysis are important to validate the previous accuracy and bias results. Under the analysis of the OLS regressions, the superiority of the MBM is clear where 56% and 58%, respectively high R&D and low R&D, of the stock price variance is explained by the multiple model.

The comparison between both intensities shows the flow-based models to have more explanatory power in high-intensive R&D firms, being consistent with previous results. The MBM on the other hand seems to provide better results in the low-intensive firms, not supporting the bias and accuracy results from Table 13. These results are in accordance with Francis et al. (2000), where valuation models provide their best on low-intensive industries.

Table XIV

Univariate Regressions of Low R&D firms

LOW R&D SAMPLE								
Variables	**Constant**	**βRIVM**	**Constant**	**βDDM**	**Constant**	**βDCFM**	**Constant**	**βMBM**
OLS Coefficient	27.39	0.61	40.24	0.39	39.55	0.09	15.73	0.66
Robust Standard Error	1.14	0.04	0.91	0.07	0.87	0.01	1.03	0.03
t-value	23.92	14.22	44.08	5.87	45.58	8.23	15.31	25.19
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
95% Confidence Interval	25.14	0.53	38.45	0.26	37.85	0.07	13.71	0.61
	29.63	0.69	42.03	0.52	41.26	0.12	17.74	0.71
Variables	**RIVM**		**DDM**		**DCFM**		**MBM**	
Observations	939		939		939		939	
F-statistic	202.31		34.48		67.66		634.53	
P-value	0.0000		0.0000		0.0000		0.0000	
R-Squared	0.30		0.05		0.07		0.58	
Root MSE	20.14		23.46		23.12		15.65	

[1] Table 14 includes the univariate regression results for the Low-Intensive R&D firms where is reported share price against the independent variables, specifically the estimates of the valuation models, all values are statistical significance using t-tests, whereby MBM Is the model with the better performance.

Table XV

Univariate Regressions of High R&D firms

HIGH R&D SAMPLE								
Variables	**Constant**	**βRIVM**	**Constant**	**βDDM**	**Constant**	**βDCFM**	**Constant**	**βMBM**
OLS Coefficient	27.68	0.68	44.52	0.68	45.64	0.10	19.77	0.65
Robust Standard Error	1.66	0.04	1.55	0.08	1.33	0.02	1.60	0.04
t-value	16.68	16.11	31.04	5.18	34.36	5.98	12.33	17.59
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
95% Confidence Interval	24.42	0.60	45.20	0.26	43.03	0.07	16.62	0.58
	30.93	0.77	51.31	0.58	48.25	0.14	22.92	0.72
Variables	**RIVM**		**DDM**		**DCFM**		**MBM**	
Observations	524		524		524		524	
F-statistic	259.58		63.28		35.80		309.41	
P-value	0.0000		0.0000		0.0000		0.0000	
R-Squared	0.43		0.10		0.13		0.56	
Root MSE	18.73		23.48		23.11		16.36	

[1] Table 15 includes the univariate regression results for the Low-Intensive R&D firms where is reported share price against the independent variables, specifically the estimates of the valuation models, all values are statistical significance using t-tests. The coefficient, Robust Standard Errors are as well represented.

By order of explanatory power, the MBM is ranked first, followed by the RIVM, DCFM and DDM. These results contradict in some part the large sample as the DDM has always overperformed the DCFM. Even though these results seem contradictory it is important to look at the coefficients of both analyses, since in the R&D sample division the coefficients are higher, meaning there is more noise not captured in the R&D sample.

3.8.4. H5: Low-Intensive R&D vs High-Intensive R&D Firms

Hypothesis 5 Analysis:

The analysis on Tables 13, 14 and 15 drawn above for the industry intensity explains the accuracy, biasedness, and regression statistics for both R&D samples showing MBM as the model that provides better value estimates. Looking to the

R&D intensity that provides better results, in all models, except the MBM, results stated that the High R&D intensive industries provided better estimates.

The opinion among Francis et al. (2000) and Schreiner and Spremann (2007) support the low-intensive industries as the sample that provided better results. MBM among the statistics provided above seems to be the only one to be in accordance with previous studies. Whether authors saw the high-intensive R&D firms being penalized on the value estimates, the analysis on this large sample leads to different results, as the RIVM, DDM, and DCFM perform better on a high R&D intensity.

This analysis suggests that the MBM reaches better results in an environment of low R&D intensity across the sample, but as well in high-intensive. However, the flow-based models benefit from a high R&D intensity in bias, accuracy, and explainability, meaning the latest results are not as clear as thought. The coefficients of the high-intensity, when compared to the low-intensity firms, do not very much, indeed the values are higher in a high-intensity environment, meaning larger portions of the stock price are not being explained. The differences in the result analysis on the R-Squared and the coefficients can be explained by the number of observations between the two samples. Similar to the results showing that trimming could reduce the variance in this analysis, the small sample on the high environment led to firms with lower Root MSE values.

