Equity Valuation Using Accounting Numbers

High vs. Low Proportion of Intangibles in Firms

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Dissertation submitted in partial fulfilment of requirements for the degree of International MSc in Management at Católica Lisbon School of Business and Economics and MSc in Finance at Lancaster University Management School, 8th September 2014.

Abstract

The shift to a new economy places on intangible assets an indispensable instrument to preserve the competitive positions of firms and their value creation process. Due to their nature being difficult to define, the wealth created by intangible assets may not be fully captured by the current accounting standards which are based on limited recognition criteria. This paper sheds light on the importance of accounting information for valuation and offers a study of how equity valuation models perform in measuring the value of firms with high and low proportions of intangibles. To this end, a comprehensive review of literature relevant to the matter of equity valuation using accounting numbers is offered followed by the results of the analyses performed to a large and a small samples of US and UK publicly traded firms. It is found that the separation of the samples into firms with high and low proportions of intangibles produces in some cases evident differences whilst in others there are no conclusive disparities. The RIVM is proven to provide superior valuation performance when compared to the P/E multiple and some tendencies in varying approaches to firm valuation by analysts, according to the extent of intangible asset proportion, are observed yet not confirmed.

Key words: *Equity Valuation, Firm Valuation, Valuation Models, Intangible Assets, Intangibles, Residual Income Valuation Model (RIVM), Price to Earnings Multiple, P/E, Valuation Errors, Low Proportion of Intangibles, High Proportion of Intangibles, PINTAN, Usefulness of Accounting Numbers, Usefulness of Accounting Information*

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1. Introduction

1.2 Research Context, Motivation

As we gradually become involved by the mists of a new economical paradigm, one less physical and which substance becomes increasingly hard to comprehend and quantify, the elements of the economy accompanied by the instruments that make it move are becoming more intangible in essence themselves. Industries are becoming increasingly knowledge-based and technology intensive, making growing efforts in research and development on behalf of growing innovation needs. The value added by knowledge and innovation is arguably hard to measure but it does make a difference - it is intangible. Today intangible assets have grown to prominence and have earned the right to the spotlight.

This shift to a new economy places on intangible assets an indispensable instrument to preserve firms' competitive positions and their value creation process.

As defined by the International Accounting Standards (IAS), an asset is a resource that is controlled by a firm as a result of past events from which it expects to benefit economically in the future. The asset category may be differentiated further in line with its tangible or intangible nature as stated by Constantin et al. (1994), be included accordingly in the balance sheet or not, and be created by internal or external sources (Srivastva et al.,1998).

1.2.1 Defining Intangible Assets

Stolowy and Cazan (2001) describe an intangible asset as an identifiable, non-monetary asset, yet lacking physical substance. As suggested by Lev (2004) and Wyatt (2005) patents, trademarks, brands, licenses, technology, employee training, know-how, skilled workforces, customer loyalty, goodwill are all examples of what can be defined as an intangible asset. For their growing importance, intangible assets must be handled and measured appropriately (Vance, 2001) so to avoid creating unbiased and unfair results of firms' performances (Cañibano et al. 1999).

Due to their nature being difficult to define, the wealth created by intangible assets may not be fully captured by the current accounting standards based on limited recognition criteria. On the other hand, this valuation difficulty may also lead to value overstatement

and uncovered investments in the balance sheet. Indeed, financial statements are regarded as unable to fully translate the fair reality of firms' financial positions whilst offering reliable but perhaps not relevant estimations (Cañibano et al., 2000).

1.3 General Framework

This paper encompasses a study of how equity valuation models perform in measuring the value of firms with high and low proportions of intangibles. It is an attempt to assess whether the differences between the two sets of firms significantly impact the performance of valuation techniques. However, the primary intent of the study is not to offer an outlook of the differences between high and low intangible-intensive industries but rather understand performance variations in valuing firms (and valuation procedures) which intangibles account for a high stake of their total assets and firms in which intangibles account for a rather (conversely) small part of total assets. Ultimately, the goal is to understand how valuation techniques perform in valuing firms in which intangibles assets have great or reduced importance.

With resort to an analysis of a large sample it will be possible to identify the idiosyncrasies of each set of firms whilst also being able to understand which valuation technique is the most appropriate in producing higher quality estimates, in other words, that which returns the lowest valuation error. A subsequent small sample analysis will address the varying approaches of analysts to these contra posing sets of firms.

To this end, a comprehensive review of literature relevant to the matter of equity valuation using accounting numbers will be presented in the next section followed by the results of the large sample analysis. The analysis of the small sample will be covered subsequently which will consist in a review of analysts' reports followed by an analysis of different patterns and trends underlying the dichotomy high vs low proportion of intangible such as valuation procedures employed, forecast horizons considered and investment recommendations. In addition, a supplemental analysis of some firm specific features such as return on assets, market size and volatility will also be covered.

Lastly, the major findings and results will be summarised and the study's concluding comments will be laid out as to make way for further research.

2. Literature review

2.2 Introduction and Debate of the Usefulness of Accounting Information

As to introduce the reader to more complex financial concepts and the debate of equity valuation and its accounting-based measuring procedures, this section is aimed at explaining what equity valuation is and the importance of accounting information as well as presenting perspectives on equity valuation and its techniques. The contribution of previous academic research to this paper is immeasurable and thus I will resort to an extensive collection of relevant literature to elucidate the reader.

As defined by Lee (1999), equity valuation is a procedure by which the present value of the stream of expected payoffs to shareholders is forecasted. Equity valuation is, therefore, a task of estimating future cash-flows to shareholders and ultimately pricing a firm's stock as a means to indicate its value. Valuation is instrumental for most levels of business decision.

By 1968, accounting information was still generally considered no to have a substantive meaning thus being seen as of limited use. Accounting practices were bound by how much they were consistent with models of theoretical nature. Ball and Brown (1968) brought change to the accounting practices canons by showing in their work that the studied firms' yearly income numbers contained at least half of all the available yearly information. In 1989, however, Lev remarks that policy oriented research alike was exceptionally scarce up until then.

Notwithstanding, it was only during the 90s that accounting information had been given major study focus for shareholder value estimation purposes (Lee, 1999).

This has rightfully given recognition to accounting information for the essential role it plays in valuing a business and interpreting a firm's financial and operational health. Additionally, it acknowledges its paramount importance to forecasting.

Furthermore, recall Lee (1999) who suggested that accounting information plays a facilitating part in the process of valuation but cannot be used as direct measure for firm value. As mentioned before, he elaborates further by stating that equity valuation is

itself an estimate of the present value of expected payoffs to shareholders. And because estimates are in essence subjective and inexact, valuation models are compared in terms of inaccuracy rather than precision or perfection.

Many equity valuation models share the same explanatory variable – expected earnings. The variable provides a suitable measure of value (Burgstahler and Dichev, 1997). Beaver (1968) has also debated over earnings. His work shows that earnings reports had information that led to change in investors' expectations with regards to future returns.

By now the reader should have realised the usefulness of accounting information for the purpose of valuing a firm. It is fundamental to assessing a firm's present realisation just as to foreseeing its future and enabling comparison of figures through and across time and competitors (Ball and Brown, 1968).

2.2.1 Perspectives of Business Valuation

Valuation methods may be seen from two viewpoints. These are the equity *(1)* and entity (2) perspectives. The equity perspective provides a direct estimation of the value of a firm's equity whilst the latter estimates the value of the firm's assets which, in turn, comprise shareholders' and creditors' claims.

The equity standpoint estimates the present value of the stream of future dividends. In other words there is no value beyond that of the proprietors – the assets of the owners.

Equity = Assets – Liabilities *(1)*

Whereas the equity perspective is preferred by most investors and analysts for delivering a more comparable form of valuation, the entity perspective estimates the present value of the Free Cash Flows since they are included in the payoff to shareholders alongside dividends. Furthermore, as it ignores the sources of capital, it avoids the impact of financing decisions and it is not impacted by accounting differences thus making it a preferable option if the previously mentioned effects occur.

Entity = Assets = Equity Claims + Creditor Claims *(2)*

Under the equity perspective the cost of capital is the cost of equity capital whilst under the entity perspective the cost of capital is represented by the WACC[1].

Regardless of the approach taken, the value estimated by an equity based or entity-based valuation models is, theoretically, the same (Palepu et al, 1999).

It is important to refer that the Financial Accounting Standards Board (2008) is the body responsible for the normalisation of the equations presented.

2.3 Accounting-based valuation models

The accounting-based valuation models differentiate between stock-based and flow-based valuation models. The former will hereon forth be referred to as multiples-based valuation model.

2.3.1 Multiples-based Valuation Models

The stock-based, multiples-based models are arguably of easier understanding (Liu et al., 2002) as a result of their intrinsic straightforwardness and simplicity and are a much appreciated method for equity valuation (Carter and Van Auken, 1990). Contrarily to flow-based models they do not make use of multi-period forecasts of a set of parameters. In fact, multiples-based models rely on information from firms which are considered comparable. To this end, comparable firms must similarly reflect the target firm with regards to future cash-flows and exposure to risk.

Ultimately, resorting to comparable firms and benchmark multiples is an exercise of trust in the market. Indeed, there is a reflection of the market in these multiples so the value us considered relative and intrinsic (Palepu et al., 2000).

Demirakos et al., 2004 have shown in their work that multiples-based techniques are the most common used for valuation purposes. This method can be used to value privately held firms which Alford (1992) proved to be useful to value IPOs. Bhojraj and Lee (2002) have also seen that the multiples-based valuation methods are very suitable for the work of investment bankers and not only useful for IPOs but also for M&A activities such as LBOs, SEOs among others.

[1] Weighted average cost of capital. It is a cost of capital calculation whereby each category of capital is proportionally weighted.

The estimation of a firm's value is generated by multiplying a value driver by a multiple acquired from a ratio or an average of the ratios of comparable firms' stock prices to the value driver (Liu et al., 2002) *(3)*.

$$Value\ of\ Firm\ i = Value\ Driver_i \times Benchmark\ Multiple \qquad (3)$$

Although this method may include an intercept, Liu et al. (2002) suggest that its addition may bring added complexity and resulting improvements in performance can only be significantly noticed in poor-performing multiples. The concluding remark is that the complexities would overdo the benefits of including an intercept.

Selecting a value driver is the first step of the multiples-based valuation. This is based on the premise that the value driver is proportional to value. Whether the valuation is performed in accordance to entity or equity perspective is irrelevant as the method suits any of the perspectives. For instance, one could make use of Net Income as an equity value driver or NOPAT as an entity value driver. The following step is the selection of comparable firms which, as previously mentioned, must be similar to the target firm in terms of future cash-flows and risk profile. Lastly, the benchmark multiple is calculated and subsequently applied with resort to equation (3) in order to finally estimated the firm's value.

2.3.1.1 Selecting the Value Driver

Since value drivers are essential inputs for multiples-based valuations, it is only paramount that these be highly correlated with the firm's value thus translating the firm's performance as closely as possible.

The value of the firm is computed recurring to an equation *(4)* that reflects the product of the value driver, its impact and the benchmark multiple. Several multiples may be used.

$$Value\ of\ Firm\ i = Weight_1 \times VD_{1,i} \times BM_1 + Weight_2 \times VD_{2,i} \times BM_2 \qquad (4)$$

Where *VD* stands for the value driver which in case there are several are assigned $Weights_{1,2}$ and *BM* is the benchmark multiple of each value driver.

Liu et el. (2002) find that earnings estimated perform significantly better than their reported counterparts. Moreover, P/E multiples were shown to be more suitable to

value most firms for its proven superior precision relative to value estimates of cash-flow multiples (Liu et al., 2007). However, as pointed out in their work, earnings can be a target of manipulation and opportunism from management leading to transitory items not related to the firm's inherent features influencing the value estimate rather negatively (Liu et al., 2007).

2.3.1.2 Selecting comparable firms

Comparables are of particular interest as they can be of use in performing fundamental analysis and forecasting sales growth ratios and profit margins (Bhojraj and Lee, 2002).

The choice for a comparable should contemplate variables that explain cross-sectional differences in multiples thus ensuring the similarity between the multiples of the comparables and the multiple of the target firm (Alford, 1992). To this end, one can either fetch an individual comparable firm or, alternatively, make use of a set of comparable firms. Finding one single comparable that is similar to the target firm is easy but its differences will reflect rather greatly, irrespective of how small they are when compared to a multiple resultant of a set of comparables. Conversely, firm-specific differences will be annulled if the benchmark multiple is computed with resort to the set of comparables.

Nevertheless, the conclusion drawn by Liu et al. (2002) was that the performance of multiples-based models was rather inferior when all the firms in the cross-section were selected as comparables.

As Palepu et al. (2002) stated, even when rigorously defined, there are industries that lay down serious barriers to finding appropriate multiples. Differences in strategy, profitability and goals, for example, pose comparability problems (Liu et al., 2002). Alford (1999) has shown that choosing comparable firms from the same industry improved accuracy with the increase in the number of SIC digits.

Despite resulting mostly in appropriate valuations, the selection of comparables based on their industry may lead to failure if the industry is not properly defined (Alford, 1992 and Liu et al., 2002). In effect, future enterprise value-to-sales and price-to-book ratios have been shown to greatly increase efficacy in comparison to industry and size based

criteria (Bhojraj and Lee, 2002), which leaves room to reconsider the fittingness of industry based comparables in generating appropriate multiples.

2.3.1.3 Calculating the Benchmark Multiple

In order to obtain an appropriate benchmark multiple, any of the following estimators can be used:

$$Arithmetic\ Average\ (Mean) = \frac{1}{n}\sum_{j=1}^{n}\frac{P_j}{VD_j} \quad (5)$$

Median = value halfway between observed maximum and minimum (6)

$$Weighted\ Average = \sum_{j=1}^{n}\left(\frac{VD_j}{\sum_{i=1}^{n} VD_i}\right) \times \frac{P_j}{VD_j} = \frac{\sum_{j=1}^{n} P_j}{\sum_{j=1}^{n} VD_j} \quad (7)$$

$$Harmonic\ Mean = \left(\frac{1}{n}\sum_{j=1}^{n}\frac{VD_j}{P_j}\right)^{-1} \quad (8)$$

The Value driver being represented by VD_i and the Price of the j_{th} comparable firm by Pi.

The arithmetic average, or mean, is the most widely adopted method and is frequently employed by analysts (Liu et al., 2002). However, its use often results in overvaluation due to the presence of outliers that significantly distort information thus being rather upward biased. All in all, mean estimators will frequently return larger values than harmonic mean (Baker and Ruback, 1999). In fact, Liu et al. (2002) found that the use of harmonic mean improves the performance of multiples-based valuation due to the reduced influence of small denominators. Consistently, Baker and Ruback (1999) had already shown that the performance of the harmonic mean *(8)* is greater than that of the remaining estimators.

2.3.2 Flow-based Valuation Models

In 2000, Francis et al. verified an equality between the market value of a share and the discounted value of the expected future payoffs derived from the share. This assumption sets the ground for flow-based models.

Despite being hard to obtain identical results in practice because of changing input forecasts, growth rates and/or discount rates, theoretically the returned value should be correspondent (Francis et al., 2000 and Corteau et al. 2006).

The discounted dividend model and the discounted cash flow model, on which I will elaborate next, are the cornerstone for accounting-based valuation as the other methods have been derived from these and adapted to comprise accounting information and thus capture its effects.

2.3.2.1 Discounted Dividend Model (DIV)

The formulation of the discounted dividend model is credited to Williams (1999) and establishes the following equality

$$Equity\ Value_F^{DIV} = \sum_{t=1}^{T} \frac{Expected\ Dividend_t}{(1+r_e)^t} \qquad (9)$$

Where, r_e denotes cost of equity capital, *F* the valuation date and *T* the expected end date of the firm.

In other terms, its premise is that a firm's equity is equal to the sum of the discounted expected dividends due to be received by shareholders over the firm's lifespan. Dividends correspond to the cash flows distributed to the shareholders (Penman, 2007). Therefore, it is the present value of the expected future cash dividends (Ross et al., 2008). The terminal value is equal to the liquidating dividend (Francis et al., 2000).

The DIV is viewed as the easiest model to employ due to forecasting being considered simple and straightforward to perform, if stable dividend policies are assumed (Brealey et al., 2005 and Penman, 2008)

It is important to note though, that depending on certain conditions the aforementioned formula might have to suffer alterations. The formula may be adapted to accommodate, for instance, a setting where a firm pays a constant steady dividend, or alternatively a constant growing dividend, and has no expectation of life termination[2].

[2] See appendices for respective formulae *(10)* and *(11)*

A noticeable opposition to this model can be found in Modigliani and Miller's (1961) work on dividend irrelevance. However, literature has further verified the impact of dividend policy in stock price. (Walter, 1956, Black and Scholes, 1974 and Fisher 1961). As mentioned previously, valuation models stem from DIV and are, indeed, a reference for most of the valuation procedures (Barker, 2001).

