Equity Valuation Using Accounting Numbers on Internet and IT Service Firms

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Abstract

The development of the new economy and establishment of Internet-based companies created an industry of fast growing corporations with much interest to investors. The valuation of these firms has drifted away from estimates provided by traditional valuation models, which tend to undervalue Internet stocks consistently. Additionally, financial information has shown to be of little use when assessing the value of dot.com stocks (Trueman et al., 2001)

The objective of this paper is to shed some light on the usefulness of accounting-based valuation models when valuing Internet stocks. It attempts to provide users with a guide to the relative performance of models when valuing Internet companies and demonstrate how the assessment of these companies is compared to the valuation of firms in other industries.

Empirical results show that Internet and IT Service companies are harder to value, compared to other firms, using traditional valuation methods. The valuation model that provides the best estimates for these enterprises is the forward P/E calculated using a harmonic mean when compared to the RIVM and AEGM.

Results also show that analysts prefer stock-based valuation models to flow-based models.

Abstract

O desenvolvimento da nova economia e das empresas cujo negócio é realizado através da Internet deu aso à criação de uma industria de empresas com um crescimento extremamente acelerado de grande interesse para possíveis investidores. A avaliação de empresas ligadas á Internet afastou-se das estimativas que eram geradas usando os modelos tradicionais de avaliação de empresas, que a maioria das vezes subvalorizava consideravelmente as acções destas firmas. Adicionalmente, a informação financeira divulgada mostrou ser pouco útil para a avaliação das acções dot.com (Trueman et al., 2001).

O objective principal desta tese é identificar a utilidade dos modelos de avaliação baseados em relatórios financeiros na avaliação de empresas online. O intuito é facultar aos analistas um guia sobre a capacidade de estimação de alguns modelos na avaliação de empresas tecnológicas e comparar a precisão das estimativas para estas empresas com as estimativas do valor de outras empresas de diferentes indústrias.

Os resultados desta análise demonstram que as empresas tecnológicas são mais difíceis de estimar usando os modelos estudados. O P/E é identificado como o modelo que produz as melhores avaliações para estas empresas em comparação com o RIVM e o AEGM.

Os restados também mostram que os analistas preferem modelos que utilização informação relativa a empresas concorrentes versus os modelos que utilização as demonstrações de resultados das empresas.

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III. Abbreviations

- AEGM- Abnormal Earnings Growth Model
- AIG- Abnormal Income Growth
- CRSP- Centre for Research in Security Prices
- CSR- Clear surplus relation
- DCF- Discounted Free Cash Flow Model
- DDM- Dividend Discount Model,
- EBIT- Earnings before interest and tax
- EBITDA- Earnings before interest, tax, depreciations and amortizations
- EBO- Edwards-Bell-Ohlson model
- EMH- Efficient Market Hypothesis
- EPS- Earnings Per Share
- EV-Enterprise Value
- GAAP- Generally accepted accounting practices
- I/B/E/S- Institutional Broker's Estimation System
- IITS- Internet and IT service companies
- IPO-Initial public offering
- Ke- Cost of Equity
- LTC- Low Tech Companies
- M&A-Mergers and acquisitions
- NAV-Net Asset Value
- NI- Net income
- NOA- net operating assets
- NOPAT- Net operating profit after tax
- OIC- Other Industry Companies
- OHTC-Other High Tech Companies
- OLS- Ordinary Least Squares
- P/B- Price-to-Book
- P/E- Price earnings
- Q1-1ST Quartile
- Q3- 3rd Quartile

- R^2- Explainability
- RI-Residual Income
- R&D- Research and Development
- RIVM- Residual Income Valuation Model
- SD- Standard Deviation
- SIC- Standard industry classification
- U.S.- United States of America
- WACC-Weighted average cost of capital

1 Introduction

The launch of the World Wide Web changed the world forever, not only by marking the lifestyle of an entire generation but by paving the way into the new economy that accompanied the dot.com bubble. The Internet played a major role in changing the structure of the world economy from a manufacturing rich market to a service-based economy where knowledge is highly valued.

Internet companies started to grow at an increasing rate, with young firms being enormously valued. Examples include Facebook that went public in 2012 as the second-largest IPO in the US of all time, reaching a market capitalization of over $100 billion on the first day (Russolillo, 2012). Also, Amazon and Microsoft are valued at $350 billion and $450 billion respectively and Whatsapp, a free messenger smartphone application with revenues of $10 million was sold for $22 billion.[1]

These companies are part of a significant industry of much interest to investors worldwide. Web-based social networks currently represent one of the fastest growing industries, with extreme market capitalizations (Klobucnik and Sievers, 2013). However, one problem subsists. With the introduction of this new industry came problems, in particular for investors who did not know how to value such a young market. Traditional valuation methods based on accounting numbers are constantly undervaluing stocks, and subjectivity became a large part of Internet stock valuation.

This issue persists today, with the increased level of intangible assets in these companies' books and the significant growth rates, no consensus has been reached on the best way to value these firms.

[1] Financial information was retreived from Bloomberg and are dated as of August 2016.

We begin this study by defining an Internet company: "It is a company, whose majority or significant part of revenues is generated by the Internet or whose basic activity is based on a constant use of the Internet." (Zarzecki, 2010)

1.1 Motivation

The question of how to value companies in such a relevant industry is what drives this research. Investors seem to believe that financial information is not sufficient to value these firms, and other factors should be introduced (Trueman et al., 2001).

Many believe that accounting numbers are not useful in valuing Internet stocks, although some academics believe that traditional methods are still relevant (Zarzechy, 2010).

The objective of this study is to shed some light on the usefulness of accounting valuation models and consequently accounting numbers. This paper will attempt to understand the relative performance of traditional valuation models such as price multiples and flow-based models.

An additional analysis will be based on analyst reports, to identify the use of these models and their ability to predict market prices.

This paper will not only attempt to gauge the usefulness of accounting valuation models, but it will also identify the best models and provide analysts with an idea of what model provides the best estimates.

The choice between different valuation models may seem arbitrary or related to the analysts' preferences or the information that he has available, but in fact, a proper estimation depends on their ability to identify the correct method, which is different for distinct types of firms. The choice of model will indeed involve a trade-off between cost and complexity.

1.2 Outline and Research Problem

This paper will start by identifying the relevant theory related to equity valuation using accounting numbers, specifying the most relevant valuation models. Model development, as well as implementation issues, will be described, followed by empirical evidence on relative performance.

The paper will then continue to analyse a large sample of firms, with the objective of answering the following question:

How do accounting valuation models perform when valuing Internet companies versus other firms?

Statistical tests along with regression analysis will be executed to establish the performance of valuation models.

Furthermore, a second analysis will be presented, on a smaller sample of firms, with the objective of understanding how analysts value companies, specifically Internet firms. This analysis will seek to identify what models analysts' use and trends in their recommendations.

2 Literature Review

2.1 Introduction

This chapter will begin by describing the main research and theories on valuation using accounting numbers. Starting by recognizing the importance of equity valuation and the two perspectives used, followed by acknowledging the use of accounting numbers for valuation purposes. This section will then identify and illustrate the most relevant literature regarding valuation and will depict some theoretical models to build a solid understanding of the theory behind the analysis in the next chapter.

2.2 The Importance of Equity Valuation

What is equity valuation? Why is it important? If markets are efficient and securities correctly priced then why do analysts need to spend resources valuing stocks? These are questions that define the financial markets, as we know them.

Equity valuation is an estimate of the present value of a stream of expected payoffs to shareholders; it implies looking into an "uncertain future" and making an "educated guess" (Lee, 1999). Although many theoretical models exist to assist analysts in the process of valuation, it remains a complicated procedure heavily reliant on the ability to forecast, subject to interpreter bias, which cannot be expected to deliver an absolute certainty (Damodaran, 2002). As Lee (1999) says eloquently, "valuation is as much art as it is science."

According to the efficient market hypothesis (EMH), stocks are efficiently priced, and markets react quickly to all available information in a rational way, leaving no opportunity for incremental gain to that obtained when an investor buys and holds a diversified portfolio (Malkier, 1989).

So why do we need equity valuation? Even if the market is efficient, there may be some degree of mispricing (Malkiel, 1989) resulting in differences between market value and the intrinsic value of a specific firm. Fundamental analysts who have the ability to identify the stock's intrinsic value correctly can determine if it is overvalued or undervalued to exploit the inefficiencies by buying or selling the specific stock. Also, sometimes there are assets for which there is no market value (for example when a firm is purchasing a department of the business and takes into account the synergies) and investors need to assess correctly the price they are willing to pay using valuation methods (Damodaran, 2002). Another practical use for valuation is provided to managers who are looking for ways to increase the value of their firm. Most business decisions involve evaluation, like capital budgeting, financing decisions, dividend policy and even credit risk analysis (Palepu, 1999). In conclusion, equity valuation is a fundamental pillar of the financial system and plays a vital role in many areas of finance, critical not only to the market equilibrium and individual investors looking to make a profit but also those interested in corporate finance.

2.3 Usefulness of Accounting Numbers in Valuation

The use of accounting numbers to investors is a crucial question that needs to be addressed initially to consequently review the validity of valuation models that incorporate accounting information, such as expected earnings, as an explanatory variable (Lev, 1989). Before determining the relevance of such valuation models, it is fundamental to identify whether accounting information is relevant to those who seek to evaluate firms. This subject has been a research area of high importance to many academics and has been extensively studied.

The arguments against the use of earnings reports are mostly related to the fact that other sources reflect the same information, which reaches the market sooner. There are other ways to estimate the value of common stock without using earnings as an intermediate step (Beaver, 1968) and the correlation between earnings and returns is weak and unstable (Lev, 1989). Also, accounting earnings are thought to lack theoretical grounds required by rigorous economic analysis (Penman, 1992).

Ball and Brown (1968) performed an investigation on the variations of stock prices at the time income numbers were released, to identify if this information would have any impact on investors' expectations regarding the firm's future payoffs. By observing a high correlation between the sign of unexpected earnings and the sign of market variations (increase or decrease in stock price), their study revealed the usefulness of earnings reports to the capital markets. Beaver (1968) verified these results by demonstrating that earnings reports have information content, for both individual investors and the market equilibrium.

The annual income numbers released in the report represent half of all the information published concerning a specific firm. However, most of it is predicted by the market in the preceding months to the release of the report (Ball and Brown, 1968).

2.4 Valuation Models

All accounting-based valuation models can be divided into two broad categories: Stock-based models (also known as multiples based) and flow-based models[1]. The first group uses market information related to comparable firms to build an evaluation, while the second uses a large set of assumptions and estimates.

This section will start by identifying the two perspectives of business valuation and will identify five primary valuation models, describing their elaboration along with implementation issues and advantages and disadvantages of using each model.

2.4.1 Valuation Perspectives

Most valuation methods can be structured in two ways. The first is to value only the equity of the firm -equity perspective and the second is to value the assets of the enterprise without taking into consideration the type of claims on such assets- entity perspective. Theoretically, both methods should produce the same estimate: The equity value (entity value) can be deduced from the entity perspective (equity perspective) by deducting (adding) the net debt of the firm (Palepu et. Al, 1999).

The equity perspective defined in equation (1) is more interesting for investors since it distinguishes amongst capital provided by shareholders and debt holders providing a valuation that incorporates firm-specific financing decisions.

$$Shareholder's\ Equity = Operating\ Entity - Net\ Debt \quad (1)$$

The entity perspective (equation (2)) values the total assets of the firm, ignoring financing decisions, which are not relevant to the value of the company, making this perspective more advantageous for the comparison of estimates from companies.

$$Operating\ Entity = Shareholder's\ Equity + Net\ Debt \quad (2)$$

2.4.2 Stock-Based Valuation Models

Stock-based valuation models also referred to as multiples valuation models, are very commonly included in financial analysts reports and investment bankers' assessments due to their implied simplicity (Bhojraj Lee, 2002). These models have the ability to make reasonable estimates without recurring to multi-year forecasts and present value calculations, that characterize most flow based valuation methods (Liu et al., 2002).

Penman (2003) points out that this type of valuation uses the prices of comparable companies to extrapolate a price for the target, operating under the assumption that markets are efficient, and peer companies are priced correctly.