This hypothesis for the MBM gives clear indications that in a low R&D environment results are better supporting Francis et al. (2000). For the flow-based models, high R&D expenditures led to better results in terms of bias and accuracy, even though the explainability analysis leads to some ambiguous results. All in all, this hypothesis is partially true as only the MBM supports it.

3.9. Large Sample Analysis Conclusions

All the tests performed, clearly indicated that the MBM is the model that provides the best results in biasedness, accuracy, and explainability. From the flow-based models, the RIVM is the model that provides better estimates followed by the DDM and DCFM. To understand how models work under different assumptions the sensitivity analysis was a good tool, where under the initial assumptions, only the 2-year period seemed to provide better results. Changes in the risk premium and the growth rates were also considered where a 7% risk premium and a 0% growth led to more accurate results. The trimming sample selection against winsorization concluded there was an indication of trimming outperformance, but no clear conclusion could be made.

The analysis of the R&D sample demonstrates that the FBMs are best with a high R&D intensity in terms of bias and accuracy whilst the MBM is better in a low R&D environment. The recommendation is that based on the results, high-intensive R&D firms should value their equity based on the FBMs but also supported with the MBM since it is the best model, whilst in low-intensive environments, firms should use MBM as main.

The analysis based on literature gaps conducted on the large sample analysis permitted to answer to the hypothesis, mostly in a clear way. After debating all the hypotheses, it is possible to conclude that [1)] Multiple-based models provide more accurate and less biased equity valuations than Flow-based models; [2)] The accrual-based valuation model (RIVM) is more accurate than the cash flow-based model (DCFM); [3)] The use of RIVM and MBM together leads to the higher explanatory power of price variance; [4)] Trimming outliers leads to more accurate and similar explainability on value estimates than the use of Winsorization; and lastly [5)] Low-intensive R&D firms provide more accurate, less biased, and higher explanation power than High-Intensive firms only on MBM, whereas the Flow-based models perform better on a high-Intensive R&D environment

4. CASE STUDY - INSIGHT ON BROKERS' REPORTS

4.1. Introduction

In the previous chapters, the performance of different accounting-based valuation models was tested. Where results show that flow-based valuations models perform worse than Multiples. It was also tested how R&D intensity influenced the models in chapter 3. For that reason, for the following tests two companies were chosen based on different R&D intensities for comparison purposes: one high-intensive and one low-intensive R&D firm.

The small sample analysis allows for a deeper study of these results, complementing the conclusions of the large sample with brokers' reports. However, it is important to take into consideration that despite the advantage studying particular events has, the small sample analysis has the disadvantage of generalizing its results. This chapter analysis will focus on the practical use of the valuation models by analysts where it will follow a sample selection rationale and the respective overview of the selected companies. In addition, some questions will be presented that will be answered based on the information found in the broker's reports and the large sample analysis results.

4.2. Analyst Reports and Sample Selection Rationale

Analysts' reports are a useful tool to help make investment decisions which are corroborated by the usefulness of the information on the reports, where they provide fundamental and technical financial data, that can be used to evaluate companies' future performance (Asquith et al., 2005). As discussed in chapter 2 analysts can use a wide range of methods for their analysis. Discussion on which model to use has arisen, from Penman (1998) where it defends that RIVM is preferable to the DCFM to Bradshaw (2002) who argues that MBM is mostly used by analysts as it leads to higher favourable recommendations. Also, Hand et al. (2017) state that the DCFM is preferred when compared with RIVM, with the latter being rarely used by analysts.

In the model choice, there is also an important point to consider, which is to see how different industries respond to different models' characteristics. Demirakos et al. (2004) researched different industries where they found that the model choice and the industry directly affected each other. Demirakos et al. (2004) conclude that analysts use MBMs more commonly when valuing stable than unstable industries. On the other hand, Francis et al. (2000) state that the firm choice from any industry independent of the industry does not influence the valuation model's performance.

Within chapter 3, a discussion was presented on how R&D intensity influences equity valuation models. It is important to continue this discussion within the following chapter to understand how analysts consider R&D intensity when choosing valuation models. The large sample stated an increase in the explainability of the flow-based models on the high-intensity sample which will be confronted with the analysts' reports.

Based on the literature discussed above, as well as the literature on the previous chapters this case study intends to answer the following questions:

1. Which valuation models are most used by equity analysts in practice?
2. How do different R&D intensities influence the model's choice by analysts?