2.3.2.2 Discounted Cash-flow Model (DCF)

The discounted cash-flow model involves estimating the cash flows of a firm by discounting them at a rate that carries an identical risk level (Lie and Lie, 2002). The DCF estimator is as follows:

$$Enterprise\ Value_F^{DCF} = \sum_{t=1}^{T} \frac{FCF_t}{(1+r_{WACC})^t} \qquad (12)$$

The FCF (13) is considered to more accurately reflect value added over a short horizon (Francis et al., 2000) and is discounted at the weighted average cost of capital (14).

$$FCF_t = NOPAT + Change\ in\ Net\ Operating\ Assets - Cash\ Investments \qquad (13)$$

$$r_{WACC} = \omega_d \times (1-\tau) \times r_d + \omega_{PS} \times r_{PS} + \omega_e \times r_e \qquad (14)$$

Where τ stands for corporate tax rate, $\omega_{d,PS,e}$ refers to proportion of debt, preferred stock and equity respectively, and $r_{d,PS,e}$ to cost of debt, preferred stock and equity respectively.

2.3.2.3 Residual Income Model (RIVM)

Residual income takes an instrumental part in equity valuation being used as a performance measure (O'Hanlon, 2002). It corresponds to the earnings that are net of capital costs. The model reflects the premium over book value given by the market due to increase or decrease in expected book values (Ohlson, 2005)[3].

From the equity perspective, residual income is calculated as follows:

$$Residual\ Income_t^e = Net\ Income_t - r_e \times BVE_{t-1} \qquad (15.1)$$

Where BE stands for book value of equity.

[3] Also known as Edwards-Bell-Ohlson (EBO) valuation method (Frankel and Lee, 1998)

From the entity perspective, residual income is calculated as follows:

$$Residual\ Income_t^{e+d} = NOPAT_t - r_{WACC} \times NOA_{t-1} \quad (15.2)$$

Where NOA stands for net operating assets.

Furthermore, the RIVM must verify the clean surplus relationship (CSR) which is represented by the equality between the change in shareholders' equity and Net income less net dividends (Lundholm and O'Keefe, 2001).

The formulae below translate that relationship, seen from the equity and entity perspectives, respectively:

$$BVE_t - BVE_{t-1} = Net\ Income_t - Dividend_t \quad (16.1)$$

$$NOA_t - NOA_{t-1} = NOPAT_t - FCF_t \quad (16.2)$$

Nevertheless, despite being in accordance to the balance sheet principles this relationship may not verify as the way GAAP sees earnings is incompatible with clean surplus accounting (Ohlson, 2005). As Ohlson states, dirty surplus items must be assumed to be insignificant (marginally equal or close to zero).

The RIVM estimator is built by adjusting the DIV estimator in order to accommodate a rearranged definition of dividend that will encompass residual income. Residual income will now be embedded in the following new estimators both from the equity perspective (17.1) and entity perspective (17.2):

$$Equity\ Value_t = BVE_t + \sum_{\tau=1}^{\infty} \frac{E_t[Residual\ Income_{t+\tau}^{e}]}{(1+r_e)^{\tau}} \quad (17.1)$$

$$Enterprise\ Value_t = NOA_t + \sum_{\tau=1}^{\infty} \frac{E_t[Residual\ Income_{t+\tau}^{e+d}]}{(1+r_{WACC})^{\tau}} \quad (17.2)$$

As Lee and Swathimanathan (1999) note, the equity perspective *(17.1)* breaks firm value into two components, these being capital invested (BVE) and the present value of the future value create, which is the sum of future residual income.

The RIVM has the advantage of not being affected by dividend or accounting policies. As Francis *et al.* (2000) have seen, dividends have no influence on the value of equity nor accounting policies impact the clean surplus relationship. Additionally, RIVM has been

found to estimate equity value more accurately than DIV or DCF while explaining 71% of changes in prices (Francis *et al.*, 2002). Arguably, distortions in book values have a smaller impact than discount and growth rates estimation errors leading to differences in valuation results between RIVM in relation to DIV and DCF. Francis et al. claim, in addition, that residual income is easier to predict and that might be one of the reasons for RIVM's greater precision.

2.3.2.3.1 Implementation issues

The RIVM may pose some implementation complications though. Cost of equity, earnings forecasts, forecast horizons, dividend pay-out ratios, terminal values are all sources of possible barriers to properly implementing RIVM (Lee and Swaminathan, 1999).

To begin with, cost of equity is calculated according to the CAPM[4] (Lee and Swaminathan, 1999) as follows:

$$r_e = r_f + \beta \times (r_m - r_f) \qquad (18)$$

Then, to forecast earnings one must resort to return on equity (ROE) which can be derived from the CSR[5]. Indeed, I/B/E/S consensus forecasts are highly correlated with current stock prices (Frankel and Lee, 1998). The RIVM proved to be able to explain more than 70% of cross-sectional price variation.

Long-term RI can be estimated in one of two possible ways. These are using analysts' long term growth forecasts (Frankel and Lee, 1998) and assume that ROE fades gradually in time, converging into the industry's average (Lee and Swaminathan, 1999).

The terminal value (TV) provides an estimate of the future RI (18)[6].

$$TV = \sum_{\tau=T+1}^{\infty} \frac{E_t[Residual\ Income^e_{t+\tau}]}{(1+r_e)^{\tau}} = \frac{E_t[Residual\ Income^e_{t+T}]\times(1+g_r)}{(1+r_e)^{T}\times(r_e-g_r)} \qquad (19)$$

[4] R_f stands for the risk free rate, β denotes the firm's beta and r_m is the market return. The risk free rate can be based on a short-term treasury bill or a long-term treasury bond (Lee and Swaminathan, 1999). Whereas, the market premium can be determined by (r_m-r_f), the market return can be indirectly determined by randomly estimating market premium, historically around 5% (Lee and Swaminathan, 1999).

[5] Note that book values can be obtain from the clean surplus relationship

[6] g_r stands for the growth rate

Seen from the equity perspective, RIVM suffers some adaptations in relation to previously presented equations.

$$Equity\ Value_t = BVE_t + \sum_{\tau=1}^{T} \frac{E_t[Residual\ Income^e_{t+\tau}]}{(1+r_e)^\tau} + TV \qquad (20)$$

It is important to recall that in presence of the clean surplus relationship, RIVM, DIV and DCF must, theoretically, provide an absolute match in terms of value.

2.3.2.4 Abnormal Earnings Growth Model (AEGM)

The abnormal earnings growth model (AEGM) was designed by Ohlson and Juettner-Nauroth and is an expanded version of the RIVM that embeds forthcoming-period expected EPS and prospective growth in earnings. Ohlson claims that AEGM model's estimator *(21)* include concepts which are more familiar to analysts.

$$Equity\ Value_t = \frac{E_t[NI_{t+1}]}{r_e} + \sum_{\tau=1}^{T} \frac{E_t[z_{t+\tau}]}{(1+r_e)^\tau} + \sum_{\tau=T+1}^{\infty} \frac{E_t[z_{t+\tau}]}{(1+r_e)^\tau}, \text{ and} \qquad (21)$$

$$z_t = \frac{1}{r_e} \times \left(\Delta NI_{t+1} - r_e \times (NI_t - DIV_t)\right) \qquad (22)$$

Where NI represents net income (earnings) and ΔNI_{t+1} its variation.

Notice that the comparable RIVM estimator *(23)* is remarkably analogous to the AEGM *(21)* as both rely on a certain forecast horizon and a terminal value.

$$Equity\ Value_t = BVE_t + \sum_{\tau=1}^{T} \frac{E_t[RI^e_{t+\tau}]}{(1+r_e)^\tau} + \sum_{\tau=T+1}^{\infty} \frac{E_t[RI^e_{t+\tau}]}{(1+r_e)^\tau} \qquad (23)$$

The differences fall into the AEGM being based on realised next-period earnings which account for a very significant part of the resulting valuation and the RIVM being based on current book value. The terminal value impacts AEGM to a lesser extent as in implication of the next period earnings comprising a rather significant part of the resulting valuation. Ohlson and Juettner-Nauroth, 2005 add that since the AEGM is not impacted by dividend policy it relies less on the CSR and more on earnings. Most importantly, the authors emphasize that next period realised earnings are a closer proxy to market value than book value.

2.3.3 Final Considerations on the Accounting-based Valuation Models

There are some important considerations to highlight. Firstly, recall Amir and Lev (1996) who importantly pointed out that information of non-financial nature can be an important value driver. In addition, consider that the extent of information available influences the performance of the valuations methods. This means that, in general, the application of these techniques works better in more matured firms within rather conventional industries of which more information is known. Amir and Lev (1996) rightly outlined that some industries imply different accounting treatments and this means there are several valuation models of less conventional nature which may be able to perform more price estimates.

Particularly, information deficit has interesting implications in bankruptcy situations and IPOs. Gilson et al. (2000) had seen that in situations of bankruptcy, because information was missing, both multiples-based and cash-flow based techniques delivered poor valuation performances despite being, in fact, unbiased. Similarly, Kim and Ritter (1999), and Gilson et al. (2000) had also seen that DCF also fails to accurately valuate firms due to difficulties in estimating cash-flows.

As mentioned before, other procedures can be employed to estimate value in case of industries and firms with peculiar features. For instance, R&D spending was proven to be an appropriate value driver for Biotech IPOs (Guo et al., 2005).

2.4 Conclusion on the Literature Review

The purpose of this review of relevant literature was to introduce the concepts of intangible assets and highlight the importance of accounting information in firm valuation (Ball and Brown, 1968). Moreover, it presented the most prominent flow-based and multiples-based valuation models, while explaining that although these models should, in theory, provide identical results, they deliver varying performances (Francis et al., 2000 and Courteau et al., 2006). Ultimately we have seen that, even though the RIVM has been shown to be more precise (Francis et al., 2000), multiples-based methods are the most widely employed (Demirakos et al., 2004). Nevertheless, valuation techniques depend on the nature and availability of the information, returning different results according to industries and firm specificities.

3. Large sample analysis

3.2 Introduction

3.2.1 Contextualising the Large Sample Analysis and Developing of Hypotheses

As seen previously in this paper, accounting information does not reflect entirely the true value of a firm. Firms that are R&D intensive, that engage in strong advertising or with high level of investments fail to see these efforts reflect in their balance sheets thus not portraying a fair reality of their final position. Notwithstanding, it has been seen that the valuation effect of intangible assets in the market value of firms is more important than that of the tangible assets (Hall, 2001). It is from this premise that it becomes interesting to understand how different proportions of intangibles behave depending on the valuation methods.

Valuation techniques should, in theory, provide identical results. However, it is because some models can, in fact, deliver a superior performance due to differing assumptions and input variables that it is relevant to ask the following question:

***Research question**: Do P/E multiple and RIVM perform worse in valuing firms with a high ratio of Intangible Assets to Total Assets (PINTAN)?*

This chapter intends to provide a comprehensive insight on the differences in valuations delivered by different valuation methods. The goal is to understand whether firms that present higher proportions of intangible assets relatively to the totality of their assets are significantly more difficult to valuate. Whereas the proportion of intangibles better reflects the reality of the firm as it is a relative measure, studying intangibles in absolute would not allow for an appropriate sample selection and thus drawing proper conclusions from a representative sample. To this end, proportion of intangibles (PINTAN) has been used. Furthermore, the hypothesis of one valuation method providing a superior, more precise valuation than other is also considered and analysis is conducted for this purpose. Finally, the paper will also evaluate if performance is different across years, for which it is believed changes in economic conjuncture are a cause, and across industries due to industry-specific features.

As a result of the scope of the large sample and, in great part, of the scope of this paper, the hypotheses developed follow below:

Hypothesis 1*: High proportion of intangibles implies inferior performance of valuation models than low PINTAN.*

Hypothesis 2*: RIVM performs better than P/E.*

Hypothesis 3*: Performance is unequal across years.*

Hypothesis 4*: Performance is unequal across industries.*

3.3 Research design

3.3.1 Data and Sample Selection

The raw dataset was retrieved from Compustat, I/B/E/S[7] and CRSP[8]. Note that Compustat data was adjusted to be consistent to I/B/E/S already adjusted stock split/dividend[9].

The sample comprised an initial number of 10432 observations of publicly traded US firms which stocks have been traded from December 2007 to December 2012[10]. However, as to construct an appropriate dataset for analysis, some exclusion criteria have been put in practice. Observations lacking fundamental information that is required for later calculations as, for instance, in valuation models or other supporting computations must be disregarded in order to enable an analysis that is representative and with significance. Hence, to begin with, observations with non-available information regarding the median of 1 and/or 2 year ahead earnings per share (EPS) forecasts were eliminated. Subsequently, observations with non-available and/or non-positive beta were deleted for further cost of capital calculation purposes. Also, to comply with the requisites of the valuation models employed, further deletion of observations with non-

[7] I/B/E/S provides analysts forecasts and market prices.
[8] CRSP provides betas.
[9] A full list of variables (Table 2) and the adjustment procedures (24) (25) are included in appendix.
[10] Refer to Fiscal Years 2006-2011.

positive EPS, BPS and/or mdfy1 and/or mdfy2 was conducted followed by the final elimination of those which revealed non-positive P/E ratios.

The resulting dataset was then trimmed in 2% - in both sides – to account for the distorting effect of extreme observations (outliers) thus ensuring greater statistical representativeness of the sample. The choice of trimming the sample in 2% falls into the fact that a first 1% cut-off attempt did not effectively eliminate all the extreme observations.

Consistent with the dichotomy underlying this paper, the resulting sample has ultimately been divided into High Proportion of Intangibles (I_H) and Low Proportion of Intangibles (I_L)[11]. The median of the proportion of intangibles (PINTAN) was set as the reference and threshold for high and low meaning that a high proportion of tangibles is above that median and low below the median.

Finally, the ultimate samples were replicated and altered twice. First, high and low are determined relatively to the respective year's median[12] PINTAN (in contrast to the whole sample's median) and second, high and low are determined relatively to each SIC3 group PINTAN median[13]. This has been done so that it can be confirmed whether the classification given for high and low PINTAN is impacting the analysis.

[11] Quartile division was initially considered but later abandoned. Division in half allowed for a larger number of observations and thus greater statistical power.
[12] Refer to Sample II_H and II_L in appendix – Table A
[13] Refer to Sample III_H and III_L in appendix – Table B

Below is a breakdown of the stages for selecting the final sample.

Table 1 – Sample Selection Process		Number of Observations
Observations of U.S. public firms between 2007 and 2012		10432
Observations with missing median of 1 (mdfy1) or 2-year (mdfy2) ahead EPS forecasts		(304)
Observations with less than 3 mdfy2 forecasts for its year and SIC3 code group		(714)
Observations with missing or non-positive beta		(85)
Observations with non-positive book value of equity per share		(407)
Observations with non-positive earnings per share		(2692)
Observations with non-positive mdfy1 or mdfy2		(172)
Observations with non-positive VAL_{RIM} and P/E valuations		(486)
Observations trimmed with cut-off set at 2%		(1235)
Final sample of U.S. public firms between 2007 and 2012		**5263**
I	Sub-sample I_H: high PINTAN firms	2631
	Sub-sample I_L: low PINTAN firms	2632
II	Sub-sample II_H: high PINTAN firms	2630
	Sub-sample II_L: low PINTAN firms	2633
Observations eliminated due to less than 6 firms present in SIC3 group		(118)
Final sample of U.S. public firms between 2007 and 2012		4347
III	Sub-sample III_H: high PINTAN firms	2164
	Sub-sample III_L: low PINTAN firms	2163

3.3.2 Research Methods

3.3.2.1 Residual Income Valuation Model (RIVM)

Due to its demonstrated better performance in comparison to DIV (Francis et al., 2000), the RIVM[14] was the selected flow-based valuation model.

$$VAL_{RIVM} = BPS + \frac{RI1}{1+KE} + \frac{RI2/(KE-G)}{1+KE} \quad (26)$$

RI1 *(34)* and RI2 *(35)* were calculated using median forecasts retrieved from I/B/E/S to ensure that extreme values do not exert unwanted influence. Note that Frankel and Lee (1998) had seen in their work that residual income is highly correlated with stock prices.

KE, in turn, stands for the cost of capital. This is calculated recurring to equation 20 covered in the previous chapter, assuming a risk free rate based on a 90-day annualised T-Bills yearly average and a 5% market premium (Lee and Swaminathan, 1999). The CRSP is the source of the beta.

The dividend pay-out ratio is calculated as follows:

$$DPAYOUT = \frac{DVC}{0.05 \times AT} \quad (27)$$

In accordance with the work of Lee and Swaminathan (1999), dividend pay-out ratio *(27)* equals one if the last reported ratio is higher than one whilst it is set to equal the firm's average return of assets if EPS are below zero.