Although multiples valuation uses a much simpler methodology, it shares the same underlying principles as the more sophisticated methods described in Section 2.4.3: value increases when future payoffs increase and decreases when risk increases and vice-versa (Liu et al., 2002).[2]

The usefulness of this method is extremely high when assessing private companies that do not have a market value, young companies with little historical records (Penman, 2003), IPO's (Kim and Ritter, 1999), mergers and

[2] Baker and Ruback (1999) also identify that multiples have incorporated an implicit forecast of future payoffs and discount rate provided by current market required rates of return and industry growth rates.

acquisitions (Bhojraj Lee, 2002), and as a complement to more sophisticated valuations (Liu et al., 2002).

This model specifies the value of stock (P_{it}) by multiplying a selected value driver (VD_t) and the corresponding price multiple generated from a selection of comparable companies (β_{it}) demonstrated in equation (3):

$$p_{it} = VD_t\beta_{it} \tag{3}$$

The model presented in equation (3) can be improved by including an intercept that takes into account the effect of other variables other than the value driver. Nevertheless, the additional complexity introduced into the model exceeds the benefits of an improved estimation for models that use well-performing drivers (Liu et al., 2002).

The two perspectives of valuation defined previously can be predicted using stock-based valuation, by adapting the choice of value driver. For example, in a valuation of equity, a value driver such as net income should be chosen, while an assessment of the entity requires a value driver like the NOPAT.

The three steps needed to obtain an efficient estimate are (1) selecting an appropriate value driver, (2) choosing a group of comparable companies and (3) computing the benchmark multiple using the information provided by the group selected in the previous step (Palepu et al., 2010). These steps represent the implementation challenges of multiples models, and their execution is directly related to the performance of the model for each company.

Issues discussed in previous literature related to these steps are presented in the remainder of this section.

2.4.2.1 Selecting the Value Driver

Selecting an appropriate value driver is a crucial factor influencing the output of the multiples valuation model considerably and should be carefully analysed in the context of the asset being priced. An important feature of the multiples analysis is that more than one value driver can be selected, by using a weighted average of various benchmark multiples (4):

$$Value\ of\ firm\ i = W_1 \times VD_{1,i} \times \beta_1 + W_2 \times VD_{2,i} \times \beta_2 + \cdots + W_n \times VD_{n,i} \times \beta_n \quad (4)$$

Where W_n is the weights assigned to each value driver $VD_{n,i}$, and β_n are the computed benchmark multiples.

This combined analysis can provide a superior estimate when merging drivers that are positively biased, such as earnings and negatively biased, like sales or asset multiples (Lee Lee, 2002).

Liu et al. (2002) studied the performance of various multiples based on enterprise value and found that forecasted earnings presented the lowest pricing errors, outperforming other multiples across most industries. His findings show that forward earnings are better that historical earnings and cash flows and book value of equity have a similar performance over sales which overall perform the worst.[3]

Various studies[4] have identified that forecasted earnings are the best performing multiple, with its performance enhancing with the increase of the forecast horizon.

As for cash flow multiples, Baker and Ruback (1999) and Lee Lee (2002) verify that using EBITDA over EBIT produces more accurate valuations.

2.4.2.2 Selecting Comparable Firms

The choice of similar companies should be based on the similarity in risk, profitability and growth among firms (Bhojraj Lee, 2002. However, this undertaking may present some exertions given that no two companies are equal.

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[3] Lee Lee (2002) also found that forecasts deliver enhanced results over historical earnings, and sales provide the worst estimates.

[4] Forecasted earnings accuracy are mentioned in Liu et al. (2002), Lee Lee (2002), Kim and Ritter (1999), Bhojraj Lee (2002). Liu et al. (2007) show that forecasts improve estimates to a greater deal using earnings multiples.

In practice, enterprises in the same industry are used based on the assumption that these firms are expected to face the same level of risk and earnings growth as well as use similar accounting methods (Alford, 1992), factors that intensively affect valuation. The issue with selecting firms in the same industry is that there is the risk of a reduced assessment in the cases where the industries are not appropriately defined, and sub-groups of distinct companies are included (Alford 1992, Liu et al. 2002).

Liu et al. (2002) highlight in their paper that choosing comparable businesses that have similar earnings growth provides better valuations than merely picking random companies. Their findings are in line with Alford (1992) who identifies that valuation pricing errors decrease as firms are selected from a narrower SIC code of up to three digits.

Another systematic approach to selecting peer companies is presented by Bhojaj Lee (2002), who use regression analysis to create a "warranted multiple" and select comparable firms based on the proximity of their "warranted multiples" to that of the target company.

2.4.2.3 Computing the Benchmark Multiple

Choosing a method of multiples computation is of high importance given that distinct processes affect the valuation of the target firm, providing different estimates (Liu et al., 2002). The most popular methods for calculating benchmark multiples are described below:

$$Simple\ Mean = \frac{1}{n} \times \sum_{i=1}^{n} \frac{Price_i}{Value\ Driver_i} \tag{5}$$

$$Value - Weighted\ Mean = \frac{\sum_{i=1}^{n} Price_i}{\sum_{i=1}^{n} Value\ Driver_i} \tag{6}$$

$$Median = Middle\ value\ between\ the\ observed\ minimum\ and\ maximum \tag{7}$$

$$Harmonic\ Mean = \left(\sum_{i=1}^{n} \frac{Value\ Driver_i}{Price_i}\ X\ \frac{1}{n}\right)^{-1} \tag{8}$$

Where *n* defines the total number of *i* comparable firms.

The use of the simple average can result in overestimations due to the existence of extreme values (Baker and Ruback, 1999)

Baker and Ruback (1999) and Liu et al. (2002) determine that the harmonic mean (8) is the best approach to calculating the benchmark multiple. It is calculated by averaging the inverted value driver and taking the inverse of that average.

In conclusion, stock-based models are very useful in situations such as IPO's, M&A's and valuing assets that do not have a market value and provide an easy and reliable estimate without having to recur to resource consuming forecasts of multi-period future payoffs. One drawback of this type of model is that it relies on the market to correctly price assets and can be subject to mispricing that disturbs the effectiveness of the estimates obtained.

2.4.3 Flow-Based Valuation Models

In this section, the most common direct valuation models will be discussed: Dividend Discount Model (DDM), Discounted Free Cash Flow Model (DCF), the Residual Income Valuation Model (RIVM) and the Abnormal Earnings Growth Model (AEGM). The main model assumptions, implementation formulas, issues, advantages, and shortcomings will be presented.

These models are all based on fundamental analysis and the assumption that the market value of a stock equals the present value of expected future payoffs (Francis et al., 2000). They construct valuation processes that can be divided into three segments: (1) forecasting of the valuation attribute up to time T; (2) forecasting the terminal value at time T; (3) estimating the cost of capital for the target firm (Courteau et al., 2006).

Theoretically, these models are expected to produce similar estimates (Lee 1999, Francis et al. 2000 and Courteau et al. 2006), but in practice, results differ due inconsistent forecasting properties, growth rates, and discount rates (Francis et al. 2000). Academics such as Lundholm and 0'Keefe (2001) find that such differences in results can be eliminated by the proper model implementation.

2.4.3.1 Dividend Discount Model

The discounted dividend model (DDM) defines the value of a firm's equity as the sum of the discounted expected dividends paid to shareholders over the life of the company (Francis et al., 2000). The model originally developed by Williams (1938) is described in equation (9).

$$V_t^{DDM} = \sum_{t=1}^{T} \frac{d_t}{(1+r_e)^t} \quad (9)$$

Where V_F^{DDM} is the market value of equity at time t, d_t is the expected dividend for year t, r_e is the cost of equity capital and T is the expected life of the firm. In this case, the terminal value is assumed to be the liquidating dividend (Francis et al., 2000). Although future dividends are uncertain, an alternative can be to use variations of this formula, assuming the firms pay a constant dividend or have a constant growth rate (Gordon et al. 1956).[5] Precautions should be taken with estimates from such models because results are highly influenced by the growth rate and therefore an incorrect input may cause deviated values (Damodoran, 2002).

Although this method is the simplest way to value stock (Damodoran, 2002), with variables that can be forecasted without many complications in the short term, it contradicts the proposition described in Modigliani Miller (1961) that states that dividend policy in period t has no effect on the price of that time. Also, by relating value to dividends, this model cannot be used for firms that do not pay dividends or that have arbitrary dividend policies (Penman, 2003).

Despite the model's shortcomings, the following models are derived from a particular specification of the DDM's terminal value (Penman, 1998).

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[5] The expected life of the enterprise is usually thought to be perpetual (T=∞). Variations of the model under this assumption are presented in Appendix 1.

2.4.3.2 Discounted Free Cash Flow Model

The discounted free cash flow (DCF) model is a variation of the DDM that substitutes dividends for free cash flows assuming that these are an improved proxy for value in the short term (Francis et al., 2000).

Free cash flow (FCF_t) is defined as the cash available to the firm's claimants after all required investments are made (10):

$$FCF_t = (SALES_t - OPEX_t - DEP_t)(1-\tau) + DEP_t - WC_t - CAPEX_t \quad (10)$$

Where for year t: $OPEX_t$ are the operating expenses, DEP_t are the depreciation expenses, τ is the corporate tax rate, WC_t is the change in working capital and $CAPEX_t$ are the capital expenditures.

The intrinsic value of the firm ($V_t^{FCF_F}$) is estimated by discounting FCF_t at the business's cost of capital (r_{WACC})(equation 12). The shareholders' equity (V_t^{FCF})(equation 11) is indirectly calculated[6] By subtracting the claim of debt holders (D_t), other non-equity investors (PS_t) and excess cash and marketable securities ($ECMS_t$) (Copeland et al., 1994).

$$V_t^{FCF} = \sum_{t=1}^{T} \frac{FCF_t}{(1+r_{WACC})^t} + ECMS_t - D_t - PS_t \quad (11)$$

with:

$$r_{WACC=}\omega_D(1-\tau)r_d + \omega_{PS}r_{ps} + \omega_E r_e \quad (12)$$

Where ω_D is the proportion of debt in the company's capital structure, ω_E is the proportion of common equity, ω_{PS} is the proportion of preferred stock, r_d, r_{ps} *and* r_e are the cost of debt, preferred stock and equity respectively.

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[6] V_t^{FCF} but can be directly computed using the DCF model with operating cash flows as an input. Both models lead to identical results if applied correctly (Copeland et al., 1994).

This method is preferred over the equity perspective calculation since corresponding equity cash flows with the correct cost of equity is exceptionally hard (Copeland et al., 1994).

In computing the $V_t^{FCF_F}$, a terminal value should be assumed to avoid infinite FCF forecasts (Damodoran, 2002). Equation (13) defines the model with a growing perpetuity:

$$V_t^{FCF_F} = \sum_{t=1}^{T} \frac{FCF_t}{(1+r_{WACC})^t} + \frac{FCF_{T+1}}{(r_{WACC}-g)} X \frac{1}{(1+r_{WACC})^T} \tag{13}$$

In most circumstances, the DCF Model requires adjustments to convert analyst forecasts of earnings into FCFs, a process that implies an increased level of difficulty (Damodoran, 2002).

Since DCF assumes investment to decrease the value, this model can be problematic for profitable enterprises that have negative free cash flows for long periods of time (Penman and Sougiannis, 1998). The DCF model may not provide a good estimate of the firm's value since cash flows provide little understanding of the company's economic performance and profitability, as declining free FCF can hint reduced performance but also an investment for the future (Copeland et al., 1994).

2.4.3.3 Residual Income Valuation Model

The RIVM also referred to as the Edwards-Bell-Ohlson (EBO) valuation technique (Frankel and Lee, 1998), is a version of the dividend discount model (Lee Swaminathan, 1999). The model mentioned in Peasnell (1982) and developed in Ohlson (1995) and Feltham and Ohlson (1996) shifts the value analysis from the expected value of dividends. It uses the clear surplus relation (CSR) as an underlying assumption: all gains and losses affecting book value are also included in earnings (14) (O'Hanlon and Peasnell, 2002). Mathematically RIVM is initially described as (15):

$$CSR \rightarrow B_t = B_{t-1} + NI_t - d_t \tag{14}$$

$$V_t^{RIVM} = \sum_{i=1}^{\infty} \frac{E_t(d_{T+i})}{(1+r_e)^i} \quad (15)$$

Where V_t^{RIVM} is the stock's value at time t, B_t is the book value of equity, $E_t(d_{t+i})$ is the expected future dividend for the period *t+i* conditional on the information available at time t and r_e is the cost of equity.