These questions are going to be tested to determine if they are in line with the findings of the large sample analysis where MBM outperforms RIVM, DDM, and DCFM, and high-intensive R&D firms provide better value estimates.

The choice of the companies was built on the previous analysis results where the MBM was the best model and based on Demirakos et al. (2004) companies were chosen from a stable industry for this small sample analysis. Regardless, Damodaran (1999) states that the calculation of the value estimates has better results under stable firms with stable cash-flows, so the choice of a stable firm was clear. The Consumer Staples and the Consumer Discretionary are two industries suitable for analysis. Bellone and Carvalho (2020) studied the volatility of different industries between 1994 and 2020. This study provided interesting findings; namely, Consumer Staples was considered as the least volatile sector, and Consumer Discretionary presented results of low volatility as well. Walkshäusl (2014) also concluded that both industries were less volatile in periods of crisis. After reviewing the valuation results from the large sample analysis and considering stable firms with relatively large size, Procter & Gamble (P&G) - from the Consumer Staples - was chosen as a high-intensive R&D firm and Target Corporation from the Consumer Discretionary – was chosen as a low-intensive R&D firm.

It is important to take into consideration that the use of a small sample limits the reliability of findings, however, some inferences can be taken from it. To add that the financial data used in the following analysis, was retrieved from the Thomson Reuters database.

4.3.Procter & Gamble Overview

Procter & Gamble was founded in 1837 and has since become one of the world's largest consumer product manufacturers. It operates in over 140 countries around the globe through 5 global business units (baby and family care, fabric and home care, beauty care, health care, and snacks and beverages) including some of the following well-known products Tide, Ariel, Pantene, Pringles, Duracell, Gillette, and Braun. The P&G is widely diversified where the sales market outside of the U.S. represents more than 60% of the firm's consolidated total sales.

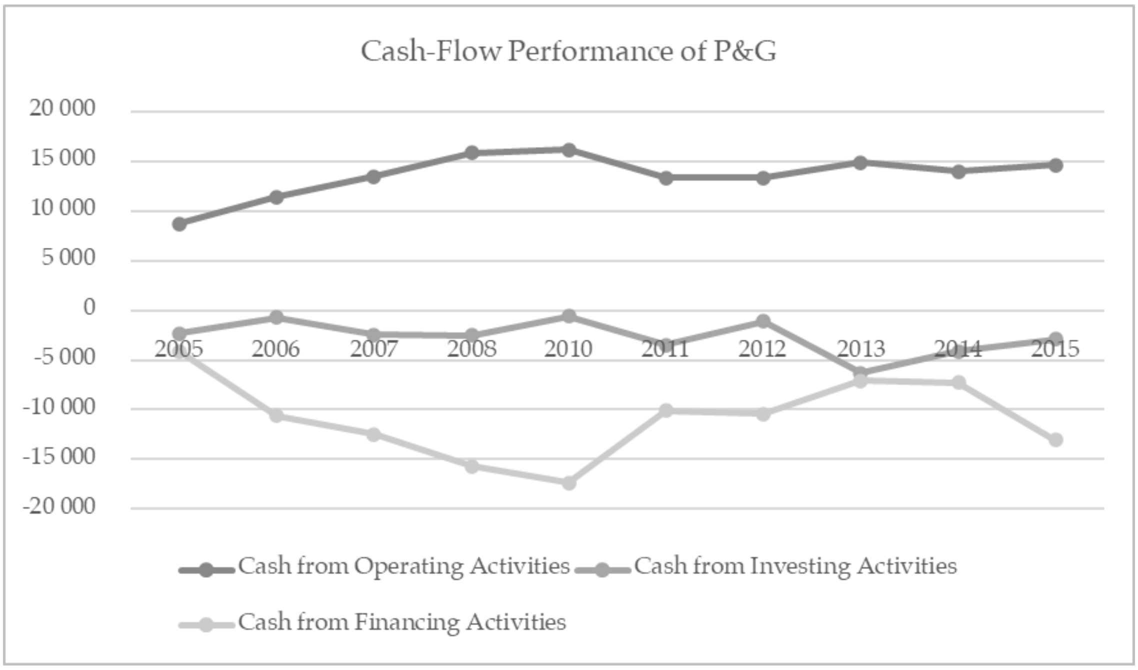

Figure 3: Cash-Flow Performance of P&G

Source: Thomson Reuters

From analysing the development of cash flows over the Large Sample period in figure 3 as above, the operating cash flow maintained constant and even increased during the financial crisis. This confirms Walkshäusl's (2014) study where during crisis periods Consumer Staples tend to outperform other industries. The financing and investment cash flows were always negative during the period due to high CAPEX, and dividend payments, and also due to 2007-2009 period, where financing demands increased mainly due to crisis.