3.3.2.2 Price to Earning (P/E) Multiple

The multiples-based valuation model employed is based on the price to earnings ratio.

As a value driver, the 2 year ahead forecasted median was selected as it is able to mitigate the impact of extreme observations. In addition, it is considered to have greater explanatory power (Liu et al., 2002).

The benchmark multiple was calculated with resort to a harmonic mean (8) which has been shown by Liu et al. (2002) to improve performance.

$$V_{HMEAN_{PE}} = MDFY2 \times HMEAN_{PE} \quad (36)$$

Based on the work of Alford (1992), the comparable firms were firms included in the same SIC3 group code and fiscal year.

[14] Based on equity calculation equations (18) and (19)

3.3.2.3 Errors and Measure of Performance

In order to evaluate performance one must look at the errors in valuation.

The signed error is a measure of bias. As such it measures the propensity for overvaluation, in case of negative signed error, and undervaluation, in case of positive signed error.

$$Signed\ Error = \frac{Price - Value\ Estimate}{Price} \quad (37)$$

In contrast, the absolute error measures inaccuracy and shows how distant the value estimate is comparatively to the market price.

$$Absolute\ Error = \frac{|Price - Value\ Estimate|}{Price} \quad (38)$$

3.4 Descriptive Statistics

3.4.1 General Descriptive Statistics

The table below summarises the number of observations in each division and in each year of the general sample (sample I).

Table 3 – Observations per sub-sample and fiscal Year

High PINTAN	2164
Low PINTAN[17]	2163
2006	892
2007	795
2008	530
2009	661
2010	746
2011	703
Total	4327

It is relevant to recall samples II[15] and III[16] which where use to verify the fitness of the High PINTAN and Low PINTAN definitions. These samples return identical results hence leading to conclusion that the high vs. low classification is, indeed, correct and applicable for firm across both different periods and industries[21]. For this reason, the use of samples II and III will be dismissed from here on.

[15] Sample II, refer to table A for descriptive statistics.
[16] Sample III, refer to table B for descriptive statistics.

Table 4 - Sample I Descriptive Statistics

Panel I: Combined Sample I	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April (P4)	4327	30.3133	19.1342	26.4600	2.8500	16.0000	39.8200	135.1500
Common Equity per Share (BPS)	4327	13.1856	8.9608	11.1124	0.6975	6.4211	17.8813	56.2731
EPS Excl. Extraordinary Items (EPS)	4327	1.7321	1.3817	1.3900	0.0350	0.7300	2.3300	10.3900
PINTAN	4327	0.2011	0.2033	0.1361	0.00	0.0222	0.3325	0.7722
Median 1-Year-Ahead EPS (MDFY1)	4327	1.8720	1.2533	1.5800	0.0200	0.9100	2.5300	6.9100
Median 2-Year-Ahead EPS (MDFY2)	4327	2.1766	1.3745	1.8500	0.2500	1.1300	2.9000	7.4600
Panel II: Sub-Sample I_L	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April (P4)	2164	29.6286	18.5642	25.7200	3.9000	16.2100	38.8900	135.1500
Common Equity per Share (BPS)	2164	13.2969	9.1397	11.0827	0.8362	6.2074	18.6015	56.2731
EPS Excl. Extraordinary Items (EPS)	2164	1.7724	1.4318	1.4200	0.0350	0.7700	2.3675	10.3900
PINTAN	2164	0.0376	0.0404	0.0223	0.00	0.00	0.0678	0.1361
Median 1-Year-Ahead EPS (MDFY1)	2164	1.8211	1.2195	1.5300	0.0300	0.8900	2.5000	6.9100
Median 2-Year-Ahead EPS (MDFY2)	2164	2.1243	1.3269	1.8300	0.2500	1.1100	2.8000	7.4600
Panel III: Sub-Sample I_H	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April (P4)	2163	30.9984	19.6685	27.1500	2.8500	15.7300	40.8900	123.5900
Common Equity per Share (BPS)	2163	13.0741	8.7790	11.1250	0.6975	6.6155	17.1997	55.1717
EPS Excl. Extraordinary Items (EPS)	2163	1.6918	1.3288	1.3600	0.0400	0.7000	2.3200	9.3700
PINTAN	2163	0.3646	0.1659	0.3325	0.1361	0.2242	0.4784	0.7722
Median 1-Year-Ahead EPS (MDFY1)	2163	1.9229	1.2845	1.6200	0.0200	0.9300	2.5900	6.6500
Median 2-Year-Ahead EPS (MDFY2)	2163	2.2289	1.4189	1.8700	0.2700	1.1500	3.0000	7.3100

The fragmentation into sub-samples lets isolate certain specificities associated to the high or low intangible proportion nature of the observations.

From the results provided by the above descriptive statistics, it is worth directing attention to the fact that the mean of stock price is highest for high PINTAN observations. One may consequently infer that investors favour high PINTAN firms, valuing it significantly more. Conversely, the low intangible proportion sub-sample indicates the highest EPS. Since EPS is strongly associated to operating income, it was only to be expected that firms with a lower proportion of intangibles return higher results in this case. However, BPS is meaningfully lower for firms with a high proportion of intangibles despite the higher average market prices. The conclusion is that the market maintains expectations for higher return on equity in firms with a higher proportion of intangibles.

Sample I exhibits a mean that is well above the median mainly due to the fact that while minimum values where limited to values higher than zero for several variables, the maximum values are large enough to end up producing a significant impact in the results[17].

[17] There is skewness to a certain extent.

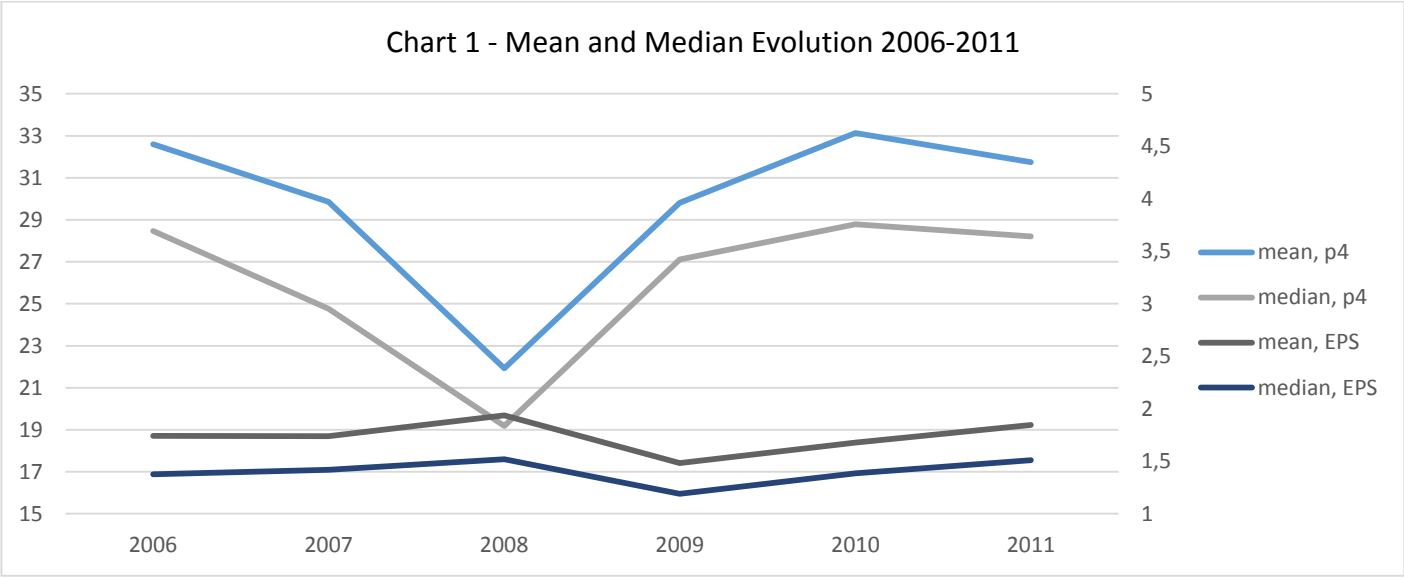
3.4.2 Descriptive Statistics by Fiscal Year

An interesting observation that is worth the exhibition of the table below is that from years 2006 to 2008 there is a visible decline in mean stock price which reflects a negative economic conjuncture followed by a recovery from 2009 until 2011.

Table 5 – Sample I Descriptive Statistics by Fiscal Year.

Combined Sample I		**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Stock Price in April (P4)	Mean	32.6	29.9	21.9	29.8	33.1	31.7
	Median	28.5	24.8	19.2	27.1	28.8	28.2
BPS	Mean	12.0	12.7	13.3	13.3	13.9	14.2
	Median	10.0	10.8	11.3	11.2	11.8	12.0
EPS	Mean	1.7	1.7	1.9	1.5	1.7	1.8
	Median	1.4	1.4	1.5	1.2	1.4	1.5
PINTAN	Mean	0.2	0.2	0.2	0.2	0.2	0.2
	Median	0.1	0.2	0.1	0.1	0.1	0.1
MDFY1	Mean	1.8	1.9	1.6	1.7	2.0	2.1
	Median	1.5	1.6	1.4	1.5	1.7	1.8
MDFY2	Mean	2.1	2.2	1.8	2.1	2.3	2.5
	Median	1.8	1.8	1.6	1.8	2.1	2.1

The abovementioned adverse economic climate can be more easily observed in the time series chart plotted below:



3.5 Data Analysis

3.5.1 Signed and Absolute Errors

3.5.1.1 Descriptive Statistics

3.5.1.1.1 General Descriptive Statistics

Performance is assessed in terms of accuracy and bias with resort to an analysis of the valuation errors. Recall that bias is positive when signed errors are negative and vice versa implying overestimation and underestimation respectively[18].

Valuation errors' descriptive statistics presented in the table below show that RIVM apparently performs better than P/E, having signed and absolute errors closer to zero. Additionally, it is curious to note that P/E is on average overvaluing firms and RIVM undervalues them, although to a lesser absolute degree.

Table 6 - Sample I Descriptive Statistics

Panel I: Combined Sample I	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
P/E Signed Error	4327	- 0.2166	0.4930	- 0.0889	- 2.4951	- 0.4043	0.0989	0.5155
P/E Absolute Error	4327	0.3540	0.4058	0.2174	0.0001	0.0945	0.4308	2.4951
RIVM Signed Error	4327	0.0759	0.3032	0.1225	- 0.9131	- 0.0900	0.2910	0.6276
RIVM Absolute Error	4327	0.2553	0.1802	0.2260	0.0001	0.1099	0.3713	0.9131

Panel II: Sub-Sample I_L	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
P/E Signed Error	2164	- 0.1984	0.4954	- 0.0719	- 2.4881	- 0.3720	0.1114	0.5130
P/E Absolute Error	2164	0.3454	0.4067	0.2093	0.0001	0.0863	0.4192	2.4881
RIVM Signed Error	2164	0.0749	0.3178	0.1318	- 0.9122	- 0.0949	0.2996	0.6276
RIVM Absolute Error	2164	0.2674	0.1873	0.2396	0.0004	0.1165	0.3907	0.9122

Panel III: Sub-Sample I_H	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
P/E Signed Error	2163	- 0.2349	0.4900	- 0.1179	- 2.4951	- 0.4224	0.0909	0.5155
P/E Absolute Error	2163	0.3625	0.4047	0.2263	0.0003	0.1034	0.4501	2.4951
RIVM Signed Error	2163	0.0768	0.2879	0.1125	- 0.9131	- 0.0864	0.2802	0.6212
RIVM Absolute Error	2163	0.2432	0.1720	0.2141	0.0001	0.1040	0.3573	0.9131

[18] Refer to equations 37 and 38 for calculation of errors.

Apart from the RIVM's superior performance regarding average valuation errors, it should be added that it is more reliable as its standard deviation is much lower, consequently leading to a smaller effect of extreme values. This fact is visible by looking at both models' maximum absolute errors. While the RIVM's absolute error does not exceed 100%, the multiple based valuation model has a maximum absolute error of nearly 250%.

Regarding the differences between high and low PINTAN, it is noticeable a slight improvement on average absolute errors in P/E valuation of low PINTAN firms and the opposite change in RIVM absolute errors, which performs better on high PINTAN firms. Although there is no significant variation in RIVM bias, it is noteworthy the increase in positive bias by P/E valuations on high PINTAN.

Finally, it is remarkable that for high PINTAN firms the median performance is nearly equal for both models' absolute errors and that they are contrarily biased but in the same degree. Naturally, the abovementioned skewness of P/E valuation errors shows that there are more extreme values for this model's valuation estimates.

3.5.1.1.2 Descriptive Statistics by Fiscal Year and SIC3

An additional view on the valuation errors is relevant this time to understand how they differ depending on the years and industries and contest the hypotheses set earlier in this paper.

Hypothesis 3*: The level of performance is unequal across years*

Hypothesis 4*: The level of performance is unequal across industries*

In table 7 below, 2008 is the year that shows the most significant inaccuracy results for both models. It is also noticeable a clear improvement in accuracy from 2009 onwards for the P/E multiple-based model although the same is not evident for the RIVM which errors appear to be considerably more volatile. The former may be consequent from the improvement of the economic environment mentioned in previous parts of the paper.

Table 7 - Sample I Descriptive Statistics By Fiscal Year

Combined Sample I		2006	2007	2008	2009	2010	2011
P/E Signed Error	Mean	-0.2411	-0.2102	-0.2515	-0.2413	-0.1908	-0.1708
	Median	-0.1190	-0.0875	-0.1009	-0.1121	-0.0638	-0.0714
PE Absolute Error	Mean	0.3332	0.3487	0.4337	0.3608	0.3463	0.3278
	Median	0.1894	0.2328	0.2761	0.2199	0.2178	0.2099
RIVM Signed Error	Mean	0.2002	0.0551	-0.0685	0.1288	0.0856	-0.0096
	Median	0.2341	0.1003	-0.0450	0.1433	0.1157	0.0303
RIVM Absolute Error	Mean	0.2720	0.2434	0.2879	0.2453	0.2348	0.2543
	Median	0.2581	0.2141	0.2560	0.2203	0.1983	0.2130

The variations across SIC3 groups are clear as industries' behaviour is different in response to the different valuation models[19].

In brief, hypotheses H3 and H4 are then validated.

3.5.1.2 Statistical Tests

3.5.1.2.1 Test on Accuracy and Bias of valuation models

To conclude whether the mean or median of the valuation errors are equal to zero[20] in consistency with the hypotheses established on the right, two tests were conducted. A first T-test of parametric nature is employed on the mean whilst a non-parametric, Wilcoxon test is used to examine the median. As seen in table 8, the null hypotheses (H_0) are both rejected at a 5%[21] significance level. The conclusion, as simple as it was expected is that valuation models are, in essence, inaccurate and biased.

T-Test

$$H_0: Mean\ Valuation\ Error = 0$$

$$H_1: Mean\ Valuation\ Error \neq 0$$

Wilcoxon Signed Rank

$$H_0: Median\ Valuation\ Error = 0$$

$$H_1: Median\ Valuation\ Error \neq 0$$

[19] Refer to table 8 in appendix.

[20] Note that error and models cannot be absolutely biased or accurate.

[21] 5% is the reference significance level from here on forth although other significance levels will be referred later on.

Table 8 – Test on Accuracy and Bias of Valuation Models

Panel I: Combined Sample I	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
P/E Signed Error	4327	- 0.2166	<0.0001	- 0.0889	<0.0001
RIVM Signed Error	4327	0.0759	<0.0001	0.1225	<0.0001
P/E Absolute Error	4327	0.3540	<0.0001	0.2174	<0.0001
RIVM Absolute Error	4327	0.2553	<0.0001	0.2260	<0.0001

Panel II: Sub-Sample I_L	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
P/E Signed Error	2164	- 0.1984	<0.0001	- 0.0719	<0.0001
RIVM Signed Error	2164	0.0749	<0.0001	0.1318	<0.0001
P/E Absolute Error	2164	0.3454	<0.0001	0.2093	<0.0001
RIVM Absolute Error	2164	0.2674	<0.0001	0.2396	<0.0001

Panel III: Sub-Sample I_H	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
P/E Signed Error	2163	- 0.2349	<0.0001	- 0.1179	<0.0001
RIVM Signed Error	2163	0.0768	<0.0001	0.1125	<0.0001
P/E Absolute Error	2163	0.3625	<0.0001	0.2263	<0.0001
RIVM Absolute Error	2163	0.2432	<0.0001	0.2141	<0.0001

3.5.1.2.2 Test on the equality of accuracy and bias across sub-samples

Recall that valuations models have been shown to be inaccurate and biased regardless of the sub-sample. The following tests were performed in order to verify the conclusions drawn before.