Assuming that the firm's earnings and book value are forecasted under the CSR (Ohlson, 1995 and Feltham and Ohlson, 1996) (14), the estimate in equation (15) can be modified to assess the intrinsic value of the stock as a function of book value of equity plus an infinite sum of discounted residual income (Lee, 1999) (shown in equations 16a, 16b and 16d).

$$V_t^{RIVM} = B_t + \sum_{i=1}^{\infty} \frac{E_t[NI_{t+i} - (r_e B_{t+i-1})]}{(1+r_e)^i} \quad (16a)$$

$$V_t^{RIVM} = B_t + \sum_{i=1}^{\infty} \frac{E_t[(ROE_{t+i} - r_e) B_{t+i-1})]}{(1+r_e)^i} \quad (16b)$$

$$RI_{t+i} = NI_{t+i} - (r_e B_{t+i-1}) \quad (16c)$$

$$V_t^{RIVM} = B_t + \sum_{i=1}^{\infty} \frac{E_t[RI_{t+i}]}{(1+r_e)^i} \quad (16d)$$

Where NI is the firm's net income, V_t^{RIVM} is the stock's intrinsic value, E_t is the expected value at time t, ROE is the after-tax return on book equity and r_e is the required cost of capital assuming a flat term structure.[7]

This model separates company value into two factors: a measure of capital invested and the present value of all future wealth (Lee Swaminathan, 1999). In other words, it separates financing from operating activities (Feltham and Ohlson, 1996).

The RIVM produces an estimate equal to the book value of equity, if the firm does not create value and will generate approximations higher (lower) than B_t if expected ROE is higher (lower) than r_e (Lee Swaminathan, 1999).

[7] The entity perspective of this model is presented in Appendix 2

This model may prove to be a useful tool in valuing companies given that estimates are not influenced by dividend policy or accounting standards (Francis et al., 2000). It also presents an advantage over the DCF models, as it treats investment as an asset and requires shorter forecasting horizons (Penman, 2003). Nevertheless, is it faced with implementation issues related to forecasting horizons, the cost of equity, terminal value calculations, corresponding book value to forecasts, earnings forecasts and dividend payout ratios (Lee Swaminathan, 1999). Another shortcoming of the model is while the RIVM uses forecasted financial statement numbers to value the firm (Ohlson, 1995), it does not link value to past reported figures (Lee,1999 and O'Hanlon and Peasnell, 2002).

Finally, the RIVM's reliance on the clear surplus relation and dependence on book values led Ohlson and Juetter-Nautoth (2005) to develop a variation of the model described next as the abnormal earnings growth model (AEGM).

2.4.3.4 Abnormal Earnings Growth Model

AEGM also referred to as the Ohlson and Juettner-Nauroth model is derived similarly to the RIVM, using the DDM. It conveys the intrinsic value of equity as the "capitalized next period expected earnings" plus the present value of the "capitalized forecast of abnormal earnings growth of subsequent years" (O'Hanlon, 2009). Abnormal earnings growth (equation 17) is defined as the difference between periodic earnings change and the standard return on the previous period retained earnings.

$$AEG_{t+1} = (Earn_{t+1} - Earn_t) - (r_e)X(RE_t) \qquad (17)$$

The AEGM uses the capitalized expected subsequent period's earnings (y_t) as an anchor (equation 18), as opposed to the RIVM, which uses the book value of equity (O'Hanlon, 2009).

$$y_t = \frac{Earn_{t+1}}{r_e} \qquad (18)$$

Similarly to the RIVM derivation, the AEGM is obtained from the DDM, and its equity perspective is described in equations (19a), (19b) and (19c).

$$V_t^{AEGM} = \frac{Earn_{t+1}}{r_e} + \sum_{t=1}^{\infty} \frac{(Earn_{t+1} - Earn_t) - (r_e - 1)X(Earn_t - d_t)}{(1+r_e)^t r_e} \quad (19a)$$

$$V_t^{AEGM} = \frac{Earn_{t+1}}{r_e} + \sum_{t=1}^{\infty} \frac{AEG_{t+1}}{(1+r_e)^t r_e} \quad (19b)$$

$$V_t^{AEGM} = \frac{Earn_{t+1}}{r_e} + \sum_{t=1}^{T} \frac{AEG_{t+1}}{(1+r_e)^t r_e} + \frac{AEG_{T+2}}{(1+r_e)^T r_e (r_e - g)} \quad (19c)$$

AEGM presents advantages over the RIVM, as its inputs are a better estimate for market value (future earnings vs. book value of equity) and are better known by analysts (Ohlson, 2005). Also, forecasted changes in earnings need to be consistent with retained earnings between consecutive periods but do not have to follow the CSR.

In addition, the model presents an intuitively appealing formula, demonstrating how the current price depends on forward earnings and their growth, with no restrictions on dividend policy (Ohlson and Juettner-Nauroth, 2005).

2.5 Valuing Internet Companies

With the increased difficulty faced when valuing Internet companies using traditional valuation methods, many scholars look to alternative methods to estimates prices for such stocks. An alternative method to value internet companies was developed by S. Schwartz and Mark Moon (2000).

Schwartz and Moon (2000) argue that internet stock prices may not be the result of a market bubble, but in fact may possibly be rational prices if growth rates in revenues are high enough. The model uses real option theory and capital budgeting techniques depending on the estimation of a number of parameters, the most relevant being the revenues, expected growth rate of revenues, losses carried forward and cash balances. It is developed in continuous time with a discrete time approximation that enables users to estimate prices using annual or quarterly data, for example. The value of the firm is written as seen is equation (20).

$$V = V(R, \mu, L, X, t) \quad (20)$$

With R being the revenues, μ the expected growth in revenues, L the loss carried forward, X the cash balances and t the time.

The model provides an explanation for the volatility and what seem to be unbelievably high stock prices, under the assumption that revenue growth rates are high and using well estimated parameters.

2.6 Empirical Evidence

2.6.1 Empirical Evidence on Stock-Based Valuation Models

Forward earnings measures with a broad forecast horizon are the best performing multiples over most industries, contradicting the idea that different industries use different multiples. Historical earnings, cash flow measures, the book value of equity and sales is the order of the performance of multiples after forward earnings (Liu et al., 2002).

Although sales are not a good performance measure in comparison to other value drivers, they are widely used to evaluate companies when earnings and cash flows are negative and in some emerging markets where earnings and cash-flows are perceived as uninformative (Liu et al., 2002)

Investors use cash flow multiples because they believe reported cash flows to be a good indication of future cash flows, which are less predisposed to management manipulation. (Liu et al., 2002)

When assessing the value of companies with weak but positive earnings, earnings based models should be avoided because these multiples give unrealistic low estimates (Lee Lee, 2002).

For enterprises that have a lot of intangible assets on their balance sheet and have much investment in R&D, earnings valuation models can produce numbers that notably underestimate their actual value. Since earnings are reduced despite the fact that these companies' value is derived from uncertain future growth opportunities (Lee Lee, 2002).

Pricing errors are also the lowest when multiples are calculated using the harmonic mean and when comparable firms are not selected randomly (Liu et al., 2002).

The power of predictability of multiples valuation models varies positively with the increase in company size and profitability and is negatively correlated with the growth in value of intangible assets (Lee Lee, 2002) and the differences in accounting practices used by comparable companies Young and Zeng (2015).

The fact that valuation results are more accurate for big businesses can be related to the fact that small enterprises have erratic earnings, and their value is derived from a small set of projects. (Lee Lee, 2002).

Given that these multiples use positive value drivers, these results may not be descriptive of firms reporting losses, start-up companies and growing businesses that have negative operating cash flows (Liu et al., 2002 and Liu et al. 2007).

Dechow et al. (1999) agree that a simple forward P/E model adequately captures how investors determine the current price.

2.6.2 Empirical Evidence on Flow-Based Models

Francis et al. (2000) compared the reliability of the DDM, DCF, and AEGM and determined that in practice, AEGM's estimates are more accurate than those produced by the first two models.[8] The explanation given for this phenomenon was the ability of the latter model to incorporate both stocks (book value of equity) and flow components (abnormal earnings), while the other two models focus exclusively on flow factors. Frankel and Lee’s (1995) findings also support

[8] Results show that the median absolute prediction error for AEGM, DCF and DDM are 30%, 41%, and 69% respectively. AEGM value estimates explain 71% of the variation in current prices compared to 51% for DDM and 35% for FCF. These results are valid when distortions in book value are less that forecasting and measuring errors in discount and growth rates.

these results. Penman and Sougiannis (1998) find a similar relationship between models by testing the models with finite-horizon forecasts, identifying that forecasting accrual earnings and book values (RIVM) have practical advantages over forecasting dividends and cash flows (DDM and DCF model), specifically for companies that use GAAP.[9]

According to Francis et al. (2000) within the flow based model category, for companies with high R&D expenditures and significant accounting discretion, the best valuation is given by the AEGM.

Lundholm and O'Keefe (2001) find that analysis such as the previous ones are misguided since direct models are derived from the same underlying assumption and should present similar estimates. According to these authors, differences in estimates are usually due to three types of errors. The first is inconsistent forecasts, caused by starting the perpetuity with the wrong values. The second, an incorrect discount rate, is the result of a difference between the cost of equity used to evaluate investment directly, and the WACC used to assess equity through an entity perspective model. The third is missing cash flows, that is caused by calculating the valuation attributes in an inconsistent way, usually due to a breach of the CSR in the financial statement forecasts. Richardson Tinaikar (2004) compare the studies performed by Penman and Sougiannis (1998) and Lundholm and O'Keefe (2001) and find that the latter is correct when assuming that flow models should present the same estimates. They also give the previous credit for identifying that the DCF model requires extended periods of forecasted information and requires accrual information.

2.6.3 Empirical Evidence on Relative Performance

Multiples valuation, compared to flow-based models, have the advantage of using a simpler method to estimate stock prices. Although, unlike flow based models, they are based on the assumption that the market is correctly pricing assets and

[9] In some circumstances GAAP allows for the breach of the clear surplus relation (Ohlson, 2005).

are subject to the risk of the entire industry or group of firms being under or overvalued Kim and Ritter (1999).

According to Liu et al. (2002), forward earnings multiples perform better that intrinsic value measures based on residual income models, given the generic assumptions in calculating the terminal value in the latter model. Conflicting with their results, Courteau et al. (2006) finds that the direct methods outperform the forward P/E multiple models, using both pricing errors and return prediction tests, but admits that a combination of both models exceeds either method used on its own.

As for non-US companies, Ashbaugh and Olsoon (2002) find that earnings multiples provide better estimations compared to book value estimates and residual models.

Ultimately there is no consensus on which valuation model provides the best estimate. Therefore a mixture of stock-based models and flow-based models can be used to complement each other and provide a good understanding of the intrinsic value of the target asset.

2.7 Concluding Remarks

The previous chapter focused on identifying and exhibiting the most common equity valuation methods, shedding light on the advantages and disadvantages of the employment of each model.

Implementation issues for stock-based models are related to the choice of comparable companies, the multiple benchmark computation and the selection of value driver, while issues for direct methods are linked with forecasts, terminal value calculations and determining the required cost of capital.

Empirical evidence is presented on the performance of each model, with conflicting points of view regarding the best-performing estimate. Liu et al. (2002) identify forward earnings multiples as the best predictor of intrinsic value, while Courteau et al. (2006) believe that direct methods perform better. Within the multiples segment, forward earnings multiples computed using harmonic mean are recognised as the best predictor of value, while within the flow based models, the RIVM is perceived to outperform other models, though little analysis has been done on the performance of the AEGM.

The following chapter will be dedicated to the analysis of the theoretical models discussed here in a practical setting, observing specifically their performance when valuing Internet companies.

3 Large Sample Analysis

3.1 Introduction

This chapter is dedicated to testing some of the models described in the previous section on a large sample of firms with the aim of identifying their relative performance.

As previously mentioned, the focus of this paper is on the performance of accounting-based valuation models in producing estimates for Internet and IT Service companies (IITS companies). The aim is to understand the usefulness of these models in a fast growing industry characterized by an increased level of volatility and uncertainty. Many analysts and academics find that accounting information is of little use when valuing Internet stocks (Trueman et al., 2000).

Such findings lead to the need for an analysis of the traditional methods of valuation for IITS firms, to shed some light on what methods should be used when valuing these companies.

The next sections will specify the research question undertaken in this study, hypothesis development, research design, some descriptive statistics of the data analysed and empirical results.