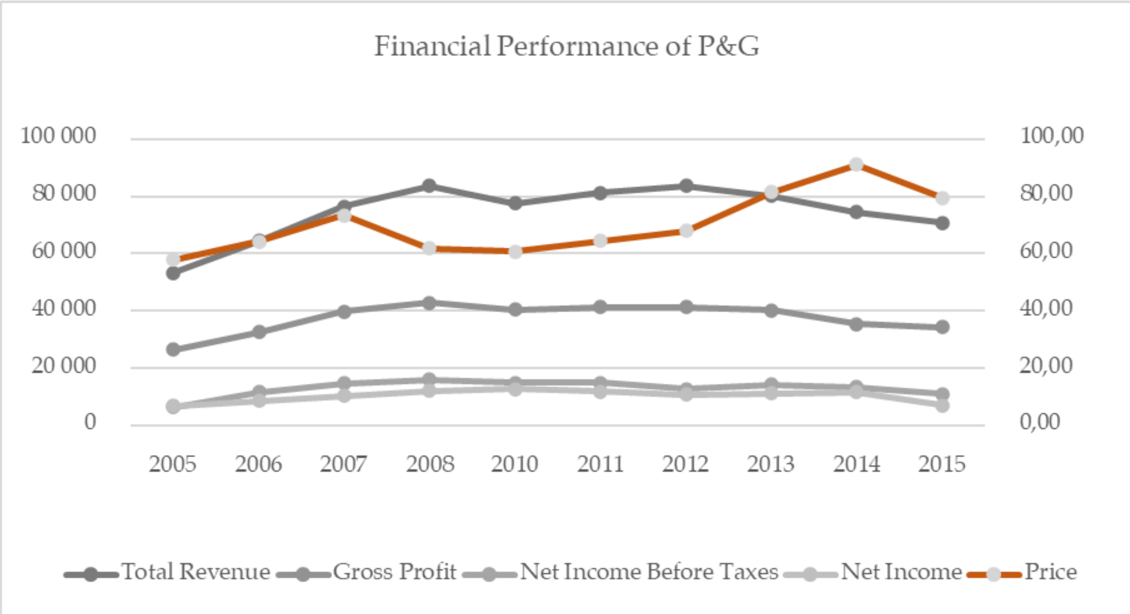

Figure 4: Financial Performance of P&G

Source: Thomson Reuters

Looking at the development of financial accounting lines over the period, figure 4 shows that Gross Profit, EBIT, and Net Income did not vary much seen by an increase until 2008 followed by a slight decrease. The same occurred with revenues, and these tendencies end up reflecting the stock price variations. The period succeeding the crisis made consumers see their purchasing power decrease (Gurtner, 2010), being the key to the decrease of financial components in the Consumer Staples companies, as reflected on P&G statements.

4.3.1. Large Sample Analysis Results

Analysing the large sample results on P&G, Table 16 below shows the estimated equity values for P&G and the respective deviation from the share price. In the period across all years, MBM provides the most accurate results. The RIVM is the second model that provides fewer deviations from the stock price until 2014, where DCFM in those later years provided better estimates than RIVM and DDM. Periods of financial struggle as in the 2008 crisis it is observable an increase in the deviations between MBM and price, while RIVM saw more accurate results on the financial crisis compared with previous years. This could indicate that RIVM tends to perform better than multiples in uncomfortable times. This is related with a topic already approached above where the multiples could be misleading if a whole industry is overvalued, that was what occur to happen during the financial crisis.

Table XVI

Large Sample Analysis Results for Procter & Gamble

Year	PRC4	RIVM	DDM	DCFM	MBM
2005	55.99	7.61 (86.4%)	0.39 (99.3%)	1.22 (97.8%)	54.47 (2.7%)
2006	63.39	19.95 (68.5%)	0.26 (99.6%)	1.81 (97.1%)	55.73 (12.1%)
2007	69.52	21.57 (96.0%)	0.31 (99.6%)	0.78 (98.9%)	56.68 (18.5%)
2008	64.54	23.86 (63.0%)	0.88 (99.6%)	2.26 (96.5%)	38.50 (40.3%)
2009	58.00	28.91 (50.1%)	8.58 (85.2%)	20.20 (65.2%)	62.92 (8.5%)
2010	63.57	33.26 (47.7%)	12.93 (79.7%)	23.35 (63.3%)	60.05 (5.5%)
2011	63.99	46.77 (26.9%)	27.39 (57.2%)	48.44 (24.3%)	64.68 (1.1%)
2012	69.24	35.84 (48.2%)	17.93 (74.1%)	17.36 (74.9%)	53.99 (22.0%)
2013	80.75	45.55 (43.6%)	27.58 (65.9%)	17.12 (78.8%)	80.45 (0.4%)
2014	87.27	48.98 (43.9%)	32.35 (62.9%)	64.00 (26.7%)	88.72 (1.7%)
2015	76.38	53.16 (30.4%)	41.82 (45.3%)	86.29 (13.0%)	84.60 (10.8%)

[1] Table 16 shows the share price and the respective equity value estimates for the individual years of the observation period as well as the percentage deviation from the share price.