T-Test

$$H_0: Mean\ Valuation\ Error\ I_H = Mean\ Valuation\ Error\ I_L$$

$$H_1: Mean\ Valuation\ Error\ I_H \neq Mean\ Valuation\ Error\ I_L$$

Wilcoxon Signed Rank[22]

$$H_0: Median\ Valuation\ Error\ I_H = Median\ Valuation\ Error\ I_L$$

$$H_1: Median\ Valuation\ Error\ I_H \neq Median\ Valuation\ Error\ I_L$$

Table 9 – Test of Equality of Means and Medians[23]

Panel I: Combined Sample I	**Mean Valuation Error**			**Median Valuation Error**		
	I_L	**I_H**	**P-Value**	**I_L**	**I_H**	**P-Value**
P/E Signed Error	- 0.1984	- 0.2349	0.0148	- 0.0719	- 0.1179	0.0008
RIVM Signed Error	0.0749	0.0768	0.8333	0.1318	0.1125	0.2713
P/E Absolute Error	0.3454	0.3625	0.1643	0.2093	0.2263	0.0124
RIVM Absolute Error	0.2674	0.2432	<0.0001	0.2396	0.2141	0.0001

The P/E technique presents, indeed, more biased results in both sub- samples although less bias for I_L than I_H although similarly accurate. The RIVM presents similar bias across samples but equality of means is rejected for accuracy.

[22] Wilcoxon signed ranked is the median p-value.

[23] For RIVM used the Satterwaite method - unequal variances, variance below 5. For P/E used Pooled method for equal variances.

3.5.1.2.3 Test on the equality of accuracy across valuation methods

Subsequently, it is pertinent to understand if the models are equally inaccurate. To this end, the newly generated variable $DIFF_{AE}$ portrays the difference between the absolute errors of the RIVM and P/E.

$$DIFF_{AE} = AE_{VAL_{RIVM}} - ABSERROR_{PE} \quad (38)$$

Based on the following hypothesis tests:

T-Test	Wilcoxon Signed Rank[24]
$H_0: Mean\ DIFF\_AE = 0$	$H_0: Median\ DIFF\_AE = 0$
$H_1: Mean\ DIFF\_AE \neq 0$	$H_1: Median\ DIFF\_AE \neq 0$

Table 10 – Test of Equality of Valuation Models

Panel A: Combined Sample A	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
RIVM AE - P/E AE	4327	- 0.0986	<0.0001	- 0.0019	<0.0001

Panel B: Sub-Sample AL	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
RIVM AE - P/E AE	2164	- 0.0780	<0.0001	0.0188	0.0408

Panel C: Sub-Sample AH	**N**	**Mean**	**P-Value**	**Median**	**P-Value**
RIVM AE - P/E AE	2163	- 0.1193	<0.0001	- 0.0201	<0.0001

From the table above, we conclude that the null hypothesis is rejected for both mean and median at the previously specified 5% significance level. The RIVM appears to be more accurate in general but its performance is particularly outstanding for the high proportion of intangibles sub-sample I_H in comparison to the P/E. In turn, the differences in the medians are evidently less substantial.

It may now be reasonable to argue that the RIVM is more appropriate to valuate firms with a high proportion of intangibles.

[24] Wilcoxon signed ranked is the median p-value.

3.5.1.2.4 Equality of Value Estimates across Fiscal Years and SIC3 Groups

To verify if there is mean equality across fiscal years and industries, an analysis of variance (ANOVA) covering the generic sample and its sub samples was conducted.

Below follow the tests' hypotheses where *m* stands for the valuation models, *j* for the samples, *f* for fiscal year and *s* for the SIC3 groups.

$$H_0: Mean\ Value\ Estimate_{m,j,2006} = \cdots = Mean\ Value\ Estimate_{m,j,f}$$

$$H_1: At\ least\ one\ mean\ value\ estimate\ is\ different$$

$$H_0: Mean\ Value\ Estimate_{m,j,104} = \cdots = Mean\ Value\ Estimate_{m,j,s}$$

$$H_1: At\ least\ one\ mean\ value\ estimate\ is\ different$$

As seen on the panels of Table 11, the null hypothesis could not be rejected only in the case of the P/E signed error across Fiscal Years in Sample I_L (yet at 5%). For all the other cases, at least one mean value estimate is different.

It is then safe to admit that value estimates differ depending on fiscal year and SIC3 group.

Table 11 – Test on the Equality of Means Across Fiscal Years and SIC3 Groups

Panel I: Combined Sample I		**N**	**P-Value**
Across Fiscal Years	P/E Signed Error	4327	0.0113
	P/E Absolute Error	4327	<0.0001
	RIVM Signed Error	4327	<0.0001
	RIVM Absolute Error	4327	<0.0001
Across SIC3 Groups	P/E Signed Error	4327	<0.0001
	P/E Absolute Error	4327	<0.0001
	RIVM Signed Error	4327	<0.0001
	RIVM Absolute Error	4327	<0.0001
Panel II: Sub-Sample I_L		**N**	**P-Value**
Across Fiscal Years	P/E Signed Error	2164	0.0599
	P/E Absolute Error	2164	0.0296
	RIVM Signed Error	2164	<0.0001
	RIVM Absolute Error	2164	0.0032
Across SIC3 Groups	P/E Signed Error	2164	<0.0001
	P/E Absolute Error	2164	<0.0001
	RIVM Signed Error	2164	<0.0001
	RIVM Absolute Error	2164	<0.0001
Panel III: Sub-Sample I_H		**N**	**P-Value**
Across Fiscal Years	P/E Signed Error	2163	0.006
	P/E Absolute Error	2163	0.0002
	RIVM Signed Error	2163	<0.0001
	RIVM Absolute Error	2163	<0.0001
Across SIC3 Groups	P/E Signed Error	2163	<0.0001
	P/E Absolute Error	2163	<0.0001
	RIVM Signed Error	2163	<0.0001
	RIVM Absolute Error	2163	<0.0001

3.5.2 Explanatory Power of Valuation Models

In order to understand the extent to which the models are able to explain market price, an Ordinary Least Squares (OLS) regression will be constructed where the market price (P4) depends on the value estimate of each model[25].

$$P4_{ij} = \alpha + \beta \times Value\ Estimate_{ij} + \varepsilon_{ij}\ ^{26} \quad (39)$$

Table 12 – Regression Results

Panel I: Combined Sample I	**N**	**Slope**	**P-Value**	**R^{2*}**
P/E Multiple (MDFY2)	4327	0.6513	<0.0001	0.6413
Residual Income Model (RIVM)	4327	0.9241	<0.0001	0.7333

Panel II: Sub-Sample I_L	**N**	**Slope**	**P-Value**	**R^{2*}**
P/E Multiple (MDFY2)	2164	0.6453	<0.0001	0.6360
Residual Income Model (RIVM)	2164	0.9103	<0.0001	0.6985

Panel III: Sub-Sample I_H	**N**	**Slope**	**P-Value**	**R^{2*}**
P/E Multiple (MDFY2)	2163	0.6570	<0.0001	0.6452
Residual Income Model (RIVM)	2163	0.9356	<0.0001	0.7638

The adjusted R squared (R^{2*}) which reflects the suitability of the model to explain the market price of the stock is higher for the RIVM than for the P/E. Indeed, RIVM is able to explain more than 75% of the stock's market price of firms with high PINTAN.

Despite both models showing a fair explanatory power, the differences between P/E multiple and RIVM are patent, though less notably for sub-sample I_L.

These results are consistent to what has been seen previously in this paper regarding the superior precision of RIVM in valuing firms with a high proportion of intangibles.

[25] VAL_{RIM} and $VHMEAN_{PE}$

[26] Where *i* represents each observation and *j* sub-samples I, I_L and I_H

3.6 Final Considerations on the Large Sample Analysis

Firstly we learn from the descriptive statistics about the apparent superior general performance of RIVM in comparison to the P/E with errors near to null, lower standard deviation and less bias (though towards undervaluation). In particular, the RIVM is slightly better valuing high PINTAN firms whilst P/E seems relatively more appropriate for valuing low PINTAN firms. Then, the analysis confirms that the level of performance of the methods studied is neither equal across years nor industries and see it admissible to say that value estimates differ depending on fiscal year and SIC3 group.

Further, the OLS regression proved RIVM holds greater explanatory power and is able to explain 75% of changes in stock market price.

It is important to highlight, however, that models are always somewhat biased and inaccurate in essence as the results in the analysis show.

In sum, in response to the research question: *Do P/E multiple and RIVM perform worse in valuing firms with a high ratio of Intangible Assets to Total Assets (PINTAN)?*, a high PINTAN implies a worse performance of the P/E but not the RIVM. The satisfactory fittingness results of the OLS regression seem to be consistently attest that fact.

4. Small Samples Analysis

4.2 Introduction

4.2.1 Contextualising the Small Sample Analysis and Developing Hypotheses

Although it is accepted that investors are already in possession of information of satisfactory relevance, the growing importance of intangibles questions the usefulness of financial statements (Lev and Zarowin, 1999). In his work, Wyatt (2005) underscores the importance of investors accessing to yet further information about a firm's intangibles. This small sample analysis is then motivated by the abovementioned literature but is also a recognition that there is a need to study the valuation effect of intangible assets in firm's market value (Hall, 2001).

Similarly to what was done in the previous section a question is asked so to provide guidance to the research in matter.

Research Question: *Do analysts approach High PINTAN firms differently than Low PINTAN firms?*

The small analysis is aimed at understanding which are the valuations methods most widely employed by analysts. It is known that multiples-based valuation is the most widely used valuation method amongst them (Demirakos et al., 2004). To verify if this is also valid for the small sample *H1* has been developed. Also it looks at whether analysts are biased or not in their investment recommendations (H2), if there are differences in forecast horizons deriving from different PINTAN levels *(H3)*, and complementarily if ROA *(H5)* market size *(H6)*, volatility *(H7)* differ according to the PINTAN of the firm.

The hypothesis by which this analysis is underpinned are as follows:

***Hypothesis 1**: Multiples-based valuation is the most used by analysts.* *(H1)*

***Hypothesis 2**: Analysts more frequently issue positive recommendations for high PINTAN firms.* *(H2)*

***Hypothesis 3**: Analysts use longer forecast horizons for high PINTAN firms.* *(H3)*

***Hypothesis 5**: Higher PINTAN firms are larger in market size.* *(H5)*

***Hypothesis 6**: High PINTAN firms are exposed to higher volatility.* *(H6)*

***Hypothesis 7**: Higher PINTAN corresponds to a higher ROA.* *(H7)*

The abovementioned hypotheses are meant to provide guidance for the analysis and set reference for the tests that will be conducted. However, regardless of whether they are rejected or not, they may help guide the research and indicate some tendencies that otherwise would not be noticed.

4.3 Data and Sample Selection

The process of selecting the sample started by choosing the fifteen firms with the highest PINTAN and the fifteen firms with the lowest PINTAN, making up for a total of 30 publicly traded UK firms. Observations with negative or missing relevant information were disregarded. Subsequently, 30 analyst reports were reviewed in order to obtain relevant information for the analysis[27].

Table 13 - High vs Low PINTAN Sample Breakdown

High PINTAN			Low PINTAN		
ICBSUC	**Name**	**PINTAN**	**ICBSUC**	**Name**	**PINTAN**
5752	WILLIAM HILL PLC	0.7743	533	OPHIR EN	0.0113
9537	SAGE GROUP PLC (THE)	0.7500	1775	ANTOFAGASTA PLC	0.0108
2791	EXPERIAN PLC	0.7324	7577	UNITED UTILITIES PLC	0.0101
2757	MELROSE INDUSTRIES	0.7241	3763	TED BAKER PLC	0.0061
5557	TALKTALK TELECOM	0.7151	1775	KAZAKHMYS PLC	0.0060
9537	MICRO FOCUS INTL	0.7137	8771	HARGREAVES LANSD	0.0043
2713	MEGGITT PLC	0.7009	573	KENTZ CORP	0.0036
5555	MONEYSUPERMARKE	0.6977	3728	REDROW PLC	0.0019
5752	LADBROKES PLC	0.6674	3728	TAYLOR WIMPEY PLC	0.0013
2791	BABCOCK INT'L GROUP	0.6290	5757	MITCHELLS & BUTLERS	0.0011
9578	LAIRD PLC	0.6269	1775	VEDANTA RESOURCES	0.0004
3785	IMPERIAL TOBACCO GRP	0.6150	3728	BELLWAY PLC	0.0000
5553	PERFORM GROUP LTD	0.6140	3728	BOVIS HOMES GROUP	0.0000
5379	HALFORDS GROUP PLC	0.5435	3724	RECKITT BENCKISER	0.0000
5557	DAILY MAIL & GENERAL	0.5434	1777	RANDGOLD RESOURCES	0.0000

[27] See list of analyst reports and brokers in appendix

4.4 Data Analysis

4.4.1 Predominant Models Employed

From the tables below it is evident that multiples-based valuation is the most common for both high and low PINTAN. However, a significant difference regarding the employment of valuation models by analyst is noted between high and low PINTAN. For firms with a high proportion of intangibles 67% of models used are multiples based, whereas for low PINTAN firms this value goes down to 47%.

Table 15 - Models employed by analysts for high PINTAN firms

PINTAN	Firms	Flow-Based Valuation Models			Multiples-Based Valuation Models				Hybrid Model
		DCF	EmV	NAV	P/E	EV/EBIT	EV/EBITDA	Hybrid Multiple	
0.7743	WILLIAM HILL PLC							1	
0.7500	SAGE GROUP PLC (THE)				1				
0.7324	EXPERIAN PLC	1							
0.7241	MELROSE INDUSTRIES							1	
0.7151	TALKTALK TELECOM				1				
0.7137	MICRO FOCUS INTL	1							
0.7009	MEGGITT PLC							1	
0.6977	MONEYSUPERMARKE						1		
0.6674	LADBROKES PLC								1
0.6290	BABCOCK INT'L GROUP				1				
0.6269	LAIRD PLC								1
0.6150	IMPERIAL TOBACCO GRP				1				
0.6140	PERFORM GROUP LTD	1							
0.5435	HALFORDS GROUP PLC						1		
0.5434	DAILY MAIL & GENERAL				1				
	Distribution	20.00%	0.00%	0.00%	33.33%	0.00%	13.33%	20.00%	13.33%

The difference in the distribution of valuation models is, however, not empirically proven as the test failed to reject null hypothesis that analysts use the same models for high and low PINTAN at a 5% significance level with a p-value of 0.46.

Table 14 - Models employed by analysts for low PINTAN firms

PINTAN	Firms	Flow-Based Valuation Models			Multiples-Based Valuation Models				Hybrid Model
		DCF	EmV	NAV	P/E	EV/EBIT	EV/EBITDA	Hybrid Multiple	
0.0113	OPHIR EN			1					
0.0108	ANTOFAGASTA PLC							1	
0.0101	UNITED UTILITIES PLC							1	
0.0061	TED BAKER PLC	1							
0.0060	KAZAKHMYS PLC						1		
0.0043	HARGREAVES LANSD	1							
0.0036	KENTZ CORP				1				
0.0019	REDROW PLC				1				
0.0013	TAYLOR WIMPEY PLC			1					
0.0011	MITCHELLS & BUTLERS	1							
0.0004	VEDANTA RESOURCES							1	
0.0000	RECKITT BENCKISER								1
	RANDGOLD								
0.0000	RESOURCES								1
0.0000	BELLWAY PLC							1	
0.0000	BOVIS HOMES GROUP			1					
	Distribution	20.00%	0.00%	20.00%	13.33%	0.00%	6.67%	26.67%	13.33%

Nevertheless, there is slight tendency in employing multiples more often to value high PINTAN firms that may be exploited in further research. Note that the small amount of observations may impact the statistical significance of the tests and therefore the subsequent conclusions drawn.

Some models presented above were firstly seen now and deserve a few remarks. As described by Carmichael et al. (2007) the net asset value model (NAV) is a technique by which the all assets are adjusted to market value and are deducted the firm's liabilities[28].

[28] It is of particular usefulness in valuing oil and gas firms where it is assumed they will consume all of its reserves until exhaustion point.

Additionally, used by JP Morgan, the embedded value model (EmV) is intended to calculate the value of a firm based on a product and forecasting up to a limited horizon with the possibility of applying terminal values for products with similar longevity *(JP Morgan).*

4.4.2 Investment Recommendations

H_0: $Investment\ Recommendation\ PINTAN_{HIGH} = Investor\ Recommendation\ PINTAN_{LOW}$

H_1: $Investment\ Recommendation\ PINTAN_{HIGH} \neq Investor\ Recommendation\ PINTAN_{LOW}$

The analysts seem to be prone towards overweight investment theses with around 67% buy recommendations for high PINTAN firms and 60% for low PINTAN firms. However, at a 5% significance level the hypothesis of different recommendations being attributed depending on PINTAN level is cannot be accepted.