3.1.1 Research Question and Prior Literature

The process of valuing Internet companies has been of high importance since the formation of the dot-com bubble. These companies have proven to be extremely hard to value due to the reduced amount of historical financial information available on many IITS firms given the young age of the industry (Trueman et al., 2000). In addition to these factors, the industry has also shown signs of enormous growth and unpredictability, making it hard to look towards accounting numbers for guidance (Trueman et al., 2001 and Zarzecki, 2010).

Unlike conventional firms, earnings are not priced in Internet stocks, and negative cash flows are seen as investments (Bartov et al., 2002), making it hard to use accounting numbers as measures of value. These factors create little consensus on whether accounting based valuation models should be used to value Internet companies.

On one side, Hand (2000 and 2001) postulates that market values are strongly correlated with accounting data, though not linearly, arguing that revenues are the key driver of IITS stock prices. Zarzecki (2010) and Core et al. (2003) also find that traditional valuation models are still relevant in valuing these companies as long as appropriate assumptions are made, and estimations for probable scenarios are taken into account.

On the other hand, Amir and Lev (1996) find that firms with high levels of intangible assets (such as IITS) are seen by investors as companies with distorted earnings since value-boosting investments are treated as expenses, consequently leading them to look at non-financial information, as indicators of worth. A trending non-financial indicator in the IITS industry is web traffic, which is found to be correlated with market values and stock returns (Rajgopal and Venkatachalam, 2000 and Zarzecki, 2010).

This matter is of such importance that academics like Schwartz and Moon (2000) have developed a model to value Internet companies, based on real options theory and capital budgeting, which was tested by Klobucnik and Sievers (2013).

Given this dichotomy, the essence of this study will be to identify the usefulness of accounting based models for the valuation of Internet and IT Service companies.

This section will not only attempt to determine the explanatory power of traditional valuation methods for IITS', but it will also seek to recognize the relative performance of stock-based and flow-based models. This dilemma is equally relevant. Theoretically, all models produce similar estimations (Lee 1999, Francis et al. 2000 and Courteau et al. 2006), but in practice, different assumptions are used and so each model produces a distinctive valuation. Additionally an attempt will be made on identifying if model performance is industry related.

The research question for this section is accordingly presented below:

Do P/E multiple, AEGM and RIVM perform worse in valuing the Internet and IT Service industry?

3.1.2 Hypotheses Development

Following the literature reviewed above, the following detailed hypotheses will be tested, in order to answer the broad research question

Hypothesis 1: Accounting based valuation models have lower accuracy and greater negative bias when valuing Internet companies in comparison to firms in other industries.

Hypothesis 2: Valuation models have lower explanatory power when valuing Internet companies.

Hypothesis 3: Stock-based models perform better than flow based models.

Hypothesis 4: Accounting based valuation models' accuracy and bias varies across industries.

Hypothesis 1 and 2 are similar in the way that they both test the usefulness of the studied valuation models for Internet companies. Hypothesis 1 observes whether or not the valuation models produce good estimates and compares results to those of other industries.

Hypothesis 2 explores to what extent the estimates produced, explain the variations in share prices observed. It is noted that to test this hypothesis, the estimates obtained for each model are regressed for towards the dependent variable that is defined as the share price in the April after the end of the fiscal year for each yearly observation. The findings of this research for both hypotheses are expected to be in line with the opinions of analysts and academics such as Schwartz and Moon (2000) who find that Internet stocks are hard to value using traditional methods.

Hypothesis 3 considers the relative performance of accounting-based valuation models. Comparing the bias, accuracy and explanatory power of each model will test this premise. Results are obtained through the use of hypothesis tests and regression analysis and are anticipated to favour the 2-year forward P/E multiple following the results of Liu et al. (2002).

Hypothesis 4 can be partially derived from the results obtained from the first two predictions. By comparing the estimates of each model between Internet companies and the other defined industries, an inference can be made on the difference among models for distinctive industries.

3.2 Research Design

This section will illustrate the sampling process undertaken to reach the four sub-samples required to test the defined hypotheses. Valuation model implementations will be recognized as well as all the relevant assumptions to answer the underlying research questions that were set out in the previous section.

The valuation models used in this chapter are the forecasted P/E multiple as the best representative of the stock-based models (Liu et al., 2002) the RIVM which is hypothesized to outperform stock-based models (Courteau et al., 2006) and the AEGM which is an improved version of the RIVM. All three models will be estimated using the equity perspective.

3.2.1 Data and Sample Selection

The original data set is comprised of accounting data, share prices and analyst forecasts for a sample of 6559 U.S. public firms between 2005 and 2013, adding up to a total of 33.552 firm-year observations.

Firm descriptive information and financial statement data are collected from Compustat®[10], while analyst forecasts are retrieved from I/B/E/S and betas and stock prices are obtained from CRSP.

The sample selection process is described in Table 1 indicating the number of observations removed to get the foundations for solid statistical testing. Observations with missing information regarding variables that are necessary for the P/E, RIVM and AEGM valuations were removed, specifically missing current and forecasted EPS, the book value of equity, shares market value, dividends forecasts, and EPS growth rates. Observations that present negative values for net income and beta were excluded given that multiples valuations and cost of capital calculations require positive values for these variables. Financial companies were also excluded from the sample, in an attempt to create uniform sub-samples representing relatively similar industries.

The total sample remaining is of 5543 observations, which may include a single firm more than once. The sample is subsequently divided into four groups of industries: (1) the Internet and IT Services, (2) Other high-tech companies, (3) Low-tech businesses and (4) Other industries.

The definition of each sub-sample is based on studies performed by Francis and Schipper (1999), Kwon (2002) and Kwon et al. (2006). The former identify high and low tech industries based on the SIC codes of each company.[11] In addition to the SIC codes submitted by these authors, agricultural, mining and natural resource companies were added to the low-tech segment and manufacturing, and automobile companies were added to the high-tech group to obtain four segments with similar sample sizes. As for the Internet and IT Services industry, it is defined by Kile and Phillips (2009), that the industry is composed by eight 3-digit SIC codes. Other Industries represent the remainder of the sample.

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[10] Compustat values for the book value of equity per share and earnings per share were adjusted for stock splits and dividends. I/B/E/S and CRSP data do not need adjustment.

[11] SIC codes for each sub-sample are presented in Appendix 3

Table 1- Sample selection process

	Number of observations
Observations of U.S. Public firms between 2005 and 2013	**33.552**
(-) Observations with missing or negative EPS	9.567
(-) Observations with no price 4 months after fiscal year	130
(-) Observations with no EPS forecasts for 1, 2 and 3 years ahead	8.016
(-)Observations with missing book value of equity	350
(-)Observations with missing DPS forecasts for 1, 2 and 3 years ahead	6.404
(-) Observations with missing SIC code	1
(-)Observations with negative or missing NI	218
(-) Observations with no comparable companies	253
(-)Observations for financial companies	3.070
Total pooled sample	**5.543**
Sub-Sample A- Internet and IT Services (IITS)	1.059
Sub-Sample B- Other high-tech companies (OTHC)	1.234
Sub-Sample C- Low tech companies (LTC)	1.529
Sub-Sample D- Other industries (OIS)	1.721

Data was also retrieved from Bloomberg to calculate the risk-free and market return. The risk-free for each valuation year was obtained using the U.S 10 year treasury bonds and the market premium was computed using the yearly S&P returns from 1993 to 2013. The variables used in the large sample analysis are identified in Appendix 4.

3.2.2 Model Implementation

3.2.2.1 Stock-Based Valuation

The stock-based valuation model used is the 2-year forward P/E multiple, defined by Liu et al. (2002) as the best performing multiple. The estimate for the equity of a stock is computed by multiplying the value driver by the benchmark multiple.

The value driver used is the median analyst forecast of earnings per share two years ahead (EPS_2) and the benchmark multiple (Pmultiple) is calculated using a harmonic mean, for increased performance (Liu et al., 2002). Comparable companies (Ncomparables) are identified using the three digits SIC codes following the study performed by Alford (1992). To obtain better estimates, the target company is not included in the comparable group, and each firm is only accounted for once.

3.2.2.2 Flow-Based Valuation

Two flow-based models were selected, the RIVM and the AEGM. These evaluations were made as of April of the year after the fiscal year end for each observation and from an equity perspective.

The RIVM is derived using two periods, based on the median analyst forecast of earnings per share and a terminal value (21). Equity value is computed by adding the discounted residual incomes for the two periods($\frac{\text{RI\_1}}{(1+\text{Ke})}$ for period 1 and $\frac{\text{RI\_2}/(\text{Ke}-\text{g}))}{(1+\text{Ke})}$ for period 2) to the book value per share adjusted for stock splits and dividends (bjvlpsAJ). The choice of a two period model is due to the need of simplification and the fact that many observations do not have data for expected earnings 3-years ahead.

$$V_t^{RIVM} = bkvlpsAJ + \frac{RI\_1}{(1+Ke)} + \frac{RI\_2/(Ke-g))}{(1+Ke)} \tag{21}$$

Where V_t^{RIVM} is the equity value estimated using the RIVM, RI_1 and RI_2 are the forecasted residual incomes for the next year and T+2, Ke is the cost of equity, and g is the growth rate. The AEGM was chosen, as it is theoretically an improvement of the RIVM (22). Estimates were originated using a two period model, with no perpetuity, as it is assumed that abnormal earnings in the long term will cease to exist given the competitiveness of the markets.

$$V_t^{AEGM} = \frac{EPS\_1}{Ke} + \frac{AEG\_1}{Ke*(1+Ke)} + \frac{AEG\_2}{Ke*(1+Ke)^2} \tag{22}$$

Where V_t^{AEGM} is the equity value estimated using the RIVM, AEG are the abnormal earnings for the period, EPS are the forecasted earnings per share for the next year and Ke is the cost of equity. Both models share the need for some assumptions such as the cost of capital, dividend payout rate and growth rates. As for the cost of equity (Ke), it was calculated using the CAPM formula (23). The inputs used were the risk-free rate (Rf), assumed to be equal to the U.S. 10 year Treasury bond rate of each year, the Market return (Rm), represented by the average S&P yearly returns over a period of 20 years and the equity betas are retrieved from CRSP

$$K_e = R_f + \beta(R_m - R_f) \tag{23}$$

Additionally, the dividend payout rate, used to retrieve the residual income numbers was assumed to be equal to 1 in the cases where the current earnings per share were less than reported dividends. Similarly, valuations that resulted in a negative estimate were set to zero, as it is not economically viable to have negative equity. This was the case for 23 observations using the RIVM model and 170 using the AEGM.

3.2.3 Performance Measures

To assess the level of bias and accuracy of valuation models, the methodology employed in Liu et al. (2002), Lie and Lie (2002) and Corteau et al. (2007) will be implemented.

Valuation bias is assumed to be the model's tendency to under- or overvalue a stock, measured by signed prediction errors (24).

$$Signed\ Prediction\ Error_t = \frac{V_t^{model} - P_t}{P_t} \quad (24)$$

Valuation accuracy is defined as the percentage of the stock's price that is not incorporated in the value estimate, measured by absolute prediction errors (25).

$$Absolute\ Prediction\ Error_t = \frac{|V_t^{model} - P_t|}{P_t} \quad (25)$$

Absolute and signed errors are compared among models and industries using t-tests and Wilcoxon sign ranked tests for means and medians respectively.

As for the explanatory power of each model, it will be identified through a linear regression using the price of the stock, at the valuation date, as an independent variable and the estimates derived from each model as an explanatory variable. The R^2 of the regression will portray the percentage of variation of the independent variable that is explained by the estimates.

The analysis of the research will be performed mostly regarding means and medians, with a higher emphasis on the latter, as it is seen as a more stable indicator (Damodoran, 2002).

3.3 Descriptive Statistics

Table 2 and 3 identify the descriptive statistics for the pooled sample and selected subsamples. Table 2 provides information on the stocks included in the analysis while Table 3 focuses on the figures regarding the absolute and signed prediction errors.

The IITC sample has a standard deviation of 2,31, that when compared to the standard deviation of 1,00 for OHTC and 0,91 for LTC, it is noted that this sample has a larger dispersion of valuation errors, meaning that these companies are harder to value, compared to those in the other subsamples.

As for the Market-to-Book ratio, the median for IITC is above the median of the pooled sample indicating that investors expect these companies to create more value given their current level of assets. This is common for stocks in this industry, given that a significant portion of their assets is intangible and may not be valued correctly or is expected to generate more future value than other firms with more traditional financial statements, such as manufacturing companies.