Overall, the superiority of the MBM and the failure of the flow-based models are also reflected in the valuation of P&G when compared with large sample results. As the MBM performs best overall, a recommended target price of $84.60 is recommended, indicating that the stock price is undervalued.

4.3.2. Analyst Reports Analysis

Two analyst reports for P&G were considered for this analysis, one from Deutsche Bank, published on October 23rd, 2015 (Schmitz & Faiza, 2015), and the other from Morningstar, published on October 23rd, 2015 (Lash, 2015). The estimates on both reports stated that P&G was undervalued.

After reviewing both reports, the valuation methods mentioned were the same for MBM and DCFM. Similarly, to the literature findings from Asquith et al.

(2005), who stated that most analysts use the MBM for valuation alienated with DCFM. Following the large sample analysis and the literature review, despite RIVM being the most accurate estimate among flow-based models, this does not seem to be an analysts' choice.

Fundamentally, the Morningstar analyst report states that P&G is a critical partner for retailers that will not risk those partnerships. They also notice that the big basket of brands that P&G holds enables long-term profitable growth aligned with the sale of unprofitable segments. Deutsche Bank analyst report emphasizes three points, the growth acceleration and its solid margin outlook, the expected EPS growth, and P&G diversification. Similarly, to Morningstar the productivity savings and the exit of unprofitable segments were referred as standing points.

The analysts' forecast used for different accounting flows for the relative valuation in both reports with a focus on EPS and EBITDA, used a two-year-ahead forecast. Regardless of whether within literature only an equity path was adopted, analysts seem to rely on both equity and entity perspectives. Considering a consistent performance of P&G over the past years; for the DCF analysis, Morningstar analysts used as main assumptions a 4% annual growth in the long-term, with gross margins approaching 52%, and operating margins exceeding 23%, leading to an expected price of $88.60. Deutsche Bank's assumptions include a 1.8% sales growth, a WACC of 6.5% by using a 3% risk-free and a 4% equity risk premium, and a terminal growth of 1.5%, leading to a share price of $90.00 Both used an entity perspective for the flow-based calculations. Table 17 presents a comparison of the reports.

Table XVII

Reports' Estimates for P&G

Valuation Method	Morningstar	Deutsche Bank
Price/Earnings	20.8x	22.4x
EV/EBITDA	13.7x	15.3x
EV/EBIT	16.8x	18.8x
Market Price	$74.85	$74.85
DCF - Price	$88.60	$90.00
Recommendation	Buy	Buy

[1] Table 17 shows the multiples determined by the investment banks alongside the DCFM estimates.

As seen in Table 17, the analysis of DCF estimates indicates that P&G is undervalued. These results are consistent with valuation estimates in the large sample of the DCFM and the MBM. Both reports used a flow-based model and a multiple at least, which was also consistent with the large sample results in high-intensity R&D firms (where both methods lead to higher explanatory power, flow-based mainly).

4.4. Target Corporation Overview

Target Corporation founded in 1910 is one of the largest retailers in the US and was ranked among the top 3 in the top 50 US retail brands list in 2014. Target operates through the US mainly, and since 2012 in Canada, after the acquisition of leasehold interests from Zellers. The company offers household goods, accessories, hardlines, food and pet supplies, and home essentials at discounted prices. These large-scale operations allow the company to benefit from economies of scale that can offer products at low prices and remaining competitive on the market, against competitors such as Walmart.