Table 16 - Investment Recommendations given by analysts in high PINTAN firms

PINTAN	Firms	Investment Recommendation		
		Buy	Hold	Sell
0.7743	WILLIAM HILL PLC			1
0.7500	SAGE GROUP PLC (THE)		1	
0.7324	EXPERIAN PLC	1		
0.7241	MELROSE INDUSTRIES	1		
0.7151	TALKTALK TELECOM	1		
0.7137	MICRO FOCUS INTL		1	
0.7009	MEGGITT PLC		1	
0.6977	MONEYSUPERMARKE	1		
0.6674	LADBROKES PLC	1		
0.6290	BABCOCK INT'L GROUP	1		
0.6269	LAIRD PLC	1		
0.6150	IMPERIAL TOBACCO GRP	1		
0.6140	PERFORM GROUP LTD	1		
0.5435	HALFORDS GROUP PLC		1	
0.5434	DAILY MAIL & GENERAL	1		
	Distribution	66.67%	26.67%	6.67%

Table 17 - Investment Recommendations given by analysts in low PINTAN firms

PINTAN	Firms	Investment Recommendation		
		Buy	Hold	Sell
0.0113	OPHIR EN	1		
0.0108	ANTOFAGASTA PLC			1
0.0101	UNITED UTILITIES PLC		1	
0.0061	TED BAKER PLC	1		
0.0060	KAZAKHMYS PLC			1
0.0043	HARGREAVES LANSD	1		
0.0036	KENTZ CORP		1	
0.0019	REDROW PLC	1		
0.0013	TAYLOR WIMPEY PLC	1		
0.0011	MITCHELLS & BUTLERS		1	
0.0004	VEDANTA RESOURCES	1		
0.0000	RECKITT BENCKISER	1		
0.0000	RANDGOLD RESOURCES		1	
0.0000	BELLWAY PLC	1		
0.0000	BOVIS HOMES GROUP	1		
	Distribution	60.00%	26.67%	13.33%

It is possible to observe a certain bias towards buy recommendations although there is no strong evidence it varies depending on whether the firm has a high or low PINTAN. The separation between high and low PINTAN does not highlight any convincing differences between recommendations.

4.4.3 Forecast Horizons

$$H_0: Forecast\ Horizon\ PINTAN_{HIGH} = Forecast\ Horizon\ PINTAN_{LOW}$$

$$H_1: Forecast\ Horizon\ PINTAN_{HIGH} \neq Forecast\ Horizon\ PINTAN_{LOW}$$

With regards to forecast horizons, the hypothesis of different treatment being given to high and low PINTAN firms is rejected as well at all significance levels. In fact, there is a clear evidence that 3 years is the preferred forecast horizon for both types of firm.

Table 18 - Forecast horizons used in high PINTAN firms

PINTAN	Firms	Forecast Horizon (years ahead)				
		2	3	4	5	>5
0.7743	WILLIAM HILL PLC				1	
0.7500	SAGE GROUP PLC (THE)		1			
0.7324	EXPERIAN PLC		1			
0.7241	MELROSE INDUSTRIES		1			
0.7151	TALKTALK TELECOM		1			
0.7137	MICRO FOCUS INTL					1
0.7009	MEGGITT PLC	1				
0.6977	MONEYSUPERMARKE		1			
0.6674	LADBROKES PLC		1			
0.6290	BABCOCK INT'L GROUP	1				
0.6269	LAIRD PLC		1			
0.6150	IMPERIAL TOBACCO GRP	1				
0.6140	PERFORM GROUP LTD		1			
0.5435	HALFORDS GROUP PLC		1			
0.5434	DAILY MAIL & GENERAL	1				
	Distribution	26.67%	60.00%	0.00%	6.67%	6.67%

Table 19 - Forecast horizons used in low PINTAN firms

PINTAN	Firms	Forecast Horizon (years ahead)				
		2	3	4	5	>5
0.0113	OPHIR EN				1	
0.0108	ANTOFAGASTA PLC				1	
0.0101	UNITED UTILITIES PLC		1			
0.0061	TED BAKER PLC		1			
0.0060	KAZAKHMYS PLC			1		
0.0043	HARGREAVES LANSD		1			
0.0036	KENTZ CORP			1		
0.0019	REDROW PLC		1			
0.0013	TAYLOR WIMPEY PLC		1			
0.0011	MITCHELLS & BUTLERS	1				
0.0004	VEDANTA RESOURCES		1			
0.0000	RECKITT BENCKISER		1			
0.0000	RANDGOLD RESOURCES		1			
0.0000	BELLWAY PLC	1				
0.0000	BOVIS HOMES GROUP		1			
	Distribution	13.33%	60.00%	13.33%	13.33%	0.00%

In sum, no tendencies in discriminating approaches regarding horizons for forecast can be seem in this analysis. The p-value distinctly fails to reject equality of forecast horizons.

4.5 Supplemental Analysis

4.5.1 ROA

$$H_0: ROA\ PINTAN_{HIGH} = ROA\ PINTAN_{LOW}$$

$$H_1: ROA\ PINTAN_{HIGH} \neq ROA\ PINTAN_{LOW}$$

ROA[29] do not take into account intangible assets. It is interesting, though, to understand how firms with different proportions of intangibles position themselves in terms of ROA. Despite being hardly quantifiable, intangible assets make part of the firm as it is, financially and operationally. Hence, even if indirectly, ROA captures value that is fuelled by the intangible assets of a firm and one could argue that it impacts the firm's operational results[30]. An immediate look at the table 20 will highlight the low PINTAN firms have a lower ROA, on average. However, the two-tailed, unequal variance t-test performed rejected the hypothesis of statistically significant differences in ROA with a p-value of 0.36. The results are rather inconclusive and a larger sample would be statistically more significant.

Table 20 – T-test and ROA breakdown by high vs low PINTAN firms

PINTAN	Firms	ROA	PINTAN	Firms	ROA
0.7743	WILLIAM HILL PLC	11.80	0.0113	OPHIR EN	-16.44
0.7500	SAGE GROUP PLC (THE)	2.21	0.0108	ANTOFAGASTA PLC	5.85
0.7324	EXPERIAN PLC	5.63	0.0101	UNITED UTILITIES PLC	5.16
0.7241	MELROSE INDUSTRIES	15.33	0.0061	TED BAKER PLC	15.24
0.7151	TALKTALK TELECOM	11.44	0.0060	KAZAKHMYS PLC	-22.39
0.7137	MICRO FOCUS INTL	24.32	0.0043	HARGREAVES LANSD	37.84
0.7009	MEGGITT PLC	6.63	0.0036	KENTZ CORP	10.27
0.6977	MONEYSUPERMARKE	14.42	0.0019	REDROW PLC	6.11
0.6674	LADBROKES PLC	8.04	0.0013	TAYLOR WIMPEY PLC	8.96
0.6290	BABCOCK INT'L GROUP	6.99	0.0011	MITCHELLS & BUTLERS	5.83
0.6269	LAIRD PLC	4.30	0.0004	VEDANTA RESOURCES	2.82
0.6150	IMPERIAL TOBACCO GRP	4.84	0.0000	RECKITT BENCKISER	6.17
0.6140	PERFORM GROUP LTD	5.54	0.0000	RANDGOLD RESOURCES	7.08
0.5435	HALFORDS GROUP PLC	8.78	0.0000	BELLWAY PLC	9.18
0.5434	DAILY MAIL & GENERAL	12.10	0.0000	BOVIS HOMES GROUP	11.70
	Mean	9.49		Mean	6.23

[29] Return on Assets: ROA=Net Income/Total Assets.
[30] For instance net income, which makes part of ROA.

4.5.2 Volatility

$$H_0: \beta\ PINTAN_{HIGH} = \beta\ PINTAN_{LOW}$$
$$H_1: \beta\ PINTAN_{HIGH} \neq \beta\ PINTAN_{LOW}$$

To realise whether there differences in volatility arising from the high vs low PINTAN dichotomy, an analysis based on the beta[31] of each firm in the sample has been conducted.

Table 21 – Volatility in high PINTAN firms

PINTAN	Firms	βeta	
		<1	>1
0.7743	WILLIAM HILL PLC	1	
0.7500	SAGE GROUP PLC (THE)	1	
0.7324	EXPERIAN PLC	1	
0.7241	MELROSE INDUSTRIES		1
0.7151	TALKTALK TELECOM	1	
0.7137	MICRO FOCUS INTL	1	
0.7009	MEGGITT PLC	1	
0.6977	MONEYSUPERMARKE	1	
0.6674	LADBROKES PLC		1
0.6290	BABCOCK INT'L GROUP	1	
0.6269	LAIRD PLC		1
0.6150	IMPERIAL TOBACCO GRP	1	
0.6140	PERFORM GROUP LTD	1	
0.5435	HALFORDS GROUP PLC	1	
0.5434	DAILY MAIL & GENERAL		1
	Distribution	73.33%	26.67%

Table 22 – Volatility in low PINTAN firms

PINTAN	Firms	βeta	
		<1	>1
0.0113	OPHIR EN	1	
0.0108	ANTOFAGASTA PLC		1
0.0101	UNITED UTILITIES PLC	1	
0.0061	TED BAKER PLC	1	
0.0060	KAZAKHMYS PLC		1
0.0043	HARGREAVES LANSD		1
0.0036	KENTZ CORP	1	
0.0019	REDROW PLC		1
0.0013	TAYLOR WIMPEY PLC		1
0.0011	MITCHELLS & BUTLERS		1
0.0004	VEDANTA RESOURCES		1
0.0000	RECKITT BENCKISER	1	
0.0000	RANDGOLD RESOURCES	1	
0.0000	BELLWAY PLC		1
0.0000	BOVIS HOMES GROUP		1
	Distribution	40.00%	60.00%

The chi squared test conducted could not rejected the null hypothesis that volatilities are equal only at a 5% significance but not at all other significances. Indeed, the differences in distribution are noticeable with 73% of high PINTAN firms having a beta below 1 and 60% of low PINTAN firms having a beta above 1. Despite the low level of significance of such a small sample this sheds light on the differences in volatility deriving from different proportions of intangibles.

[31] Beta retrieved from Datastream

4.5.3 Market Size

$$H_0: Market\ Value\ PINTAN_{HIGH} = Market\ Value\ PINTAN_{LOW}$$
$$H_1: Market\ Value\ PINTAN_{HIGH} \neq Market\ Value\ PINTAN_{LOW}$$

Finally, a test on the market size of the firms rejects the hypothesis that size and proportion of intangibles have any related implication. In fact, the sample shows no differences in tendency of market size[32] between samples.

The firms have been split into 5 categories ranging from $300m to $100Bn.

Table 23 - Market size in high PINTAN firms

PINTAN	Firms	Market Size measured by Market Value				
		>$100 Billion)	>$10 Billion	>$2 Billion	>$300 Million	<$300 Million
0.7743	WILLIAM HILL PLC			1		
0.7500	SAGE GROUP PLC (THE)			1		
0.7324	EXPERIAN PLC		1			
0.7241	MELROSE INDUSTRIES			1		
0.7151	TALKTALK TELECOM			1		
0.7137	MICRO FOCUS INTL				1	
0.7009	MEGGITT PLC			1		
0.6977	MONEYSUPERMARKE				1	
0.6674	LADBROKES PLC				1	
0.6290	BABCOCK INT'L GROUP			1		
0.6269	LAIRD PLC				1	
0.6150	IMPERIAL TOBACCO GRP		1			
0.6140	PERFORM GROUP LTD				1	
0.5435	HALFORDS GROUP PLC				1	
0.5434	DAILY MAIL & GENERAL			1		
	Distribution	0.00%	13.33%	46.67%	40.00%	0.00%

[32] Represented by 31/12/2013 market value.

Table 24 - Market size in low PINTAN firms

PINTAN	Firms	Market Size measured by Market Value				
		>$100 Billion	>$10 Billion	>$2 Billion	>$300 Million	<$300 Million
0.0113	OPHIR EN				1	
0.0108	ANTOFAGASTA PLC			1		
0.0101	UNITED UTILITIES PLC			1		
0.0061	TED BAKER PLC				1	
0.0060	KAZAKHMYS PLC				1	
0.0043	HARGREAVES LANSD			1		
0.0036	KENTZ CORP				1	
0.0019	REDROW PLC				1	
0.0013	TAYLOR WIMPEY PLC			1		
0.0011	MITCHELLS & BUTLERS				1	
0.0004	VEDANTA RESOURCES			1		
0.0000	RECKITT BENCKISER		1			
0.0000	RANDGOLD RESOURCES			1		
0.0000	BELLWAY PLC				1	
0.0000	BOVIS HOMES GROUP				1	
	Distribution	0.00%	6.67%	40.00%	53.33%	0.00%

The p-value of the test rejects the null hypothesis at all significance levels and it becomes clear that a separation by PINTAN nature does not offer any observation worthy of remark.

4.6 Final Considerations on the Small Sample Analysis

The small sample analysis showed no significant differences arising from the sub-sample division into firms with a high and low proportion of intangibles. However, evident differences in volatility were manifested at least at 10% significance.

Indeed, multiples-based valuation were found to be the dominant techniques in accordance to the works of Demirakos et al. (2004). An inclination to use multiples based models in valuing high PINTAN firms could be observed but not statistically confirmed. In turn forecast horizons proved equal for both sub-samples, whilst investment recommendations showed positive bias and market size analysis did not highlight any peculiarities. With regards to the null hypotheses considered earlier in the analysis, none could be reject at a 5% significance, with the exception for volatility having been mentioned already. Therefore, the conclusion is that there is no evidence that analysts convey a different approach to high PINTAN firms in relation to low PINTAN ones.

Nevertheless, there seem to be a few tendencies for differences in some elements resulting from different PINTAN levels and even though the tests performed have, in great extent, not verified dissimilarities, there definitely is room left for further research.

5. Conclusion

The purpose of this paper was to shed light in the matter of intangible assets and what implications they bring to equity valuation. Intangible assets are a crucial instrument to preserving firms' competitive positions and their value creation process in an economy that is becoming itself less tangible. Nevertheless, the current accounting standards which are based on limited recognition criteria fail to capture the entirety of the wealth created by intangible assets.

The literature review highlights the importance of accounting numbers in the process of valuing a firm (Ball and Brown, 1968), reveals that the most accurate valuation model is the RIVM (Francis et al., 2000) despite multiples-based models being more frequently used (Demirakos et al., 2004). Important to retain is that the model in question are, in nature, inaccurate and biased and their performances vary according to firm and industry specificities.

The large sample analysis offered the conclusion that RIVM performed better in general than the P/E multiple and proved to be more appropriate in valuing firm with a high proportion of intangibles than the P/E. The RIVM presented lower errors and was more unbiased. In turn the P/E multiple appeared to perform superiorly in valuing low PINTAN firms. It is revealed that the level of performance of both valuation techniques is neither equal across years nor industries and see it fair to say that value estimates differ depending on fiscal year and SIC3 group.

Finally, in response to the question of whether analysts treated high PINTAN firms differently from low PINTAN firms, the small sample analysis did not provide clearly conclusive results. It revealed that analysts maintain a preference for multiples-based methods although it did not prove differences between its use preferentially for valuing high PINTAN or low PINTAN. Also it did not prove that analysts employ different forecast horizons, nor that they provided different recommendations according to PINTAN level. Equally inconclusive was the complementary analysis of ROA, market size and volatility. The test involving the latter though could only reject β equality at a 5% but not at 10% and 15% significance which is worthy of remark.

In sum, the analysis of the large sample showed some convincing results about RIVM being the most precise in valuing firms with higher proportions of intangibles. On the other hand, one may argue that the small sample analysis proved to have fallen short in conclusiveness due to the statistical limits imposed by such a short number of observations, conversely to the large sample. Nevertheless, it gave some interesting indications that leave room for further research as, for instance, remarkable tendencies in models employed by analysts, volatility differences between the two sets of firms.