Both current and forecasted earnings per share are reduced for IITC and OHTC, probably because the companies spend more on R&D and other investments that will create value in the long run, but are expensed in the current period. It is noted that the dispersion of earnings per share is also higher for Internet companies with 98% of observations ranging between 0,025 and 11,54 while OIC ranges between 0,5 and 8,75. This shows that not only do these companies have low earnings; they are more heterogeneous among peer firms. Given the high market-to-book ratio and the low level of earnings, results can be predicted to favour the hypothesis that earnings are less useful in valuing Internet stocks.

In all samples, the means tend to be above the median values, indicating a degree of skewness, which may be a result of the restriction of the lower bound to zero for some variables, to eliminate negative equity valuations.

Table 2- Descriptive Statistics for the Stocks

Pooled Sample	N	Mean	SD	1%	Q1	Median	Q3	99%
Share Price in April (t+1)	5543	45,6725	0,5843	5,7600	24,6100	37,7300	56,4500	158,0000
Market-to-Book ratio	5543	13,1445	8,1131	0,7137	1,6894	2,5175	4,0023	25,3352
Adjusted EPS	5543	2,4118	0,0348	0,0900	1,0900	1,8400	3,0003	11,0000
Median of 1-year ahead EPS forecast	5543	2,6931	0,0417	0,1700	1,3100	2,1100	3,3000	11,1300
Median of 2-year ahead EPS forecast	5543	3,0669	0,0493	0,3000	1,5400	2,3900	3,7400	11,8200

Sub Sample A- Internet and IT Services	N	Mean	SD	1%	Q1	Median	Q3	99%
Share Price in April (t+1)	1059	42,7074	2,3123	2,4900	17,4100	28,4400	45,9000	471,3800
Market-to-Book ratio	1059	5,1676	0,2883	0,8219	2,1762	3,4185	5,4764	23,1022
Adjusted EPS	1059	1,5192	0,0707	0,0250	0,5000	1,0000	1,7100	11,5400
Median of 1-year ahead EPS forecast	1059	1,8777	0,0910	0,0500	0,7500	1,3300	2,2100	12,3000
Median of 2-year ahead EPS forecast	1059	2,1964	0,1083	0,1100	0,9200	1,5500	2,5400	14,0400

Sub Sample B- Other High Tech C.	N	Mean	SD	1%	Q1	Median	Q3	99%
Share Price in April (t+1)	1234	50,6234	1,0073	8,0700	27,1500	43,7050	65,1400	158,0000
Market-to-Book ratio	1234	3,9549	0,3462	0,8227	1,7942	2,6097	3,9090	22,2538
Adjusted EPS	1234	2,8408	0,0623	0,1500	1,3800	2,2925	3,7200	10,4200
Median of 1-year ahead EPS forecast	1234	3,2625	0,1026	0,3000	1,6200	2,6400	4,1000	11,7900
Median of 2-year ahead EPS forecast	1234	3,7532	0,1436	0,4900	1,9000	3,0150	4,7200	11,9200

Sub Sample C- Low Tech Companies	N	Mean	SD	1%	Q1	Median	Q3	99%
Share Price in April (t+1)	1529	50,1654	0,9171	9,6400	27,7500	42,1500	65,2200	152,8700
Market-to-Book ratio	1529	7,9973	2,2197	0,7594	1,7771	2,6372	4,1994	52,7301
Adjusted EPS	1529	2,8903	0,0832	0,1600	1,3700	2,1700	3,5500	11,7100
Median of 1-year ahead EPS forecast	1529	3,1694	0,0932	0,2000	1,6000	2,4800	3,9300	12,3600
Median of 2-year ahead EPS forecast	1529	3,5876	0,0888	0,4800	1,8900	2,8100	4,4700	13,4100

Sub-Sample D- Other industries	N	Mean	SD	1%	Q1	Median	Q3	99%
Share Price in April (t+1)	1721	39,9556	0,5393	5,9000	24,9800	36,2700	50,4000	114,1100
Market-to-Book ratio	1721	29,2151	26,0554	0,6080	1,4530	2,0271	3,0624	17,8051
Adjusted EPS	1721	2,2282	0,0522	0,1400	1,2200	1,8400	2,7400	8,9100
Median of 1-year ahead EPS forecast	1721	2,3633	0,0460	0,2800	1,3700	1,9800	2,9700	7,8100
Median of 2-year ahead EPS forecast	1721	2,6479	0,0570	0,5000	1,5700	2,2200	3,2100	8,7500

Table 3 illustrates the descriptive statistics for the prediction errors of each model across the four sub-samples, demonstrating a preview of what may be the results of the statistical tests performed in the next section.

The median absolute error, indicating the accuracy of the model, is lowest for the P/E, in the whole sample, confirming the hypothesis that the P/E model produces better estimates.

The model's performance is supported by the low standard deviation when compared with the flow-based models, which although producing similar volatilities, remain above the risk of the P/E model. The P/E is also shown to be the model that creates estimates with the lower percentage of price left unexplained, within every sub-sample, followed by the RIVM for IITC and LTC (see table 3).

The OHTC and OIC present a ranking of models starting with the P/E as best performing followed by the AEGM and consequently the RIVM. This can be an indication of difference performance across industries. The industry with the highest absolute valuation errors is IITC for all three models, indicating that these companies are harder to value.

Regarding the signed prediction errors, these are mostly negative for all models, meaning that the accounting based models analysed tend to under-value stocks. These errors are positive in less than 50% for the P/E and less than 25% for the RIVM and AEGM.

These values are highlighted in the IITC subsample, suggesting that the models are undervaluing these stocks due to their reliance on earnings as a value driver. As discussed, earnings may not capture the full value of the firm. The IITC sub-sample is found to be the industry with the most bias, with a median signed error further away from zero compared to the other sub-samples.

Additionally, the P/E multiple is, once again, the least biased, with median signed errors closest to zero. Thus, the P/E shows signs of providing better accuracy and bias than the other models. This is partially due to the fact that this valuation model incorporates industry specific bias. This occurs because the valuation depends on that of other companies in the same industry, which may also be highly valued. The large market values of peer companies, causes the P/E model to produce higher values which in turn are more in line with the market values of the observed company. This model may be very misguiding in circumstances where the entire industry is over or undervalued.

In conclusion, the analysis of valuation errors' descriptive statistics provides the basis for a preliminary validation of the following hypotheses:

Hypothesis 1: Accounting based valuation models have lower accuracy and greater negative bias when valuing Internet companies in comparison to firms in other industries.

Hypothesis 3: Stock-based models perform better than flow based models.

Hypothesis 4: Models performance varies across industries.

Table 3- Descriptive Statistics for Valuation Model Errors

	Pooled Sample	N	Mean	SD	1%	Q1	Median	Q3	99%
P/E Multiple	Absolute prediction errors	5543	0,3371	0,0117	0,0039	0,1039	0,2193	0,4216	1,7097
	Signed prediction errors	5543	0,0000	0,0125	-0,8156	-0,2811	-0,0622	0,1553	1,7097
RIVM	Absolute prediction errors	5543	0,5505	0,0180	0,0105	0,2913	0,4834	0,6658	1,8519
	Signed prediction errors	5543	-0,2639	0,0191	-0,9519	-0,6266	-0,4380	-0,1501	1,8338
AEGM	Absolute prediction errors	5543	0,5643	0,0195	0,0121	0,2796	0,4854	0,6720	2,4245
	Signed prediction errors	5543	-0,3705	0,0203	-1,5801	-0,6580	-0,4617	-0,2181	1,2136
	Sub Sample A- Internet and IT Services	**N**	**Mean**	**SD**	**1%**	**Q1**	**Median**	**Q3**	**99%**
P/E Multiple	Absolute prediction errors	1059	0,4636	0,0422	0,0084	0,1387	0,2919	0,5129	3,8567
	Signed prediction errors	1059	-0,0162	0,0445	-0,9136	-0,4289	-0,1560	0,1215	3,8567
RIVM	Absolute prediction errors	1059	0,6392	0,0261	0,0231	0,4144	0,5842	0,7550	2,6912
	Signed prediction errors	1059	-0,4621	0,0294	-0,9904	-0,7446	-0,5798	-0,3963	2,6912
AEGM	Absolute prediction errors	1059	0,6716	0,0356	0,0276	0,3977	0,5732	0,7668	3,0784
	Signed prediction errors	1059	-0,4687	0,0385	-1,5801	-0,7583	-0,5536	-0,3710	2,4817
	Sub Sample B- Other High Tech Companies	**N**	**Mean**	**SD**	**1%**	**Q1**	**Median**	**Q3**	**99%**
P/E Multiple	Absolute Prediction Errors	1234	0,2742	0,0123	0,0030	0,0890	0,1822	0,3498	1,3667
	Signed Prediction Errors	1234	0,0102	0,0145	-0,8474	-0,2146	-0,0314	0,1638	1,3667
RIVM	Absolute Prediction Errors	1234	0,5391	0,0559	0,0103	0,3129	0,4863	0,6380	0,9471
	Signed Prediction Errors	1234	-0,3746	0,0570	-0,8831	-0,6320	-0,4795	-0,2983	0,7186
AEGM	Absolute Prediction Errors	1234	0,5925	0,0674	0,0242	0,3463	0,5022	0,6635	1,7171
	Signed Prediction Errors	1234	-0,4078	0,0685	-1,3306	-0,6609	-0,4956	-0,3317	0,5298
	Sub Sample C- Low Tech Companies	**N**	**Mean**	**SD**	**1%**	**Q1**	**Median**	**Q3**	**99%**
P/E Multiple	Absolute Prediction Errors	1529	0,3204	0,0125	0,0044	0,1113	0,2427	0,4397	1,2736
	Signed Prediction Errors	1529	-0,0006	0,0149	-0,7968	-0,2674	-0,0307	0,2039	1,2736
RIVM	Absolute Prediction Errors	1529	0,5128	0,0152	0,0088	0,2725	0,4819	0,6712	1,6197
	Signed Prediction Errors	1529	-0,3177	0,0183	-0,9520	-0,6345	-0,4404	-0,1787	1,6197
AEGM	Absolute Prediction Errors	1529	0,5606	0,0177	0,0128	0,3003	0,5137	0,7090	2,2085
	Signed Prediction Errors	1529	-0,4301	0,0199	-1,7246	-0,6890	-0,4942	-0,2405	1,2087
	Sub Sample D- Other industries	**N**	**Mean**	**SD**	**1%**	**Q1**	**Median**	**Q3**	**99%**
P/E Multiple	Absolute Prediction Errors	1721	0,3194	0,0230	0,0033	0,0927	0,1925	0,3807	1,4581
	Signed Prediction Errors	1721	0,0032	0,0242	-0,7529	-0,2549	-0,0572	0,1327	1,4581
RIVM	Absolute Prediction Errors	1721	0,5377	0,0363	0,0087	0,2197	0,4210	0,6190	2,1713
	Signed Prediction Errors	1721	-0,0148	0,0385	-0,8772	-0,5054	-0,2087	0,2321	2,1582
AEGM	Absolute Prediction Errors	1721	0,4813	0,0293	0,0062	0,1749	0,3795	0,5603	2,4863
	Signed Prediction Errors	1721	-0,0148	0,0385	-1,5043	-0,5244	-0,3170	-0,0037	1,4170

3.4 Empirical Results

3.4.1 Intra-Sample Analysis

This section will examine the validity of valuation errors within the pooled sample and each sub-sample. The objective of this analysis is to test whether the models are unbiased and accurate in each sample. A parametric t-test is used for mean values, and a Wilcoxon signed rank test (non- parametric) is performed on the medians. These tests are executed to determine if the average and median errors are equal to zero:

T-Test
H0: Mean Valuation Error = 0
H1: Mean Valuation Error ≠ 0

Wilcoxon Signed Rank
H0: Median Valuation Error = 0
H1: Median Valuation Error ≠ 0

Where H0 is the null hypothesis and H1 is the alternative hypothesis.

The results of both tests are described in Table 4, where H0 is rejected at a 5% significance level if the p-value for each estimate is lower than 0,05.[12]

As predicted, the null hypothesis is rejected in all tests except one, for the whole sample and within each sub-sample. P-values are extremely low for all valuation errors, except for the t-test regarding the signed prediction error for the P/E. Thus for the RIVM and AEGM, which have mean and median valuation errors significantly different from zero, it is determined that the valuation models are both inaccurate and biased. As for the P/E model, H0 is not rejected at a 5% significance level, or even at a 20% significance level. Therefore we can only presume that this model is unbiased.