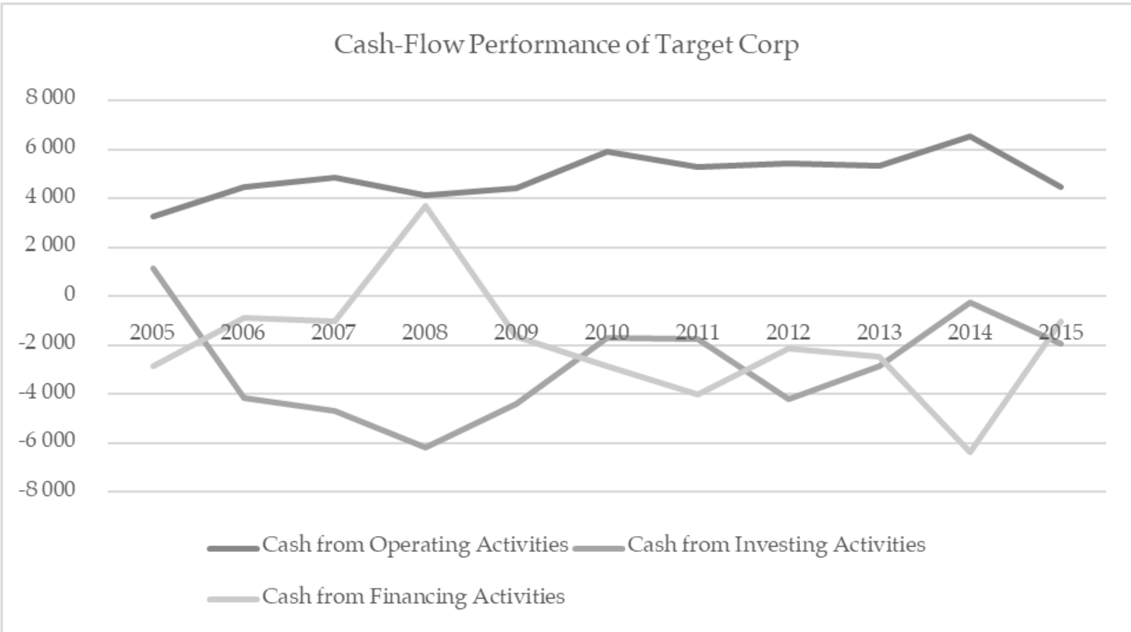

Figure 5: Cash-Flow Performance of Target Corp.

Source: Thomson Reuters

From analysing the development of cash flows over the Large Sample period represented in figure 5, the operating cash flow was constant over the period, similar to P&G due to the favourable industry insertion. The financing cash flows went negative after 2008 mainly due to an increase in financing demands during the 2008 crisis, where they were forced to reduce their workforce from approximately 600 employees and 400 open positions. During the last 5 years, Target had a stable Cash-flow from investing activities due to low investment in R&D, with failing partnerships with the electronics business being one of the biggest weaknesses.

Looking at the development of financial accounting lines over the time-period, figure 6 shows that Gross Profit, EBIT, and Net Income do not vary much. Revenues, on the other hand, have increased reflecting the stock price variations. Target stock price collapsed mainly during the financial crisis of 2008/2009, where all the market expectations suffered from all the anxiety of the market participants. Being an essential firm to the market it rapidly recovers its pre-crisis stock price.

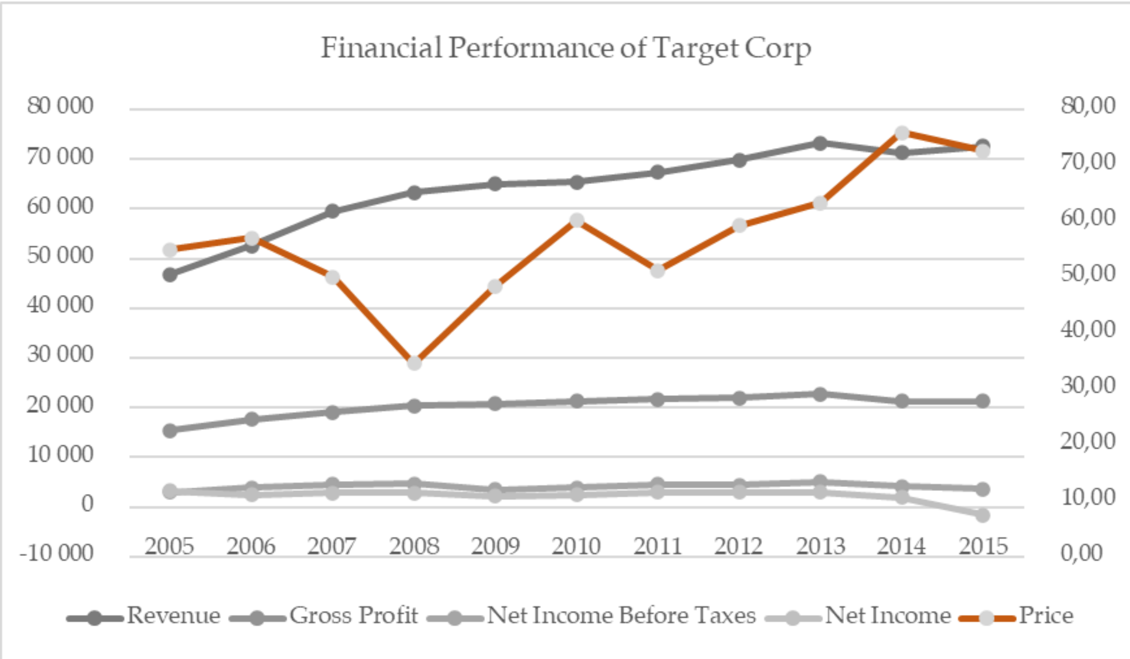

Figure 6: Financial Performance of Target Corp.