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7. Appendices

2.3.2.1 Discounted Dividend Model (DIV)

$$Equity\ Value_t^{DIV} = \frac{Expected\ Dividend_{t+1}}{r_e} \quad (10)$$

$$Equity\ Value_t^{DIV} = \frac{Expected\ Dividend_{t+1}}{r_e - growth\ rate} \quad (11)$$

3.3.1 Data and Sample Selection

$$Adjusted\ Variable\ Per\ Share = \frac{Unadjusted\ Variable\ (Total)}{CSHO \times AJEX} \quad (24)$$

$$Adjusted\ Variable\ Per\ Share = \frac{Unadjusted\ Variable\ (Total)}{CSHPRI \times AJEX} \quad (25)$$

Table 2 – Definition of Variables

Variable	Database	Type	Units	Description
ABSERROR_PE	N/A	Num	% of P4	Absolute Error of P/E Valuation Relative to P4
ACT	Compustat	Num	$ Millions	Total Current Assets
ACTUAL	I/B/E/S	Num	$ Millions	IBES Actual Earnings
AE_VAL_RIVM	N/A	Num	% of P4	Absolute Error of RIM Valuation Relative to P4
AJEX	Compustat	Num	N/A	Adjustment Factor
AM	Compustat	Num	$ Millions	Amortization of Intangibles
AQC	Compustat	Num	$ Millions	Acquisitions
AT	Compustat	Num	$ Millions	Total Assets
BETA	CRSP	Num	N/A	Market Beta Using Daily Returns
BPS	N/A	Num	$	Total Common Equity per Share (Adjusted with AJEX)
BPS1	N/A	Num	$	$BPS + MDFY1 \times (1 - \frac{DVC}{EPS})$
CAPX	Compustat	Num	$ Millions	Capital Expenditures
CEQ	Compustat	Num	$ Millions	Total Common Equity
CHE	Compustat	Num	$ Millions	Cash and Short-Term Investments
CONM	Compustat	Char	N/A	Company Name
CSHO	Compustat	Num	Millions	Common Shares Outstanding

CSHPRI	Compustat	Num	Millions	Common Shares Used to Calculate Earnings Per Share - Basic
CV	N/A	Num	$	$\frac{RI2/(KE-G)}{1+KE}$
DATADATE		Num	N/A	Fiscal Year End Date
DIFF_AE	N/A	Num	%	Difference in Absolute Errors Between the RIM and P/E multiple
DC_RI1	N/A	Num	$	Discounted RI1 at Cost of Equity Capital
DD1	Compustat	Num	$ Millions	Long-Term Debt Due in One Year
DLC	Compustat	Num	$ Millions	Total Debt in Current Liabilities
DLTT	Compustat	Num	$ Millions	Total Long-Term Debt
DP	Compustat	Num	$ Millions	Depreciation and Amortization
DPAYOUT	N/A	Num	$	DVC/EPS
DPC	Compustat	Num	$ Millions	Depreciation and Amortization (Cash Flow)
DVC	Compustat	Num	$ Millions	Dividends Common
DVPA	Compustat	Num	$ Millions	Preferred Dividends in Arrears
EP	N/A	Num	$	$MDFY2/P4$
EPS	N/A	Num	$	EPSPX Adjusted with AJEX
EPSPX	Compustat	Num	$ Millions	Earnings Per Share Excluding Extraordinary Items
FYEAR	Compustat	Num	N/A	Fiscal Year
G	N/A	Num	%	Assumed Growth Rate for RIM
GVKEY	Compustat	Char	N/A	Global Company Key
HIGH	N/A	Num	N/A	Dummy that Equals 1 (0) if Observation is High (Low) P/OI
HMEAN_PE	N/A	Num	$	Harmonic Mean of Yearly, SIC3 Comparables' P/E
IB	Compustat	Num	$ Millions	Income Before Extraordinary Items
INTAN	Compustat	Num	$ Millions	Total Intangible Assets
INVT	Compustat	Num	$ Millions	Total Inventories
IVCH	Compustat	Num	$ Millions	Increase in Investments
KE	N/A	Num	N/A	Cost of Equity Capital (r_e, *20*)

LCT	Compustat	Num	$ Millions	Total Current Liabilities
MDFY1	I/B/E/S	Num	$	Median of 1-Year-Ahead EPS Forecasts
MDFY2	I/B/E/S	Num	$	Median of 2-Year-Ahead EPS Forecasts
MDFY3	I/B/E/S	Num	$	Median of 3-Year-Ahead EPS Forecasts
MDFY4	I/B/E/S	Num	$	Median of 4-Year-Ahead EPS Forecasts
MDFY5	I/B/E/S	Num	$	Median of 5-Year-Ahead EPS Forecasts
MDLTG	I/B/E/S	Num	$	Median of Long-Term Growth Forecasts
MNFY1	I/B/E/S	Num	$	Mean of 1-Year-Ahead EPS Forecasts
MNFY2	I/B/E/S	Num	$	Mean of 2-Year-Ahead EPS Forecasts
MNFY3	I/B/E/S	Num	$	Mean of 3-Year-Ahead EPS Forecasts
MNFY4	I/B/E/S	Num	$	Mean of 4-Year-Ahead EPS Forecasts
MNFY5	I/B/E/S	Num	$	Mean of 5-Year-Ahead EPS Forecasts
MNLTG	I/B/E/S	Num	$	Mean of Long-Term Growth Forecasts
NI	Compustat	Num	$ Millions	Net Income (Loss)
NUFY1	I/B/E/S	Num	N/A	Number of 1-Year-Ahead EPS Forecasts
NUFY2	I/B/E/S	Num	N/A	Number of 2-Year-Ahead EPS Forecasts
NUFY3	I/B/E/S	Num	N/A	Number of 3-Year-Ahead EPS Forecasts
NUFY4	I/B/E/S	Num	N/A	Number of 4-Year-Ahead EPS Forecasts
NUFY5	I/B/E/S	Num	N/A	Number of 5-Year-Ahead EPS Forecasts
NULTG	I/B/E/S	Num	N/A	Number of Long-Term Growth Forecasts
OANCF	Compustat	Num	$ Millions	Net Cash Flow from Operating Activities
OIADP	Compustat	Num	$ Millions	Operating Income After Depreciation
OIBDP	Compustat	Num	$ Millions	Operating Income Before Depreciation
P4	I/B/E/S	Num	$	Share Price in April
PE	N/A	Num	$	$P4/MDFY2$
PERMNO	CRSP	Num	N/A	Permanent Identification Number in CRSP
PPENT	Compustat	Num	$ Millions	Total (Net) Property, Plant, and Equipment
PRCC_C	Compustat	Num	$	Annual (Calendar) Price Close
PRCC_F	Compustat	Num	$	Annual (Fiscal) Price Close

PSTK	Compustat	Num	$ Millions	Total Preferred Stock	
PSTKL	Compustat	Num	$ Millions	Preferred Stock – Liquidating Value	
RECT	Compustat	Num	$ Millions	Total Receivables	
RI1	N/A	Num	$	$MDFY1 - KE \times BPS$	*(34)*
RI2	N/A	Num	$	$MDFY2 - KE \times BPS1$	*(35)*
SALE	Compustat	Num	$ Millions	Sales	
SE_VAL_RIVM	N/A	Num	% of P4	Signed Error of RIM Valuation Relative to P4	
SERROR_PE	N/A	Num	% of P4	Signed Error of P/E Valuation Relative to P4	
SIC2	Compustat	Num	N/A	2-Digit SIC	
SIC3	Compustat	Num	N/A	3-Digit SIC	
SICH	Compustat	Num	N/A	Standard Industrial Classification – Historical	
SIV	Compustat	Num	$ Millions	Sale of Investments	
SPI	Compustat	Num	$ Millions	Special Items	
SPPE	Compustat	Num	$ Millions	Sale of Property	
TIC	Compustat	Char	N/A	Ticker Symbol	
TICKER	I/B/E/S	Char	N/A	I/B/E/S Company Identifier	
TSTKP	Compustat	Num	$ Millions	Preferred Treasury Stock	
TXT	Compustat	Num	$ Millions	Total Income Taxes	
V_HMEAN_PE	N/A	Num	$	P/E Valuation using Harmonic Mean*)*	
VAL_RIVM	N/A	Num	$	RIM Valuation	
VALDATE		Num	N/A	Valuation Date	
XIDO	Compustat	Num	$ Millions	Extraordinary Items and Discontinued Operations	
XINT	Compustat	Num	$ Millions	Total Interest and Related Expense	
XRD	Compustat	Num	$ Millions	Research and Development Expense	

3. Large Sample Analysis

Table A - Sample II Descriptive Statistics – Fiscal Year

Panel I: Combined Sample II	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	4327	30.3133	19.1342	26.4600	2.8500	16.0000	39.8200	135.1500
Common Equity per Share	4327	13.1856	8.9608	11.1124	0.6975	6.4211	17.8813	56.2731
EPS Excl. Extraordinary Items	4327	1.7321	1.3817	1.3900	0.0350	0.7300	2.3300	10.3900
PINTAN	4327	0.2011	0.2033	0.1361	0.00	0.0222	0.3325	0.7722
Median 1-Year-Ahead EPS	4327	1.8720	1.2533	1.5800	0.0200	0.9100	2.5300	6.9100
Median 2-Year-Ahead EPS	4327	2.1766	1.3745	1.8500	0.2500	1.1300	2.9000	7.4600
P/E Signed Error	4327	-0.2166	0.4930	-0.0889	-2.4951	-0.4043	-0.0989	0.5155
P/E Absolute Error	4327	0.3540	0.4058	0.2174	0.0001	0.0945	0.4308	2.4951
RIVM Signed Error	4327	0.0759	0.3032	0.1225	-0.9131	-0.0900	0.2910	0.6276
RIVM Absolute Error	4327	0.2553	0.1802	0.2260	0.0001	0.1099	0.3713	0.9131

Panel II: Sub-Sample II_L	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	2165	29.7332	18.6342	25.8500	3.9000	16.2400	38.9600	135.1500
Common Equity per Share	2165	13.3352	9.1585	11.1350	0.8362	6.2259	18.6728	56.2731
EPS Excl. Extraordinary Items	2165	1.7765	1.4308	1.4300	0.0350	0.7700	2.3800	10.3900
PINTAN	2165	0.0377	0.0407	0.0223	0.00	0.00	0.0678	0.1531
Median 1-Year-Ahead EPS	2165	1.8254	1.2197	1.5300	0.0300	0.8900	2.5000	6.9100
Median 2-Year-Ahead EPS	2165	2.1298	1.3274	1.8300	0.2500	1.1100	2.8200	7.4600
P/E Signed Error	2165	-0.1984	0.4981	-0.0712	-2.4881	-0.3696	0.1123	0.5130
P/E Absolute Error	2165	0.3464	0.4092	0.2089	0.0001	0.0867	0.4189	2.4881
RIVM Signed Error	2165	0.0745	0.3181	0.1318	-0.9122	-0.0963	0.2983	0.6276
RIVM Absolute Error	2165	0.2676	0.1874	0.2411	0.0004	0.1167	0.3902	0.9122

Panel III: Sub-Sample II_H	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	2162	30.8943	19.6092	27.0200	2.8500	15.7300	40.7400	123.5900
Common Equity per Share	2162	13.0357	8.7580	11.0559	0.6975	6.6103	17.1317	55.1717

EPS Excl. Extraordinary Items	2162	1.6876	1.3296	1.3600	0.0400	0.7000	2.2900	9.3700
PINTAN	2162	0.3647	0.1660	0.3327	0.1310	0.2245	0.4784	0.7722
Median 1-Year-Ahead EPS	2162	1.9187	1.2847	1.6150	0.0200	0.9300	2.5600	6.6500
Median 2-Year-Ahead EPS	2162	2.2234	1.4188	1.8700	0.2700	1.1400	2.9800	7.3100
P/E Signed Error	2162	-0.2349	0.4872	-0.1195	-2.4951	-0.4225	0.0900	0.5155
P/E Absolute Error	2162	0.3615	0.4022	0.2266	0.0003	0.1034	0.4491	2.4951
RIVM Signed Error	2162	0.0773	0.2876	0.1125	-0.9131	-0.0854	0.2807	0.6212
RIVM Absolute Error	2162	0.2431	0.1720	0.2138	0.0001	0.1038	0.3567	0.9131

Table B - Sample III Descriptive Statistics – SIC3

Panel A: Combined Sample III	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	4229	30.3538	19.1795	26.4900	2.8500	16.0500	39.8200	135.1500
Common Equity per Share	4229	13.1645	8.9152	11.1250	0.6975	6.4353	17.8070	55.1717
EPS Excl. Extraordinary Items	4229	1.7339	1.3780	1.3900	0.0350	0.7300	2.3400	10.3900
PINTAN	4229	0.1996	0.2028	0.1345	0.00	0.0215	0.3280	0.7722
Median 1-Year-Ahead EPS	4229	1.8760	1.2546	1.5900	0.0200	0.9100	2.5400	6.9100
Median 2-Year-Ahead EPS	4229	2.1799	1.3768	1.8500	0.2500	1.1300	2.9000	7.4600
P/E Signed Error	4229	-0.2147	0.4887	-0.0886	-2.4951	-0.4028	0.0968	0.5155
P/E Absolute Error	4229	0.3509	0.4022	0.2163	0.0001	0.0939	0.4278	2.4951
RIVM Signed Error	4229	0.0761	0.3027	0.1221	-0.9131	-0.0891	0.2894	0.6276
RIVM Absolute Error	4229	0.2549	0.1802	0.2249	0.0001	0.1097	0.3708	0.9131

Panel B: Sub-Sample III_L	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	2165	29.0403	18.6726	24.9400	2.8500	15.4700	38.0700	135.1500
Common Equity per Share	2165	11.8653	8.3500	9.8558	0.6975	5.4879	16.1602	55.1717
EPS Excl. Extraordinary Items	2165	1.6674	1.3653	1.3300	0.0350	0.7100	2.2400	10.3900
PINTAN	2165	0.0849	0.1144	0.0359	0.00	0.00	0.1345	0.6075
Median 1-Year-Ahead EPS	2165	1.7446	1.1935	1.4700	0.0200	0.8400	2.3500	6.9100

Median 2-Year-Ahead EPS	2165	2.0446	1.3123	1.7400	0.2500	1.0400	2.6900	7.2900
P/E Signed Error	2165	-0.1916	0.4901	-0.0731	-2.4881	-0.3688	0.1340	0.5126
P/E Absolute Error	2165	0.3495	0.3933	0.2218	0.0005	0.0996	0.4190	2.4881
RIVM Signed Error	2165	0.0867	0.3130	0.1315	-0.9122	-0.0787	0.3078	0.6276
RIVM Absolute Error	2165	0.2652	0.1876	0.2399	0.0004	0.1115	0.3892	0.9122

Panel C: Sub-Sample III_H	**N**	**Mean**	**Standard Deviation**	**Median**	**Minimum**	**Q1**	**Q3**	**Maximum**
Share Price in April	2064	31.7316	19.6073	27.6200	3.6400	16.7350	42.2400	132.6000
Common Equity per Share	2064	14.5273	9.2804	12.4426	0.8591	7.6818	19.2280	54.8257
EPS Excl. Extraordinary Items	2064	1.8038	1.3882	1.4775	0.0400	0.7600	2.4600	9.3700
PINTAN	2064	0.3200	0.2054	0.3108	0.0005	0.1423	0.4690	0.7722
Median 1-Year-Ahead EPS	2064	2.0137	1.3017	1.7200	0.0500	1.0000	2.7300	6.6500
Median 2-Year-Ahead EPS	2064	2.3218	1.4279	2.0000	0.2700	1.2000	3.1200	7.4600
P/E Signed Error	2064	-0.2389	0.4863	-0.1142	-2.4951	-0.4152	0.0693	0.5155
P/E Absolute Error	2064	0.3524	0.4115	0.2109	0.0001	0.0880	0.4383	2.4951
RIVM Signed Error	2064	0.0650	0.2912	0.1132	-0.9131	-0.0989	0.2680	0.6212
RIVM Absolute Error	2064	0.2441	0.1715	0.2130	0.0001	0.1089	0.3535	0.9131