As a preliminary analysis of the performance of valuation models across industries, it is noted that the sample that has the lowest absolute and signed

[12] A significance level of 5% and consequently confidence level of 95% will be used from here on forth.

error for the P/E model is the OHTC and for the RIVM and AEMG are the LCH. These results are based on a median comparison. Similarly, the sample with the highest absolute and signed error for the P/E, RIVM, and AEGM is the IITC, corroborating our initial hypothesis:

Hypothesis 1: Accounting based valuation models have lower accuracy and greater bias when valuing Internet companies in comparison to firms in other industries.

Table 4- Test on Accuracy and Bias of Valuation Models

	Pooled Sample	N	Mean	P-Value	Median	P-Value
P/E Multiple	Absolute Error	5543	0,3371	0,000	0,2193	0,0000
	Signed prediction errors	5543	0,0000	1,000	-0,0622	0,0000
RIVM	Absolute Error	5543	0,5505	0,000	0,4854	0,0000
	Signed prediction errors	5543	-0,2639	0,000	-0,4380	0,0000
AEGM	Absolute Error	5543	0,5643	0,000	0,4834	0,0000
	Signed prediction errors	5543	-0,3705	0,000	-0,4617	0,0000

	Sub-Sample A- Internet and IT Services	N	Mean	P-Value	Median	P-Value
P/E Multiple	Absolute Error	1059	0,4636	0,0000	0,2919	0,0000
	Signed Error	1059	-0,0162	0,7168	-0,1560	0,0000
RIVM	Absolute Error	1059	0,6392	0,0000	0,5742	0,0000
	Signed Error	1059	-0,4621	0,0000	-0,5598	0,0000
AEGM	Absolute Error	1059	0,6716	0,0000	0,5832	0,0000
	Signed Error	1059	-0,4687	0,0000	-0,5736	0,0000

	Sub Sample B- Other High Tech Companies	N	Mean	P-Value	Median	P-Value
P/E Multiple	Absolute Error	1234	0,2742	0,0000	0,1822	0,0000
	Signed Error	1234	0,0102	0,4833	-0,0314	0,0023
RIVM	Absolute Error	1234	0,5391	0,0000	0,4863	0,0000
	Signed Error	1234	-0,3746	0,0000	-0,4795	0,0000
AEGM	Absolute Error	1234	0,5925	0,0000	0,5022	0,0000
	Signed Error	1234	-0,4078	0,0000	-0,4956	0,0000

	Sub Sample C- Low Tech Companies	N	Mean	P-Value	Median	P-Value
P/E Multiple	Absolute Error	1529	0,3204	0,0000	0,2427	0,0000
	Signed Error	1529	-0,0006	0,9685	-0,0307	0,0013
RIVM	Absolute Error	1529	0,5128	0,0000	0,4819	0,0000
	Signed Error	1529	-0,3177	0,0000	-0,4404	0,0000
AEGM	Absolute Error	1529	0,5606	0,0000	0,5137	0,0000

		N	Mean	P-Value	Median	P-Value
	Signed Error	1529	-0,4301	0,0000	-0,4942	0,0000

Sub Sample D- Other industries		N	Mean	P-Value	Median	P-Value
P/E Multiple	Absolute Error	1721	0,3194	0,0000	0,1925	0,0000
	Signed Error	1721	0,0032	0,8959	-0,0572	0,0000
RIVM	Absolute Error	1721	0,5377	0,0000	0,4210	0,0000
	Signed Error	1721	-0,0148	0,0076	-0,2087	0,0000
AEGM	Absolute Error	1721	0,4813	0,0000	0,3795	0,0000
	Signed Error	1721	-0,0148	0,0000	-0,3170	0,0000

3.4.2 Cross-Sample Analysis

While in the intra-sample analysis, the objective was to uncover if there are differences between the models in each subsample, the focus of this analysis is on whether these models perform the same way across all the sub-samples.

Table 5 displays the results of a one-way ANOVA test, used to compare the mean valuation errors across industries. The Hypothesis tested is defined as:

2-tail T-test
Ho: Mean Valuation Error Industry i = Mean Valuation Error Industry j
H1: Mean Valuation Error Industry i ≠Mean Valuation Error Industry j

The ANOVA test is robust therefore can be used for the samples created which have different standard deviations and do not follow the normal distribution. Given that sample sizes are similar, the results should be valid.

Thus, given the low p-value for all models, H0 is rejected. In other words, the models are proven to have different mean errors and accordingly are assumed to produce different estimates for various industries. This test confirms the hypothesis defined previously:

Hypothesis 4: Models performance varies across industries.

Table 5- ANOVA analysis for cross-sample mean comparison

	Absolute Errors		Signed Errors	
	F-statistic	P-value	F-statistic	P-value
P/E	10,1500	0,0000	0,1600	0,0000
RIVM	2,0300	0,1077	27,9500	0,0000
AEGM	3,9800	0,0076	7,5000	0,0001

3.4.3 Differences in Valuation Errors across Valuation Models

This section focuses on the relative performance of the valuation models, to understand if models produce similar valuation error and consequently if not, which model produces the smallest errors, being less inaccurate and more biased.

The analysis is performed on the pooled sample to identify overall performance, and within each subsample, to understand which model could be used in future valuations of certain companies.

Initially, a test is conducted to determine if the mean errors are equal in all models:

2-tail T-test
Mean Valuation Error P/E = Mean Valuation Error RIVM = Mean Valuation Error AEGM
Mean Valuation Error P/E ≠ Mean Valuation Error RIVM ≠ Mean Valuation Error AEGM

Results in Table 6 show that H0 is rejected for absolute errors in all industries. Therefore at least one mean is different from the others. Given these results, the analysis is further improved by testing the models in pairs for both mean and median equality. With this, we can identify models relative performance:

2-tail T-test
Mean Absolute Valuation Error Model x - Mean Valuation Error Model y = 0
Mean Absolute Valuation Error Model x - Mean Valuation Error Model z = 0

Wilcoxon Signed Rank
Median Valuation Error Modelx - Median Valuation Error Modely = 0
Median Valuation Error Modelx - Median Valuation Error Modelz = 0

Table 6- ANOVA Test on Model Performance for all Models

Absolute Errors	Mean P/E	Mean RIVM	Mean AEGM	F-stat
Pooled Sample	0,3371	0,5505	0,5643	0,0000
Sub-Sample A- Internet and IT Services	0,4636	0,6392	0,6716	0,0000
Sub-Sample B- Other High Tech C.	0,2742	0,5391	0,5925	0,0000
Sub-Sample C- Low Tech Companies	0,3204	0,5128	0,5606	0,0000
Sub-Sample D- Other industries	0,3194	0,5377	0,4813	0,0000
Signed Errors	**Mean P/E**	**Mean RIVM**	**Mean AEGM**	**F-stat**
Pooled Sample	7,96E-09	-0,2639	-0,3705	0,0000
Sub Sample A- Internet and IT Services	-0,0162	-0,4621	-0,4687	0,0000
Sub-Sample B- Other High Tech C.	0,0102	-0,3746	-0,4078	0,0000
Sub-Sample C- Low Tech Companies	-0,0006	-0,3177	-0,4301	0,0000
Sub-Sample D- Other industries	0,0032	-0,0148	-0,0148	0,0000

Table 7 shows the results of the paired t-test and Wilcoxon sum rank test for the means and medians respectively. These tests identify if there are any differences between individual models for the whole sample and each sub-sample.

Rejecting the null hypothesis means that there is a difference between the two models indicated. Relative performance is found in the sign of the average and median in the next table. A positive value favours the second model specified, as this value can be interpreted as the mean errors of the first model minus the mean errors of the second model. Negative means and medians in the table signify that the latter model has larger errors.

The null hypothesis is rejected for all combinations of errors, except for the signed error of the RIVM versus the AEGM for LTC. For all other observations, it indicates that valuation models have different mean and median errors, specifying that models perform differently not only across industries but within each industry. As for the exception mentioned, given that the test on accuracy finds that models have different performances, we cannot accept based only on the bias test that these models produce similar results.

Finally, as for the relative performance of the models, it is noted that the P/E outperforms both RIVM and AEGM in all industries, proving to be the most accurate model among those studied. The ranking between the flow-based models is different depending on the industry. For the all but the IITC, the AEGM outperforms the RIVM.

This outcome verifies the validity of the following hypothesis:

Hypothesis 3: *Stock-based models perform better than flow based models.*

Hypothesis 4: *Models performance varies across industries.*

Table 7- Test on Model Performance

Pooled Sample	N	Mean	P-Value	Median	P-Value
Absolute Error P/E-RIVM	5543	-0,2134	0,0000	-0,2338	0,0000
Absolute Error P/E-AEGM	5543	-0,2272	0,0000	-0,2255	0,0000
Absolute Error AEGM-RIVM	5543	0,0138	0,0918	0,0102	0,0000

Sub Sample A- Internet and IT Services	N	Mean	P-Value	Median	P-Value
Absolute Error P/E-RIVM	1059	-0,1756	0,0000	-0,2557	0,0432
Absolute Error P/E-AEGM	1059	-0,2081	0,0000	-0,2448	0,0000
Absolute Error AEGM-RIVM	1059	0,0325	0,0163	-0,0021	0,0000

Sub Sample B- Other High Tech Companies	N	Mean	P-Value	Median	P-Value
Absolute Error P/E-RIVM	1234	-0,2649	0,0000	-0,2796	0,0000
Absolute Error P/E-AEGM	1234	-0,3183	0,0000	-0,3011	0,0000
Absolute Error AEGM-RIVM	1234	0,0534	0,0001	0,0201	0,0000

Sub Sample C- Low Tech Companies	N	Mean	P-Value	Median	P-Value
Absolute Error P/E-RIVM	1529	-0,1924	0,0000	-0,2275	0,0000
Absolute Error P/E-AEGM	1529	-0,2402	0,0000	-0,2437	0,0000
Absolute Error AEGM-RIVM	1529	0,0478	0,0000	0,0222	0,0000

Sub Sample D- Other industries	N	Mean	P-Value	Median	P-Value
Absolute Error P/E-RIVM	1721	-0,2183	0,0000	-0,1859	0,0000
Absolute Error P/E-AEGM	1721	-0,1620	0,0000	-0,1358	0,0000
Absolute Error AEGM-RIVM	1721	-0,0564	0,0077	0,0001	0,0008

Pooled Sample	N	Mean	P-Value	Median	P-Value
Signed Error P/E-RIVM	5543	0,2639	0,0000	0,3326	0,0000
Signed Error P/E-AEGM	5543	0,3705	0,0000	0,3496	0,0000
Signed Error AEGM-RIVM	5543	-0,1066	0,0000	-0,0333	0,0000

Sub Sample A- Internet and IT Services	N	Mean	P-Value	Median	P-Value
Signed Error P/E-RIVM	1059	0,4459	0,0000	0,3844	0,0000
Signed Error P/E-AEGM	1059	0,4525	0,0000	0,3677	0,0000
Signed Error AEGM-RIVM	1059	-0,0066	0,6370	0,0024	0,2516

Sub Sample B- Other High Tech Companies	N	Mean	P-Value	Median	P-Value
Signed Error P/E-RIVM	1234	0,3848	0,0000	0,4278	0,0000
Signed Error P/E-AEGM	1234	0,4180	0,0000	0,4427	0,0000
Signed Error AEGM-RIVM	1234	-0,0332	0,0139	-0,0222	0,0000

Sub Sample C- Low Tech Companies	N	Mean	P-Value	Median	P-Value
Signed Error P/E-RIVM	1529	0,3171	0,0000	0,3452	0,0000
Signed Error P/E-AEGM	1529	0,4296	0,0000	0,3840	0,0000
Signed Error AEGM-RIVM	1529	-0,1124	0,0000	-0,0339	0,0000

Sub Sample D- Other industries	N	Mean	P-Value	Median	P-Value
Signed Error P/E-RIVM	1721	0,0180	0,3551	0,1178	0,0000
Signed Error P/E-AEGM	1721	0,2337	0,0000	0,2113	0,0000
Signed Error AEGM-RIVM	1721	-0,2157	0,0000	-0,0947	0,0000

3.4.4 Explanatory Power of Valuation Models

The objective of this section is to provide some insight on the explanatory power of each model within each sample. To do so, an OLS regression is performed, using the price in April as the dependent variable and the value estimates for each model as the explanatory variable. The value estimate is computed by applying the formulas of the models described in the literature review to the data obtained from Compustat I/B/E/S and CRSP. The three regressions are univariate. Therefore the R^2 represents the explanatory power of each model, with no need to be adjusted.