Source: Thomson Reuters

4.4.1. Large Sample Analysis Results

Analysing the large sample results on P&G, Table 18 shows the estimated equity values for Target and the respective deviation from the share price. As expected MBM provides the most accurate results. The RIVM is the second model that provides fewer deviations from the stock price, but since 2010, DCFM has closest valuation errors to the RIVM. Also, during the financial crisis period it is observable a deterioration of the accuracy in estimates, not so intensive as in P&G.

Overall, MBM provides close estimates to the stock price, the failure of the flow-based models is also reflected in the valuation of Target, as it was on the P&G valuation data when compared with large sample results. As the MBM performs best overall, a recommended target price of $79.68 is recommended, indicating that the stock price is at a fair price.

Table XVIII

Large Sample Analysis Results for Target Corp.

Year	PRC4	RIVM	DDM	DCFM	MBM
2005	53.70	15.11 (71.9%)	0.13 (99.8%)	1.55 (97.1%)	43.80 (18.4%)
2006	48.92	16.60 (66.1%)	0.10 (99.8%)	0.63 (98.7%)	53.81 (10.0%)
2007	62.43	18.54 (70.3%)	0.10 (99.8%)	0.93 (98.5%)	69.36 (11.1%)
2008	53.36	19.28 (63.9%)	0.20 (99.6%)	1.69 (96.8%)	55.17 (3.4%)
2009	39.30	23.54 (40.1%)	3.96 (89.9%)	5.77 (85.3%)	45.08 (14.7%)
2010	54.53	39.74 (27.1%)	7.32 (86.6%)	71.73 (31.5%)	62.41 (14.5%)
2011	49.53	32.29 (34.8%)	5.56 (88.8%)	30.37 (38.7%)	72.90 (47.2%)
2012	57.91	52.41 (9.5%)	18.38 (68.3%)	47.74 (17.6%)	66.99 (15.7%)
2013	69.50	48.03 (30.9%)	14.07 (79.8%)	12.92 (118.6%)	83.62 (20.3%)
2014	56.76	48.28 (14.9%)	22.89 (59.7%)	23.85 (58.0%)	57.04 (0.5%)
2015	79.32	48.75 (38.5%)	30.27 (61.8%)	71.22 (10.2%)	79.68 (0.5%)

[1] Table 16 shows the share price and the respective equity value estimates for the individual years of the observation period as well as the percentage deviation from the share price.

4.4.2. Analyst Reports Analysis

Same as P&G, two analyst reports were considered for this analysis, one from J.P.Morgan, published on May 20th, 2015 (Castellani et al., 2015), and the other from Evercore ISI, published on May 22nd, 2015 (Arcilla et al., 2015). After reviewing both reports, the valuation methods used were only through multiples indicating a hold position.

Fundamentally, J.P.Morgan's analyst report upholds a hold recommendation on Target, as customer concerns persist along with long-term concerns on margins. There are some investments needed to establish Target's brand in the e-commerce segment as well as on growth in the U.S. market since they left the Canadian market. These investment needs will change CAPEX directions by increasing its expenses, while potentially decreasing earnings for the following periods. Similarly, Evercore ISI analysts reference the same points as expected since valuations were made almost in the same period. They also add to their analysis that beyond the negative impact of Amazon/E-commerce exponential growth, the competition with Walmart was very close and Walmart was winning over the last two years in terms of revenues, gross profit, and EBIT growth. Analysts have a consensus on holding Target, stating that is currently at a fair price.

The analysts' forecast used only a relative valuation approach in both reports, using equity and entity perspectives. The EPS and EBITDA were the value drivers used, calculated with a two-year-ahead forecast. J.P.Morgan calculates an estimated price target of $80.96, this is based on 16x EPS multiple forecasts and forecasted earnings of $5.06, and also supported by an EBITDA multiple of 8x. Evercore uses for the P/E calculation a multiple 16x and expected earnings of $5.10 in 2016, leading to a stock price of $81.60. Both reports do not use the DDM but refer to the valuation analysis that the 2.7% dividend yield supports the multiples used. As dividends are not reliable all the time, valuation estimates might be difficult to calculate, but either way, dividends can be used as a supportive role in valuation. Table 19 presents a comparison of the data of both reports.

Table XIX

Reports' Estimates for Target Corp.