Table C - Sample I Descriptive Statistics by SIC3

Combined Sample I	**Mean**						**Median**					
3-Digit SIC	p4	BPS	EPS	PINTAN	mdfy1	mdfy2	p4	BPS	EPS	PINTAN	mdfy1	mdfy2
104	29.2	13.8	1.3	0.0	1.8	2.4	29.4	6.3	0.6	0.0	1.5	2.4
122	34.4	11.0	1.9	0.0	2.5	3.2	33.5	9.9	1.8	0.0	2.5	3.1
131	36.4	16.6	2.1	0.0	2.1	2.6	31.6	14.0	1.6	0.0	1.7	2.2
138	27.8	14.5	2.2	0.1	2.2	2.7	25.7	12.6	1.8	0.1	2.0	2.4
140	49.9	16.5	2.3	0.1	2.6	3.2	33.8	12.6	1.9	0.1	2.1	2.4
153	33.4	31.6	4.5	0.0	1.2	1.7	30.8	31.4	3.8	0.0	1.0	1.5
160	31.0	11.8	2.0	0.1	1.9	2.2	27.8	12.1	1.8	0.0	1.8	2.2
162	18.4	10.4	1.2	0.2	1.3	1.5	16.6	10.6	0.9	0.2	1.3	1.4
170	15.3	9.6	1.4	0.2	1.1	1.6	15.5	6.4	0.8	0.2	1.0	1.6
202	15.5	8.0	0.9	0.3	1.2	1.5	16.9	8.2	0.9	0.5	1.5	1.7
204	54.2	16.1	3.6	0.3	4.0	4.4	54.2	15.9	3.4	0.3	3.8	4.1
205	18.8	6.3	0.8	0.2	0.9	1.1	18.5	6.2	0.7	0.2	0.8	1.0
206	42.5	7.3	1.5	0.3	1.8	2.0	44.9	9.1	1.5	0.3	2.0	2.2
207	11.9	7.0	1.0	0.2	1.0	1.2	11.8	7.6	0.9	0.2	1.0	1.3
208	42.2	12.8	2.3	0.3	2.5	2.8	36.4	10.7	2.2	0.4	2.3	2.6
209	20.1	5.5	0.8	0.1	1.0	1.3	18.1	5.0	0.8	0.1	1.1	1.4
211	32.7	6.8	2.4	0.4	2.4	2.6	28.9	3.7	2.2	0.5	2.2	2.4
227	28.2	18.2	1.4	0.2	1.7	2.1	14.1	5.0	0.6	0.2	0.9	1.2
230	37.8	16.3	2.2	0.2	2.5	2.8	31.8	12.8	1.9	0.1	2.1	2.4
233	31.6	13.1	1.9	0.4	2.0	2.2	31.6	13.1	1.9	0.4	2.0	2.2
240	35.4	16.5	1.6	0.0	1.1	1.6	21.7	10.0	1.0	0.0	0.7	1.0
242	36.0	17.1	1.1	0.1	0.9	1.3	38.1	17.2	1.3	0.0	1.1	1.1
245	13.6	5.7	1.9	0.3	0.7	1.1	13.6	5.7	1.9	0.3	0.7	1.1
251	23.3	7.1	1.1	0.2	1.2	1.5	21.9	6.3	1.1	0.3	1.0	1.4
262	29.6	11.2	2.3	0.1	2.3	2.6	23.4	11.3	1.9	0.0	1.9	2.2
263	28.1	14.7	2.4	0.1	1.7	2.1	28.2	15.4	1.8	0.1	1.7	2.1
265	32.5	9.4	1.6	0.1	1.9	2.1	32.5	9.4	1.6	0.1	1.9	2.1
267	33.7	13.1	2.2	0.3	2.3	2.6	27.7	14.2	1.7	0.3	1.8	2.2
271	26.1	18.6	2.1	0.5	1.8	2.0	23.9	11.5	1.7	0.5	1.5	1.9
275	22.4	10.3	1.0	0.3	1.4	1.6	16.5	9.5	1.0	0.3	1.3	1.4
278	38.7	9.6	1.5	0.5	2.2	2.5	38.7	9.6	1.5	0.5	2.2	2.5
280	32.1	12.9	1.5	0.2	2.1	2.5	31.8	14.2	1.5	0.3	2.1	2.4
281	32.8	11.9	2.0	0.1	2.1	2.5	29.1	12.5	1.7	0.1	1.9	2.1
282	29.2	10.2	1.9	0.2	2.2	2.5	27.4	9.9	1.9	0.1	2.2	2.5
284	39.2	7.7	2.0	0.3	2.2	2.5	35.9	6.7	1.7	0.3	2.0	2.2
285	51.8	15.4	3.0	0.2	3.5	4.0	60.4	14.7	4.0	0.3	4.1	4.7
286	35.4	12.7	2.1	0.1	2.5	2.8	33.9	12.3	2.2	0.1	2.6	2.9
287	25.3	6.3	1.5	0.1	1.9	2.0	17.0	5.3	0.7	0.0	0.9	1.2
289	39.4	15.3	2.4	0.3	2.6	3.1	37.0	11.7	2.4	0.3	2.3	2.8
291	35.7	18.5	3.6	0.0	3.4	3.6	30.7	19.9	3.4	0.0	3.3	3.5
301	50.5	29.5	1.9	0.1	2.9	2.8	50.5	29.5	1.9	0.1	2.9	2.8
308	30.2	13.3	1.7	0.2	2.0	2.3	32.3	12.4	1.6	0.2	2.0	2.1
314	23.0	11.1	1.4	0.1	1.5	1.7	21.4	10.8	1.2	0.1	1.4	1.7
329	41.2	21.8	2.6	0.1	2.4	2.8	33.9	22.3	2.3	0.1	2.3	2.8

331	33.8	16.7	2.2	0.1	2.3	3.0	30.5	18.1	2.1	0.0	2.0	2.9
334	18.0	20.1	1.1	0.2	1.6	2.0	15.8	9.3	0.6	0.3	1.1	1.5
335	30.8	18.0	1.9	0.1	2.1	2.5	30.7	16.6	1.7	0.1	2.1	2.4
339	25.0	10.5	1.1	0.2	1.1	2.4	25.0	10.5	1.1	0.2	1.1	2.4
341	31.2	7.3	2.0	0.2	2.2	2.4	26.7	7.3	1.8	0.2	2.1	2.2
342	34.2	17.1	2.0	0.3	2.4	2.8	28.4	15.5	1.4	0.3	1.6	1.8
344	38.9	16.7	2.0	0.3	2.1	2.7	28.0	14.7	1.5	0.3	1.7	2.0
348	12.9	4.4	0.7	0.0	0.6	0.8	12.9	4.4	0.7	0.0	0.6	0.8
349	35.7	18.9	1.8	0.3	2.2	2.6	34.2	20.9	1.7	0.3	2.2	2.6
351	44.9	12.7	1.9	0.3	2.2	3.1	47.7	12.3	1.8	0.4	2.0	3.0
353	40.4	15.6	2.3	0.2	2.4	2.9	34.8	14.4	2.1	0.1	2.4	2.8
354	37.7	16.2	3.0	0.2	2.5	2.9	32.3	16.1	2.5	0.3	2.3	2.5
355	27.3	12.7	1.8	0.2	1.7	2.1	24.9	13.5	1.5	0.1	1.4	1.9
356	32.9	13.2	1.7	0.3	2.1	2.4	33.5	14.3	1.6	0.2	1.9	2.2
357	22.5	9.1	1.0	0.2	1.3	1.6	19.1	7.5	0.6	0.1	1.0	1.3
358	38.7	10.0	2.0	0.2	2.3	2.7	38.2	10.7	1.9	0.1	2.3	2.8
361	55.8	28.2	2.6	0.3	3.5	4.1	57.1	23.2	3.0	0.2	3.8	4.3
362	29.5	15.1	2.3	0.4	2.3	2.7	23.5	10.5	1.7	0.4	2.0	2.2
364	43.2	17.7	2.9	0.3	2.8	3.2	43.0	17.9	2.7	0.4	3.0	3.3
365	19.3	7.3	0.9	0.3	1.1	1.3	19.3	7.3	0.9	0.3	1.1	1.3
366	23.1	10.8	1.2	0.2	1.3	1.5	17.6	7.0	0.7	0.1	0.9	1.1
367	22.1	8.0	1.0	0.1	1.2	1.5	17.6	7.5	0.8	0.1	1.0	1.3
369	24.6	12.3	1.2	0.3	1.6	1.9	22.4	13.5	0.8	0.2	1.5	1.8
371	28.7	13.1	1.7	0.1	2.0	2.4	22.4	11.4	0.9	0.1	1.3	1.9
372	42.4	15.0	2.5	0.3	2.9	3.4	35.3	13.9	2.3	0.3	2.5	2.9
373	37.8	16.8	2.3	0.2	2.4	2.7	23.2	21.1	1.8	0.2	1.4	1.8
374	34.5	15.2	2.0	0.2	2.0	2.3	31.6	16.2	1.8	0.1	1.9	2.4
379	29.3	6.1	2.0	0.2	2.2	2.4	22.8	3.9	1.6	0.0	1.7	1.9
381	39.8	20.4	2.8	0.3	3.0	3.3	33.4	14.3	1.6	0.4	1.7	2.0
382	36.1	13.2	1.5	0.3	1.8	2.1	28.1	11.0	1.2	0.2	1.4	1.7
384	27.0	8.4	0.9	0.2	0.9	1.2	27.0	8.9	0.9	0.1	0.8	1.1
386	5.2	3.5	0.4	0.4	0.5	0.6	5.2	3.5	0.4	0.4	0.5	0.6
394	21.4	9.6	1.5	0.2	1.5	1.7	19.4	8.9	1.4	0.2	1.6	1.6
399	12.3	5.9	0.9	0.4	0.9	1.1	7.8	5.1	0.5	0.4	0.7	0.7
401	45.6	20.7	2.7	0.1	2.8	3.3	43.1	22.3	2.3	0.0	2.6	3.1
421	27.1	9.8	1.4	0.1	1.4	1.7	20.3	9.5	1.1	0.0	1.0	1.3
440	41.3	24.3	2.7	0.0	2.5	2.9	39.9	25.9	2.4	0.0	2.4	2.5
441	46.5	36.5	5.7	0.1	4.5	4.9	46.3	34.0	4.4	0.0	5.1	4.4
451	20.4	11.2	1.7	0.0	1.9	2.1	15.7	9.4	1.6	0.0	1.4	1.7
470	32.3	16.4	2.1	0.2	2.1	2.4	33.8	19.5	2.1	0.0	2.1	2.2
473	33.0	8.2	1.3	0.3	1.5	1.8	30.5	8.2	1.5	0.2	1.6	1.8
481	29.0	14.8	1.6	0.3	1.7	1.9	25.7	12.8	1.5	0.3	1.6	1.8
483	25.3	10.5	1.3	0.5	1.5	1.7	27.2	10.0	1.1	0.6	1.3	1.6
484	39.0	17.4	2.6	0.5	2.4	2.9	35.3	16.0	1.5	0.6	1.9	2.2
488	22.8	18.1	1.2	0.5	1.6	1.9	24.5	14.4	1.1	0.6	1.6	2.0
489	36.4	14.4	1.1	0.1	1.4	1.8	29.4	14.6	1.1	0.1	1.6	1.8
491	34.4	22.1	2.3	0.0	2.4	2.6	32.1	19.5	2.2	0.0	2.3	2.5
492	35.3	17.0	2.1	0.0	2.2	2.4	32.3	17.6	2.0	0.0	2.1	2.3
493	34.4	23.2	2.3	0.0	2.4	2.6	30.9	21.8	2.1	0.0	2.4	2.5
494	22.5	11.8	1.0	0.0	1.1	1.2	20.5	11.2	0.9	0.0	1.0	1.1

495	30.4	10.2	1.3	0.4	1.5	1.7	28.1	10.0	1.2	0.3	1.4	1.6
499	11.5	6.6	0.6	0.1	0.6	0.8	11.9	7.2	0.6	0.1	0.5	0.6
501	29.8	10.9	1.5	0.4	1.9	2.1	17.0	9.5	0.7	0.5	1.2	1.4
504	31.0	15.6	1.8	0.2	2.0	2.3	29.2	16.0	1.7	0.2	1.9	2.2
505	36.7	23.2	3.0	0.2	3.0	3.4	33.6	24.0	2.5	0.2	2.7	3.1
506	33.8	17.1	3.1	0.2	3.0	3.4	31.7	17.3	3.2	0.2	3.2	3.0
507	30.1	14.5	1.7	0.4	1.9	2.3	21.9	13.4	1.4	0.4	1.8	2.2
508	22.7	9.6	1.4	0.2	1.6	2.0	21.9	9.5	1.4	0.2	1.7	2.0
509	20.5	4.8	0.8	0.2	1.1	1.5	18.1	4.9	0.7	0.2	1.1	1.6
512	22.8	9.5	1.1	0.4	1.5	1.7	19.2	11.1	1.3	0.3	1.5	1.6
517	36.0	16.5	2.3	0.1	2.2	2.6	30.6	18.7	2.0	0.0	2.0	2.2
540	46.9	12.2	1.6	0.5	1.9	2.2	46.9	12.2	1.6	0.5	1.9	2.2
550	22.3	14.8	1.5	0.2	1.7	2.0	19.6	12.3	1.5	0.2	1.7	1.8
581	31.0	8.7	1.5	0.1	1.6	1.9	28.1	7.8	1.1	0.1	1.3	1.5
591	36.4	20.9	1.9	0.6	2.5	2.9	37.3	23.9	2.0	0.6	2.7	3.0
594	20.1	9.3	1.2	0.1	1.3	1.6	17.8	9.4	1.3	0.0	1.2	1.4
596	16.5	7.6	1.0	0.2	1.0	1.3	13.5	7.4	0.9	0.1	0.9	1.0
701	35.4	10.4	2.1	0.2	1.4	1.7	34.7	9.8	1.8	0.2	1.5	1.9
720	9.7	6.1	0.4	0.3	0.5	0.6	9.6	6.1	0.4	0.3	0.5	0.6
731	27.9	8.9	1.8	0.4	1.8	2.1	28.5	10.5	1.2	0.4	1.5	1.7
732	31.3	11.5	1.9	0.5	2.2	2.5	35.8	12.7	1.9	0.5	2.5	2.8
733	30.9	14.4	1.7	0.6	1.8	2.0	29.7	13.8	1.8	0.6	1.7	1.9
735	27.2	13.7	1.9	0.1	2.1	2.4	24.1	12.0	1.6	0.1	1.8	2.1
736	20.8	10.6	1.1	0.3	1.2	1.4	17.3	8.2	0.8	0.2	0.9	1.1
737	24.3	7.4	1.0	0.3	1.2	1.5	19.1	6.3	0.7	0.3	1.0	1.2
738	23.8	8.7	1.4	0.3	1.4	1.6	21.3	7.2	1.2	0.2	1.3	1.4
751	42.7	20.5	2.4	0.1	2.8	3.3	47.6	25.8	2.1	0.1	2.7	3.2
781	21.9	10.1	1.1	0.0	1.4	1.5	23.2	10.7	1.2	0.0	1.6	1.6
783	18.6	8.9	1.0	0.4	1.1	1.3	19.3	8.9	1.0	0.4	1.2	1.4
784	21.7	6.0	0.8	0.0	0.8	1.1	21.7	6.0	0.8	0.0	0.8	1.1
794	36.7	28.3	2.4	0.3	1.9	2.1	37.6	29.3	2.3	0.3	1.7	1.7
799	39.7	11.5	1.3	0.1	1.5	1.9	35.3	10.7	1.3	0.0	1.7	2.1
800	14.0	10.5	0.9	0.5	1.0	1.2	14.7	10.4	0.9	0.5	1.0	1.2
801	26.8	16.6	1.9	0.6	2.0	2.3	23.5	14.0	1.5	0.5	1.6	1.8
805	23.8	15.9	1.8	0.2	1.7	1.9	18.7	12.8	1.4	0.2	1.4	1.6
806	28.3	17.6	2.1	0.4	2.1	2.4	28.6	18.0	2.2	0.3	2.4	2.6
807	41.5	12.8	2.4	0.4	2.7	3.1	46.3	15.5	2.9	0.5	2.9	3.3
808	34.2	16.0	2.6	0.6	2.7	2.9	31.3	16.3	2.4	0.6	2.6	2.8
809	26.2	9.3	1.4	0.4	1.6	1.8	20.6	8.2	1.2	0.5	1.3	1.5
820	31.2	7.3	1.5	0.2	1.7	2.1	21.9	6.8	1.1	0.3	1.5	1.8
830	19.7	11.9	0.7	0.2	0.9	1.1	20.6	12.9	0.8	0.0	0.9	1.2
870	33.3	6.3	1.2	0.2	1.4	1.7	35.3	3.8	1.1	0.2	1.3	1.6
871	32.7	23.7	2.2	0.3	2.3	2.6	31.3	20.4	2.3	0.2	2.5	2.8
872	30.7	10.0	1.1	0.5	1.3	1.6	34.5	9.8	1.1	0.5	1.3	1.5
874	25.7	11.6	1.4	0.3	1.5	1.7	23.7	10.2	1.3	0.2	1.3	1.6
874	25.3	11.5	1.4	9.0	1.5	1.7	23.6	10.1	1.2	7.2	1.3	1.6