The regressions were executed using a constant to incorporate other factors that can affect the price.

$$P_i = \propto + \beta\, V_i^{model} + \varepsilon_i \qquad (26)$$

The results presented in Table 8 show the values of the R^2, the coefficients, and p-values of each regression.

For the regression, the following tests are performed:

2-tail T-test
$R^2 = 0$
$R^2 \neq 0$

The p-values of the β analysis are low indicating that the null hypothesis is rejected for all observations except the P/E of the pooled sample, signifying that the explanatory power of the model is significantly different from zero.

The P/E has a higher explanatory power for the whole sample (59,7%), corroborating the results obtained before regarding the model's performance over the RIVM and AEGM.

The P/E also has a higher explanatory power in the IITC industry (74%), which is not a result of a larger sample, given that it is not the biggest sample studied. Nonetheless, the coefficient in this industry is the lowest, meaning that variations in the value estimate impact changes in the price the least.

Explanatory power is highest for the IITC industry across all models, contradicting the hypothesis defined:

Hypothesis 2: *Valuation models have lower explanatory power when valuing Internet companies.*

Table 8- Univariate Regressions

Pooled Sample	Intercept	P-Value	Coefficient	P-Value	R^2
P/E	7,4362	0,3940	0,0102	0,0000	0,5978
RIVM	30,9555	0,0000	0,4955	0,0000	0,1998
AEGM	33,6733	0,0000	0,4660	0,0000	0,1735

Sub Sample A- Internet and IT Services	Intercept	P-Value	Coefficient	P-Value	R^2
P/E	1,1776	0,0000	0,0233	0,0000	0,7470
RIVM	7,0309	0,0000	2,0306	0,0000	0,7134
AEGM	7,6880	0,0000	2,0511	0,0000	0,7009

Sub Sample B- Other High Tech Companies	Intercept	P-Value	Coefficient	P-Value	R^2
P/E	13,4166	0,0000	0,0210	0,0000	0,5222
RIVM	45,5291	0,0000	0,1754	0,0000	0,0692
AEGM	47,4730	0,0000	0,1155	0,0000	0,0409

Sub Sample C- Low Tech Companies	Intercept	P-Value	Coefficient	P-Value	R^2
P/E	17,6579	0,0000	0,0170	0,0000	0,5209
RIVM	32,6760	0,0000	0,5547	0,0000	0,2481
AEGM	34,6219	0,0000	0,5662	0,0000	0,2322

Sub Sample D- Other industries	Intercept	P-Value	Coefficient	P-Value	R^2
P/E	14,0465	0,0000	0,0165	0,0000	0,5188
RIVM	29,3181	0,0000	0,2954	0,0000	0,2244
AEGM	27,7467	0,0000	0,4289	0,0000	0,2413

3.5 Supplementary analysis

To conclude the regression analysis of the large sample of firms, a scenario test is done to assess the research's strength when assumptions used in valuation models such as the growth and market return vary. The AEGM model will be tested for the variations in the explanatory power of stock price when terminal values are included. Table 9 compares scenarios where one or both variables change relative to the original case presented in the first column.

It is noted that the RIVM produces the best estimates, for the whole sample and IITC, when growth rate and market risk are reduced to 0% and 10% respectively. As for the AEGM, higher explanatory power is achieved in the same circumstances as stated for the RIVM for the IITC and in the current scenario for the total sample. The relative ranking is not affected by the changes in the scenario, advocating for the validity of the analysis conducted so far.

Table 9- Scenario Analysis

Pooled Sample

	g=3% and Rm=11,08%			g=0% and Rm=11,08%			g=2% and Rm=11,08%			g=4% and Rm=11,08%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	0,4955	0,1998	0,0000	0,7420	0,2462	0,0000	0,5934	0,2211	0,0000	0,3458	0,1565	0,0000
AEGM	0,4660	0,1735	0,0000	0,1448	0,0736	0,0000	0,1112	0,0613	0,0000	0,0611	0,0411	0,0000
	g=3% and Rm=12%			g=0% and Rm=12%			g=2% and Rm=12%			g=4% and Rm=12%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	0,5630	0,2024	0,0000	0,8048	0,2446	0,0000	0,6578	0,2211	0,0000	0,4287	0,1692	0,0000
AEGM	0,1113	0,0557	0,0000	0,1696	0,0749	0,0000	0,1334	0,0631	0,0000	0,0818	0,0451	0,0000
	g=3% and Rm=10%			g=0% and Rm=10%			g=2% and Rm=10%			g=4% and Rm=10%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	0,4160	0,1956	0,0000	0,6688	0,2483	0,0000	0,5184	0,2211	0,0000	0,2352	0,1297	0,0000
AEGM	0,0687	0,0508	0,0000	0,1181	0,0722	0,0000	0,0877	0,0594	0,0000	0,0381	0,0343	0,0000

Sub-Sample A- Internet and IT Service Companies

	g=3% and Rm=11,08%			g=0% and Rm=11,08%			g=2% and Rm=11,08%			g=4% and Rm=11,08%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	2.030624	0.7134	0,0000	2.472164	0.7213	0,0000	2.191182	0.7175	0,0000	1.854301	0.7070	0,0000
AEGM	1.257768	0.6820	0,0000	1.445597	0.7030	0,0000	1.329493	0.6910	0,0000	1.174029	0.6699	0,0000
	g=3% and Rm=12%			g=0% and Rm=12%			g=2% and Rm=12%			g=4% and Rm=12%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	2.278224	0.7131	0,0000	2.701027	0.7201	0,0000	2.432171	0.7168	0,0000	2.109063	0.7076	0,0000
AEGM	1.499213	0.6819	0,0000	1.678697	0.7005	0,0000	1.56782	0.6898	0,0000	1.419053	0.6715	0,0000
	g=3% and Rm=10%			g=0% and Rm=10%			g=2% and Rm=10%			g=4% and Rm=10%		
	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value	β	R^2	P-Value
RIVM	1.744545	0.7134	0,0000	2.207661	0.7227	0,0090	1.912767	0.7183	0,0000	1.559751	0.7054	0,0000
AEGM	.9954519	0.6813	0,0000	1.189437	0.7059	0,0000	1.069448	0.6920	0,0000	.9090997	0.6667	0,0000

An additional analysis is conducted with the aim of identifying what assumptions for g and Rm would be needed such that the RIVM and AEGM produce unbiased price estimates for IITC. A series of simulations were performed, until a combination of growth rate and market premium produced a price estimates with signed prediction errors with a p-value lower than 0,01. Results show that with a growth rate of 20% and Rm set to 8%, signed prediction errors are non significant both for the RIVM as well as the AEGM. These results are not surprising, as it has been identified that RIVM and AEGM tend to underestimate Internet stocks partially due to the low growth rates used in the estimates.

3.6 Concluding Remarks

Four hypotheses were tested in this section, based on a large sample of U.S. publicly traded firms. The first, theorized that traditional valuation models were less accurate and more biased when valuing Internet stocks. This hypothesis was validated by comparing the absolute and signed valuation errors for each sample, resulting in higher values of these errors for the specified sample.The second hypothesis was related to the explanatory power of models for Internet stocks. A regression analysis proved that models explain a smaller amount of share prices in this sample, in comparison to other industries.

The third hypothesis speculated that stock-based models performed better than flow-based models, and was validated for all samples using t-tests and Wilcoxon signed-rank tests to compare mean and median valuation errors.

Also a regression analysis helped prove that stock-based valuation models provide estimates with higher accuracy and explanatory power and lower bias.

Finally, throughout the analysis, tests for different industries provided distinct results, attesting that model performance varies across industries.

In conclusion, it is possible to assume that Internet companies are not easy to value, and that models have different performances depending on the industry and type of firm being valued. Traditional valuation methods do in fact perform worse when it comes to valuing Internet stocks

A possibility when valuing these businesses could be to use a mixture of stock-based models and other models that incorporate non-financial information in an attempt to produce better estimates.

The next chapter will take a closer look at individual companies and investigate how analysts value Internet stocks in comparison to stocks from other industries. The remainder of this paper will try to identify if analysts follow what was discussed here, and prefer stock-based models over flow-based models to value IITCs.

4 Small Sample Analysis

4.1 Introduction

The preceding chapter explores the relative performance of theoretical models, identifying that, for most cases studied, the forward P/E model provides better estimates in comparison to the RIVM and AEGM. This chapter will build upon the analysis performed and attempt to identify if in practice analysts prefer the specified model to value Internet stocks as well as stocks from other industries.

The analysis conducted in this section provides a link between the theoretical models studied and what is used in the real world to evaluate stocks. By looking closely at individual analyst reports, this paper will attempt to answer a number of questions related to what methods are used in practice and whether or not those methods are different depending on the industry and type of company being valued.

4.1.1 Research Question and Hypothesis Development

The research question that will guide this section is described below:

How do analysts value Internet and IT service companies?

To answer this question, the following hypothesis was developed, so that after careful exploration, the conclusions reached can provide some insight on how analysts value IITC.

Hypothesis 1*: Multiples-based valuation is the most used by analysts.*

The choice of valuation model for IITC, is theorized in hypothesis 1 to follow the findings of Asquith et al. (2005), who expose that 99.1% of analysts mention the use of earnings multiples, while only 12.8% use a flow-based model (see also Demirakos et al., 2004)

4.2 Research Design

4.2.1 Data and Sample Selection

The sample selection process for this analysis is based on the samples created in the previous section, with the exception of the IITC sample. OICs were omitted from this analysis given the industry's broad range of firms. Also, the IITC industry was restricted in this analysis to only 737 SIC code companies, to retrieve a sample of only pure Internet companies. In each industry defined in Section 3, ten randomly picked firms were selected. Hence a total of 30 analyst reports were taken from the Thomson Reuters database (See table 10 for a detailed list of the companies studied).

In an attempt to achieve consistency across samples, the same ten broker houses were used for all three samples (Table 11). Reports consisting of less than seven pages were rejected to obtain in-depth considerations of the companies, as well as reports covering more than one firm. Additionally, a requirement of each report was the clear statement of an investment recommendation, target price, and valuation model.

The final sample is consisted of 30 analyst reports, of distinct U.S. publicly traded companies, from 10 brokers, with an average of 14 pages each.

Table 10- Sample Separation across Industries

	SIC Code	Company	Ticker
IITC	737	Alphabet Inc.	GOOGL
	737	Amazon Com Inc.	AMZN
	737	Citrix Systems Inc.	CTXS
	737	Ebay Inc.	EBAY
	737	Facebook Inc.	FB
	737	Groupon Inc.	GRPN
	737	Netflix Inc.	NFLX
	737	Priceline Group Inc.	PCLN
	737	Trip Advisor Inc.	TRIP
	737	Yahoo Inc.	YHOO
	SIC Code	**Company**	**Ticker**
OTHC	481	Atlantic Tele Network Inc.	ATNI
	301	Cooper Tire & Rubber Co.	CTB
	349	Crane Co.	CR
	371	Dana Holding Corp.	DAN
	353	Joy Global Inc.	JOY
	349	Parker Hannifin Corp.	PH
	362	Rockwell Automation Inc.	ROK
	342	Snap On Inc.	SNA
	349	Watts Water Technologies Inc.	WTS
	384	Zimmer Holdings Inc.	ZH
	SIC Code	**Company**	**Ticker**
LTC	131	Enterprise Products Partners LP.	EPD
	271	Gannett Inc.	GCI
	286	International Flavors & Frag Inc.	IFF
	262	Kimberly Clark Corp.	KMB
	131	Kroger Company.	KR
	211	Loews Corp.	L
	131	Pioneer Natural Resources Co.	PXD
	488	Schulman A Inc.	SHLM
	201	Tyson Foods Inc.	TSN
	421	United Parcel Service Inc.	UPS

Table 11- Brokers Included in Sample

Brokers	IITC	OHTC	LTH
Ascendian	1	1	1
Cowen and Company	1	1	1
Evercore ISI	1	1	1
Guggenheim	1	1	1
JP Morgan	1	1	1
Macquarie Research	1	1	1
Morgan Stanley	1	1	1
New Construct	1	1	1
Pipper Jaffray	1	1	1
SunTrust Robinson Humphrey	1	1	1

4.3 Descriptive Statistics

Table 12 and 13 show the descriptive statistics for the companies reviewed and report information, respectively. It is noted that the IITC sample has the highest growth rates, which is consistent with what has been said regarding this industry. As for market capitalization, the firms selected for the first sample are extremely larger in comparison to the other samples, which can be a result of errors in sampling or indications or a large industry in the total market.