Valuation Method	J.P.Morgan	Evercore ISI
Price/Earnings	16x	16x
EPS_FY2016	5.06	5.10
EV/EBITDA	8x	8.2x
Market Price	$74.85	$74.85
P/E - Price	$80.96	$81.60
Recommendation	Hold	Hold

[1] Table 19 shows the multiples determined by the investment banks alongside the DCFM estimates.

The analysis of MBM estimates in Table 19 indicates a consistent forecast that Target is currently well-priced. The large sample results were that MBM estimated price was $79.68 indicating that the company was indeed at a fair price. The use of multiples only in these reports is in some part aligned to the overall results where MBM is the best model, but also related with the R&D intensity analysis; whereby MBM apart from being the best model, was also the one that provided better results for low-intensive firms when compared to high-intensive.

4.5. Case Study Conclusions

The valuation results of the company's estimates in the large sample are partially reflected in the individual valuation of both, P&G and Target, as mainly only the MBM indicates similar results to the analysts' reports. Through an advance search on Reuters searching for the valuation models names of all analyst reports published in 2015, RIVM was not used and DDM was shown once for Target, being supportive of the previous analyst reports analysis for Target, where dividends played a support role in the valuation analysis.

The MBM overall is the predominant choice for both P&G and Target, answering the first question on which model is preferred by analysts. Apart from the low complexity of data when using multiples compared to the DCFM (which involves more complex assumptions), the MBM report accurately estimated when compared with the large sample and the analysts' reports expectations. Regarding the R&D intensity and the valuation model choice, Target, a low-intensive R&D firm used only MBMs while P&G used both MBMs and a DCFM analysis. Despite results representing a low sample, and thus only some general inferences can be made, these results are in accordance with the large sample results. In crisis periods inferences taken lead to an increase of the accuracy of the flow-based models, compared to a deterioration of the multiple model.

Overall, the recommendation for P&G is to buy, in this case, we can conclude that the large sample and the analysts' recommendations are aligned. For Target, the recommendation is to hold which also supports the results of the MBM estimates in the large sample analysis. In both cases the MBM is the way to go.

5. CONCLUSION

The increasing importance of firm valuations in the context of investing activities as well as financing decisions leads to the debate on which valuation method is the most appropriate. According to theory, all models should lead to the same value, which, as seen from the research conducted, is practically impossible. Therefore, in this thesis, the discounted dividend model, the discounted cash-flow model, the residual income valuation model, and the multiple-based models were considered to test which model achieves the most reliable estimates.

Additional importance on conducting new research on these models was because the literature review revealed that few studies were covering both multiple and flow-based models. Also, the sample selection was never in-depth analysed, being a point to proceed on further investigation. Furthermore, papers were covering periods long past, and thus the need to update and check if there were new tendencies. The observation period covered the period from 2005 to 2015, in which data from 2,092 US companies were used for the respective equity valuations. The research carried out was tested for bias, accuracy, and explanatory power and demonstrate a clear indication of RIVM and MBM as the best models. The DDM, in particular, performed poorly leading to the following ranking, starting by MBM and followed by RIVM, DCFM, and DDM.

Further, an analysis on the impact of R&D intensity was considered by assessing the influence of R&D expenditures on the valuations. The results showed that the MBM always performed better in terms of accuracy, bias, and explainability, in both high and low-intensive R&D samples. The high R&D sample, contrary to literature findings, achieved the best results on the analysis, but only for the flow-based models. The MBM performed best overall and had the best results in a low R&D environment supporting previous studies (Francis et al., 2000). A sensitivity analysis was conducted, exposing the RIVM as the model most susceptible to the applied sensitivity changes. Also, on the sensitivity analysis was done on the outliers modelling, which resulted in the improvement of valuation errors using Trimming against Winsorization.

In order to test the sample findings on an individual basis, the results were evaluated and compared for P&G and Target, a high and low-intensive R&D firm, respectively. For all of the periods, the results of the large sample analysis were reflected in the individual analysis, where the MBM always performed better. It was visible after the case study analysis, that no analyst report covered the RIVM, with the DCFM and MBM being the most common. Under the large sample analysis, P&G, a high R&D intensive seems to use the flow-based models apart from the multiples, showing that the higher accuracy in the R&D sample analysis is reflected on analyst's valuation models choices.

Overall, the strong superiority of MBM is evident, and based on the results it is practically appropriate to use this method since MBM outperforms all flow-based models. Important to consider that the whole investigation is mostly applied to mature and large companies, thus it is important to consider how different variables could affect the valuation performance of small companies. This limitation is directly linked to the sample reduction, thus trying to incorporate those lost variable in a model for additional analysis would of investors' interest. For further research, an analysis of how company valuations behaved during the financial crisis would also be worthwhile, as during the period it was noticeable the decrease in MBM valuation estimates accuracy compared to an increase of RIVM accuracy.

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