Table D – Descriptive statistics by SIC3 groups - Errors

Combined Sample I	**Mean**				**Median**			
3-Digit SIC	P/E SE	P/E AE	RIVM SE	RIVM AE	P/E SE	P/E AE	RIVM SE	RIVM AE
104	-0.1677	0.4335	0.0141	0.3391	0.0023	0.3442	0.0592	0.3246
122	-0.1826	0.4254	-0.2483	0.3290	-0.0143	0.2846	-0.2500	0.2524
131	-0.3463	0.4723	0.0691	0.2976	-0.3215	0.4024	0.1070	0.2688
138	-0.1269	0.2611	-0.2314	0.3067	-0.0919	0.1974	-0.1810	0.2165
140	-0.1533	0.3319	0.1303	0.2909	-0.1571	0.2508	0.1339	0.2238
153	-0.8920	0.9403	0.0660	0.2728	-0.7093	0.7093	0.1347	0.1849
160	-0.0687	0.1868	0.0478	0.1628	-0.0485	0.1243	0.1000	0.1401
162	-0.0710	0.2509	-0.0127	0.2061	0.0470	0.1560	-0.0432	0.1737
170	0.0508	0.2602	-0.2760	0.2760	0.1118	0.3111	-0.2940	0.2940
202	-0.2500	0.2500	-0.1097	0.2340	-0.2993	0.2993	-0.2289	0.2289
204	-0.0058	0.2065	-0.0973	0.1009	0.0301	0.2007	-0.0495	0.0495
205	0.0943	0.1556	0.2855	0.2855	0.1612	0.1612	0.3680	0.3680
206	-0.0088	0.1368	0.3832	0.3832	0.0594	0.0938	0.3976	0.3976
207	-0.1312	0.2614	-0.2237	0.2511	-0.2301	0.2590	-0.1392	0.1473
208	-0.0272	0.1949	0.1139	0.1692	-0.0409	0.1584	0.0927	0.1299
209	-0.0748	0.3538	0.0656	0.3261	0.0698	0.2860	0.0199	0.2422
211	-0.3197	0.4143	-0.1453	0.2176	-0.0855	0.1525	-0.1105	0.1704
227	-0.0423	0.2068	0.0420	0.2267	0.0196	0.1964	0.1430	0.2252
230	-0.0239	0.2140	0.0355	0.2261	-0.0619	0.1755	0.1016	0.1618
233	0.0586	0.2695	0.2045	0.2045	0.0586	0.2695	0.2045	0.2045
240	-0.4658	0.5722	0.5161	0.5161	-0.3646	0.4417	0.5120	0.5120
242	-0.2712	0.5216	0.3999	0.3999	-0.2773	0.4990	0.4397	0.4397
245	-1.1601	1.1742	0.1102	0.3601	-1.1601	1.1742	0.1102	0.3601
251	-0.5487	0.5964	0.1055	0.1871	-0.4158	0.4158	0.1451	0.1713
262	-0.3444	0.5347	-0.1731	0.2337	-0.1943	0.3497	-0.1099	0.1581
263	0.0108	0.2103	0.0323	0.2696	-0.0827	0.2070	0.0772	0.2697
265	-0.4379	0.4379	0.1658	0.1658	-0.4379	0.4379	0.1658	0.1658
267	0.0684	0.1787	-0.0016	0.1438	0.0944	0.1828	0.0498	0.1238
271	-0.1509	0.3336	-0.0051	0.2598	0.0327	0.2264	0.0419	0.2557
275	-0.0256	0.2936	0.0195	0.3629	0.0902	0.2769	0.1599	0.3167
278	0.0370	0.1092	0.1391	0.1391	0.0370	0.1092	0.1391	0.1391
280	0.0134	0.1260	-0.0083	0.2103	0.0724	0.0935	0.0368	0.1493
281	-0.1217	0.3458	0.0203	0.3035	0.0410	0.2471	0.1184	0.2932
282	0.0087	0.1686	-0.0905	0.1979	0.0224	0.1021	-0.0655	0.2027
284	-0.0605	0.2597	0.1083	0.2053	0.0201	0.1968	0.1598	0.2240
285	-0.0189	0.2555	-0.0754	0.1803	0.0389	0.1259	-0.0376	0.1427
286	-1.1076	1.1076	-0.0429	0.2313	-0.9649	0.9649	0.0346	0.1660
287	-0.0622	0.2120	-0.0331	0.1617	0.0453	0.1434	-0.0147	0.0523
289	-0.3733	0.4379	-0.0445	0.1696	-0.2771	0.2771	-0.0372	0.1357
291	0.0278	0.1537	-0.3557	0.3849	0.0067	0.1251	-0.3068	0.3068
301	0.3033	0.3033	0.3869	0.3869	0.3033	0.3033	0.3869	0.3869
308	-0.0073	0.2200	0.0061	0.2160	0.0105	0.2311	0.0353	0.2399
314	-0.1640	0.3231	0.0317	0.2555	-0.0619	0.2187	0.1148	0.2279
329	-0.2146	0.3786	0.0535	0.2386	-0.1058	0.3212	0.0934	0.2294
331	0.0086	0.2046	-0.2063	0.3012	0.0462	0.1800	-0.1201	0.2334
334	-0.1009	0.1983	-0.2534	0.2534	0.0404	0.1527	-0.2073	0.2073

335	0.0743	0.2241	-0.0227	0.2137	0.1126	0.2278	0.0227	0.2169
339	0.0063	0.1751	-0.1350	0.1676	0.0063	0.1751	-0.1350	0.1676
341	0.0199	0.1234	-0.0876	0.1156	0.0314	0.1375	-0.0904	0.0912
342	-0.0817	0.2649	-0.0957	0.2520	-0.0233	0.2131	-0.0233	0.1534
344	0.0374	0.2418	0.1080	0.1920	0.0815	0.2084	0.1506	0.1778
348	0.2683	0.2683	0.2912	0.2912	0.2683	0.2683	0.2912	0.2912
349	0.0298	0.2014	0.0813	0.1986	0.0186	0.2084	0.1043	0.1531
351	-0.1620	0.1905	0.1116	0.1555	-0.1128	0.1128	0.1340	0.1340
353	-0.0034	0.1850	0.0594	0.2176	0.0050	0.1613	0.1004	0.2158
354	-0.1028	0.2433	0.0546	0.1649	0.0489	0.1758	0.0399	0.1196
355	-0.0091	0.1947	0.0815	0.1958	-0.0022	0.1239	0.1131	0.1867
356	-0.0266	0.1991	0.0746	0.2066	0.0467	0.1804	0.1232	0.1892
357	-0.3790	0.4752	0.1556	0.3003	-0.2660	0.3196	0.2009	0.3040
358	-0.1305	0.2410	0.0572	0.1487	-0.1606	0.1994	0.0358	0.1428
361	-0.7378	0.7378	0.1241	0.1554	-0.2999	0.2999	0.0752	0.0979
362	-1.0430	1.2159	-0.1839	0.2229	-1.3919	1.3919	-0.1896	0.1896
364	-0.1240	0.2366	0.0530	0.1879	-0.0019	0.1154	0.1042	0.1462
365	-0.6161	1.0108	-0.0118	0.4577	-0.6161	1.0108	-0.0118	0.4577
366	-0.3096	0.4302	0.1452	0.2579	-0.2353	0.3238	0.1926	0.2378
367	-0.5967	0.6402	0.0778	0.2678	-0.4596	0.4651	0.1456	0.2395
369	-0.3079	0.4160	0.0343	0.2584	-0.1735	0.2621	0.1374	0.2319
371	-0.0621	0.2872	-0.0288	0.2271	-0.0073	0.2846	0.0075	0.1673
372	0.0163	0.1561	-0.0569	0.1637	0.0516	0.1429	-0.0185	0.1220
373	-0.0063	0.0970	0.0446	0.1494	0.0111	0.0505	0.0968	0.1064
374	-0.1430	0.3127	0.0976	0.2159	-0.0263	0.2076	0.1217	0.1986
379	0.1631	0.2671	-0.1933	0.2898	0.2336	0.3281	-0.1259	0.1602
381	-0.2348	0.3795	0.0552	0.2899	-0.0993	0.2708	0.1714	0.3174
382	-0.5898	0.6187	0.2423	0.2850	-0.4778	0.4778	0.2612	0.2981
384	-2.0706	2.0706	0.4751	0.4751	-2.1844	2.1844	0.4827	0.4827
386	-1.0681	1.0681	-0.2402	0.2471	-1.0681	1.0681	-0.2402	0.2471
394	-0.1489	0.2225	-0.0479	0.1811	-0.1169	0.1358	-0.0528	0.1482
399	-0.4812	0.5945	-0.1421	0.2268	-0.2385	0.3048	-0.0661	0.1849
401	-0.0620	0.1784	0.1174	0.2255	-0.0618	0.1626	0.1278	0.2100
421	-0.2123	0.3432	0.2006	0.2283	-0.1458	0.2501	0.2286	0.2412
440	-0.1955	0.3847	0.0439	0.2487	-0.1130	0.3273	0.0135	0.2265
441	-0.2018	0.2043	-0.2374	0.2374	-0.0843	0.0843	-0.2309	0.2309
451	-0.0224	0.3279	-0.3209	0.3987	0.0873	0.2304	-0.4028	0.4028
470	-0.3338	0.4741	0.0822	0.1804	-0.0343	0.3090	0.1255	0.1607
473	-0.0164	0.3081	0.2630	0.3300	0.1170	0.2510	0.3165	0.3270
481	-0.5259	0.5613	0.1326	0.2425	-0.4763	0.4763	0.1485	0.2117
483	-0.4857	0.5636	0.0366	0.3061	-0.3558	0.4110	0.0873	0.3189
484	-0.2745	0.3549	0.0273	0.1950	-0.0565	0.2066	0.0682	0.1351
488	-0.8406	0.8406	0.0027	0.1382	-0.9141	0.9141	0.0460	0.1369
489	-1.2053	1.2053	0.2971	0.3361	-1.1490	1.1490	0.3463	0.3463
491	-0.0314	0.1123	0.0553	0.2010	-0.0277	0.0827	0.1192	0.1721
492	-0.0033	0.1381	0.1588	0.2085	-0.0189	0.0981	0.1728	0.1939
493	-0.0029	0.0800	0.0910	0.1729	-0.0096	0.0667	0.1236	0.1556
494	0.0115	0.1232	0.4110	0.4110	0.0134	0.1100	0.4268	0.4268
495	-0.0296	0.1909	0.2758	0.2938	-0.0321	0.1676	0.2989	0.2989
499	-0.2214	0.5537	0.1438	0.3466	-0.1760	0.4342	0.2747	0.3463

501	-0.0041	0.1020	0.1441	0.1441	0.0554	0.0914	0.1343	0.1343
504	-0.1002	0.3448	0.0461	0.2275	-0.0279	0.3270	0.0543	0.2228
505	-0.0043	0.2515	-0.0990	0.2893	-0.0345	0.1980	-0.0891	0.2881
506	0.1573	0.2336	-0.2002	0.2720	0.1870	0.2429	-0.1124	0.2115
507	0.0953	0.3514	-0.0313	0.2832	0.2035	0.2961	0.0540	0.2280
508	-0.1029	0.2057	-0.1503	0.2412	-0.0741	0.1523	-0.0551	0.1598
509	-0.1312	0.4907	-0.1011	0.3476	0.1504	0.2999	0.0598	0.2465
512	-0.0730	0.2373	0.0611	0.2261	0.0050	0.1521	0.1356	0.1598
517	0.1244	0.3293	0.0442	0.1715	0.2386	0.3993	0.0331	0.1496
540	-0.9781	0.9781	0.4542	0.4542	-0.9781	0.9781	0.4542	0.4542
550	-0.0811	0.2078	-0.0733	0.1927	-0.0651	0.1454	-0.0350	0.1365
581	-0.2450	0.3222	0.2051	0.2616	-0.2281	0.2744	0.2487	0.2653
591	-0.0067	0.2024	-0.0052	0.1686	0.0028	0.1901	-0.0015	0.1533
594	-0.4030	0.4957	-0.0276	0.2181	-0.1777	0.1870	0.0333	0.1436
596	-0.6926	0.7117	-0.0484	0.3097	-0.7052	0.7052	0.0071	0.2840
701	-0.8194	0.8194	0.2172	0.2559	-0.6877	0.6877	0.2436	0.2436
720	-0.2241	0.3854	0.2081	0.2973	-0.0005	0.4123	0.3020	0.3020
731	-0.2195	0.4491	0.0546	0.2547	-0.1277	0.2903	0.0149	0.1998
732	-0.1261	0.1754	-0.0197	0.1441	-0.0360	0.1772	0.0375	0.0888
733	-0.2594	0.3514	0.1079	0.2985	-0.2737	0.2737	0.2205	0.3167
735	-0.3560	0.5271	-0.1083	0.2455	-0.1477	0.3099	-0.0389	0.2008
736	-0.0178	0.2032	0.1309	0.2395	0.0418	0.1374	0.1441	0.2077
737	-0.2787	0.4162	0.2068	0.3221	-0.2161	0.3282	0.2660	0.3241
738	-0.1984	0.2621	0.0871	0.2327	-0.1386	0.1529	0.1440	0.2084
751	0.0140	0.2099	-0.0409	0.2607	0.0748	0.1868	0.0239	0.1927
781	-0.2574	0.5960	0.1628	0.2765	0.1159	0.2914	0.1901	0.2379
783	-0.7760	0.7760	0.1317	0.1596	-0.4324	0.4324	0.1167	0.1445
784	-0.8035	0.8035	0.4397	0.4397	-0.8035	0.8035	0.4397	0.4397
794	-0.2431	0.7244	0.0792	0.3477	0.2607	0.4247	0.2479	0.3263
799	-0.6331	0.6767	0.3215	0.3439	-0.6012	0.6012	0.3290	0.3290
800	-0.9312	1.0650	0.0329	0.2866	-0.9183	1.0520	0.0866	0.3196
801	-0.0449	0.1821	0.0554	0.2648	-0.0369	0.1338	0.0633	0.2727
805	-0.0992	0.2119	-0.0388	0.2333	-0.0361	0.1539	0.0268	0.2093
806	-0.1424	0.2056	-0.0489	0.2326	-0.0831	0.1376	0.0424	0.1878
807	-0.2810	0.4079	0.1037	0.1808	-0.1787	0.3230	0.0756	0.1295
808	0.0227	0.1533	-0.0225	0.1965	0.0691	0.1421	0.0742	0.1462
809	-0.2669	0.3373	0.1494	0.2178	-0.3015	0.3347	0.1677	0.2039
820	-0.1860	0.3649	0.0147	0.3260	-0.0916	0.2815	0.1404	0.2920
830	-0.9048	0.9048	0.3433	0.3433	-0.4734	0.4734	0.3351	0.3351
870	0.0125	0.2786	0.3381	0.3560	0.1066	0.2289	0.3476	0.3476
871	-0.0404	0.2638	0.0271	0.2273	0.1010	0.1739	0.0748	0.1875
872	-0.4097	0.5412	0.3567	0.3567	-0.3466	0.3466	0.3307	0.3307
874	-0.4896	0.5905	0.1894	0.2619	-0.4185	0.4211	0.2042	0.2529
874	-0.0910	0.2837	0.0099	0.2361	-0.0035	0.2287	0.0505	0.2035

4. Small Sample Analysis

Table E – List of Analyst Reports Accessed

PINTAN	Name	Broker	Latest Accessed
0.7743	WILLIAM HILL PLC	Deutsche Bank	08/09/2014
0.7500	SAGE GROUP PLC (THE)	JP Morgan	08/09/2014
0.7324	EXPERIAN PLC	JP Morgan	08/09/2014
0.7241	MELROSE INDUSTRIES	RBC Capital	08/09/2014
0.7151	TALKTALK TELECOM	Credit Suisse	08/09/2014
0.7137	MICRO FOCUS INTL	JP Morgan	08/09/2014
0.7009	MEGGITT PLC	Deutsche Bank	08/09/2014
0.6977	MONEYSUPERMARKE	Investec	08/09/2014
0.6674	LADBROKES PLC	Deutsche Bank	08/09/2014
0.6290	BABCOCK INT'L GROUP	JP Morgan	08/09/2014
0.6269	LAIRD PLC	JP Morgan	08/09/2014
0.6150	IMPERIAL TOBACCO GRP	Morgan Stanley	08/09/2014
0.6140	PERFORM GROUP LTD	JP Morgan	08/09/2014
0.5435	HALFORDS GROUP PLC	JP Morgan	08/09/2014
0.5434	DAILY MAIL & GENERAL	Investec	08/09/2014
0.0113	OPHIR EN	Credit Suisse	08/09/2014
0.0108	ANTOFAGASTA PLC	Investec	08/09/2014
0.0101	UNITED UTILITIES PLC	RBC Capital	08/09/2014
0.0061	TED BAKER PLC	Jefferies	08/09/2014
0.0060	KAZAKHMYS PLC	Cannacord Genuity	08/09/2014
0.0043	HARGREAVES LANSD	Credit Suisse	08/09/2014
0.0036	KENTZ CORP	Cannacord Genuity	08/09/2014
0.0019	REDROW PLC	Jefferies	08/09/2014
0.0013	TAYLOR WIMPEY PLC	Deutsche Bank	08/09/2014
0.0011	MITCHELLS & BUTLERS	JP Morgan	08/09/2014
0.0004	VEDANTA RESOURCES	RBC Capital	08/09/2014
0.0000	RECKITT BENCKISER	Deutsche Bank	08/09/2014
0.0000	RANDGOLD RESOURCES	HSBC	08/09/2014
0.0000	BELLWAY PLC	HSBC	08/09/2014
0.0000	BOVIS HOMES GROUP	Deutsche Bank	08/09/2014