Table 12- Company Descriptive Statistics

		Market Cap		Beta		ROA		EPS		Growth	
	Reports	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Full Sample	30	62,24	15,90	1,05	1,04	6,85%	6,53%	5,37	2,33	7,24%	6,35%
IITC	10	147,29	39,43	1,01	1,03	7,37%	7,51%	8,99	1,95	12,93%	6,85%
OHTC	10	8,05	3,25	1,18	1,14	7,91%	7,91%	4,28	3,91	2,24%	4,35%
LTC	10	31,37	29,00	0,96	0,86	5,27%	4,84%	2,83	2,22	6,55%	7,15%

Furthermore, the model that best describes the target price in each report is described as the dominant model, and will be assumed to be the choice of valuation model of analysts, although other models are also included in their reports.[13] With this information, it is possible to identify a preference towards the stock-based models, for most industries, validating hypothesis 1.

Table 13- Report Descriptive Statistics

		Recommendations			**Dominant Model**		**Forecast Period**	
	Reports	Sell	Buy	Hold	Flow-Based	Stock-Based	Mean	Median
Full Sample	30	1	18	11	11	19	4,2	3
IITC	10	1	6	3	2	8	3,4	2,5
OHTC	10	0	4	6	5	5	4,1	4
LTC	10	0	8	2	4	6	5,1	5,5

[13] Appendix 4 shows the valuation models used in each report.

4.4 Empirical Results

4.4.1 Dominant Model Analysis

Table 14 specifies the dominant model for each company. Models are grouped into flow or stock based as defined by theory.

Table 14- Valuation Model Selection

	Flow-Based Models				**Stock-Based Models**						
	DCF	RIVM	NAV	Other	P/E	Fwd. P/E	PEG	EV/EBITDA	EV/Sales	Hybrid	Other
IITC	20%	0%	10%	0%	20%	20%	0%	20%	0%	10%	10%
	30%				**70%**						
OHTC	20%	10%	0%	10%	10%	30%	0%	0%	0%	10%	0%
	40%				**60%**						
LTC	40%	0%	0%	0%	10%	20%	10%	10%	0%	0%	10%
	40%				60%						
Total Sample	27%	3%	3%	3%	13%	23%	3%	10%	0%	7%	7%
	37%				**63%**						

To identify if the choice of model is different depending on the industry, a set of Chi-Square tests is done, comparing paired industries. This methodology is similar to the one defined by Demirakos et al. (2004). The results of the tests are shown in Table 15, where p-values lower than 0,05 indicate the rejection of the null hypothesis at a 95% confidence interval. The null hypothesis in this test is that there are no differences of models chosen between the two industries defined. Results do not provide evidence to reject the null. Therefore, contrary to predictions, there are no significant differences in model choice across industries.

Given the high percentage of stock-based models used in the whole sample, (63% vs. 37% for flow-based models) we can assume that analysts prefer multiples valuation, accepting hypothesis 1.

Table 15- Chi-Squared Test for Dominant Model

		Dominant Model	
	Reports	**Flow-Based**	**Stock-Based**
Full Sample	30	11	19
IITC (1)	10	2	8
OHTC (2)	10	5	5
LTC (3)	10	4	6
		Pearson's χ^2	**P-Value**
	Chi-Square Test 1-2	0.8333	0.361
	Chi-Square Test 2-3	0.2020	0.653
	Chi-Square Test 1-3	0.2198	0.639

4.5 Concluding remarks

The analysis of the descriptive statistics and the tests performed throughout this section provided information regarding the hypotheses developed and consequently shed some light on the defined research question.

In this section it was found that although there is no different choice of valuation model depending on the industry, multiples-based valuation is the most used by analysts, supporting hypothesis 1 and Asquith et al. (2015).

In conclusion, it is found that analysts use the model designated in Section 3 as the best performing model.

5 Conclusions

The analysis conducted throughout this paper provides information on the relative performance of theoretical valuation models and how these models are used in practice.

The large sample analysis demonstrated that, according to theory, Internet companies are harder to value. Models such at the P/E multiple, the RIVM, and AEGM provide estimates that are less accurate and more bias when valuing these firms in comparison to companies in other industries. These models also have lower explanatory power over Internet stock prices. There is, consequently, need to improve the underlying assumptions of these models or supplement the estimates provided with non-financial information or other non-traditional models.

The assertion of the outperformance of stock-based models over flow-based models in the large sample analysis is complemented in the small sample analysis, where it is shown that analysts also prefer multiples in their valuations.

The small sample analysis verified not only analyst's preferences for multiples models but also inclinations towards positive ratings. Differences for volatility, ROA and forecast horizons among distinct industries were not found.

A variation of this study is recommended, using a more strict definition of the IITC industry. The analysis conducted here included many industries that were not fully Internet related, due to sampling issues, hence a more rigorous definition might provide distinctive results.

A further improvement on this study would be to compare the traditional valuation methods analysed with recent models developed to value Internet stocks in an attempt to verify if these models can be outperformed or even complemented with models that incorporate non-financial information. Another issue to be further looked into is the degree of non-financial information included in analyst reports, to identify the importance that is given to such information as well as its relevance, in specific for Internet companies.

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7 Appendix

7.1 Appendix 1- Dividend Discount Model Variations

$$V_t^{DDM} = \frac{d_{t+1}}{r_e} \quad (26)$$

$$V_t^{DDM} = \frac{d_{t+1}}{r_e - g} \quad (27)$$

7.2 Appendix 2- RIVM: enterprise perspective

Residual income:

$$RI_t^{e+d} = NOPLAT_t - r_{WACC} X NOA_{t-1} \quad (28)$$

Clean surplus relation:

$$NOA_t - NOA_{t-1} = NOPLAT_t - FCF_t \quad (29)$$

enterprise value using RIVM:

$$V_t^{RIVM_F} = NOA_t + \sum_{i=1}^{\infty} \frac{E_t\left[RI_{t+i}^{e+d}\right]}{(1+r_{WACC})^i} \quad (30)$$

7.3 Appendix 3- Sample industries

Denomination	SIC code
Internet and IT Services	**IITS**
Nonstore retailers	596
Insurance agents, brokers, and service	641
Advertising	731
Mailing, reproduction, commercial art and photography, and stenographic services	733
Computer programming, data processing, and other computer related services	737
Miscellaneous business services	738
Engineering, accounting, research, management, and related services	870
Management and public relations services	874
Other High Tech Companies	**OHTC**
Drugs	283
Computer and Office Equipment	357
Electrical Machinery and Equipment, Excluding Computers	360
Electrical Transmissions and Distribution Equipment	361
Electrical Industrial Apparatus	362
Household Appliances	363
Electrical Lighting and Wiring Equipment	364
Household Audio, Video Equipment, Audio Receiving	365
Communication Equipment	366
Electronic Components, Semiconductors	367
Computer Hardware (Including Mini, Micro, Mainframes, Terminals, Discs, Tape...)	368
Telephone Communications	481
Research, Development, Testing Services	873
Plastic, rubber, glass, metal and other manufacturing, machinery and others	300-399
Communications	480-489
Automotive dealers and gasoline service stations	550-559
Automotive repair, services, and parking	750-754
Low Tech Companies	**LTC**

Heavy Construction, Excluding Building	160
Construction-Special Trade	170
Dairy Products	202
Textile Mill Products	220
Lumber and Wood Products, Excluding Furniture	240
Wood Buildings, Mobile Homes	245
Paper and Allied Products	260
Railroads	401
Trucking, Courier Services, Excluding Air	421
Water Transportation	440
Scheduled Air Transportation, Air Courier	451
Grocery Stores	541
Agricultural, farming, forestry, mining, natural resources, construction, food manufacturing, textils and others	100-299

7.4 Appendix 4- Large Sample Analysis Variables

Variable	**Description**
ADIF_AR	APerrorA-APerrorR- Difference between the absolute prediction error of the AEGM and RIVM
ADIF_MA	APerrorM-APerrorA- Difference between the absolute prediction error of the P/E and AEGM
ADIF_MR	APerrorM-APerrorR- Difference between the absolute prediction error of the P/E and RIVM
AEGMVal	Equity estimate for the AEGM model
AEG_1	(EPS_1-epspxAJ)-Ke*(epspxAJ-d0) – Abnormal Earnings for t+1
AEG_2	(EPS_2-EPS_1)-Ke*(EPS_1-d1) – Abnormal Earnings for t+1
ajex	Compustat Adjustment Factor
APerrorA	Absolute Prediction Error for the AEGM Model
APerrorM	Absolute Prediction Error for the RIVM Model
APerrorR	Absolute Prediction Error for the P/E Model

at	Total Assets
beta	Beta
bkvlps	Book Value Per Share
bkvlpsAJ	Adjusted Book Value Per Share
BV_1	Book Value 1-year ahead
ceq	Total Common Equity
comnam	Company Name
csho	Common Shares Outstanding
cshpri	Common Shares used to Calculate EPS
d0	Dividends paid at year 0
d1	Dividends paid at year 1
date	Date
DPS_1	Median Analyst Forecast Dividends Per Share 1 Year Ahead
DPS_2	Median Analyst Forecast Dividends Per Share 2 Years Ahead
dvc	Median Analyst Forecast Dividends Common/Ordinary
EPS_1	Median Analyst Forecast Earnings Per Share 1 Year Ahead
EPS_2	Median Analyst Forecast Earnings Per Share 2 Years Ahead
EPS_g	Median Analyst Forecast Earnings Per Share growth rate
epsprice	EPS_2/prc4
g	Growth rate
gvkey	Standard and Poor's Identifier
industry	Industry identifier (1=IITC, 2=OHTC, 3=LTC, 0=OIC)
Ke	Cost of equity
mkvalt	Market Value- Total- Fiscal

MtB	Market-to-Book Ratio
Multvaluation	Equity estimate for the P/E model
Ncomparables	Number of Comparable Companies
ni	Net Income (loss)
payout	Dividend Payout Ratio (dvc/(0.05*at)
prc4	Stock Price 4 months after fiscal year end
Pmultiple	(sumepsprice *(1/Ncomparables))$^{-1}$
rf	Risk Free Rate
RIVMVal_1	Equity estimate for the RIVM model
RI_1	Residual Income 1 Year Ahead
RI_2	Residual Income 2 Years Ahead
Rm	Market Return
SDIF_AR	SPerrorA-SPerrorR
SDIF_MA	SPerrorM-SPerrorA
SDIF_MR	SPerrorM-SPerrorR
sic	Standard Industry Code
SPerrorA	Signed Prediction Error AEGM Model
SPerrorR	Signed Prediction Error RIVM Model
SPerrorR1	Signed Prediction Error P/E Model
sumepsprice	Sum of Comparables EPS_2/prc4
tic	Ticker Symbol
trdstat	Tradind Status

7.5 Appendix 5- Valuation Models used by analysts

		Flow-Based Models				Stock-Based Models						
	Ticker	DCF	RIVM	NAV	Other	P/E	Forward P/E	PEG	EV/EBITDA	EV/Sales	Hybrid	Other
IITC	GOOGL	1										1
	AMZN					1	1		1			
	CTXS	1				1		1				
	EBAY						1	1	1	1	1	4
	FB	1					1	1				
	GRPN	1							1	1		1
	NFLX	1					1	1	1	1		1
	PCLN					1		1				
	TRIP						1					
	YHOO			1								
	Ticker	DCF	RIVM	NAV	Other	P/E	Forward P/E	PEG	EV/EBITDA	EV/Sales	Hybrid	Other
OTHC	ATNI	1					1			1		1
	CTB				1				1			
	CR						1					1
	DAN					1		1		1		
	JOY	1			1				1	1		
	PH		1				1	1	1			1
	ROK	1					1	1				1
	SNA						1		1	1		1
	WTS	1			1							
	ZH	1									1	
	Ticker	DCF	RIVM	NAV	Other	P/E	Forward P/E	PEG	EV/EBITDA	EV/Sales	Hybrid	Other
LTC	EPD	1										
	GCI					1			1			1
	IFF		1				1	1		1		1
	KMB	1					1	1		1		
	KR							1		1		1
	L	1					1	1	1			
	PXD								1			
	SHLM						1	1	1	1		1
	TSN	1							1			
	UPS	1										