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Improving the accuracy of the multiple valuation method

Estimating the equity value of insurance companies

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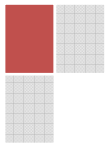


Management Summary

The multiple valuation method is the most used valuation method in equity valuation. Nevertheless it is much less discussed in academic research than the discounted cash flow valuation method. Where the discounted cash flow method focuses on the future cash flows of a firm, the multiple valuation method uses peers to create a firm multiple, which estimates the market value of a company.

The goal of this paper is to improve the accuracy of valuation estimates of the market value of equity of insurance companies using multiples. In order to achieve more accurate value estimates, 29 European public insurance companies will be researched on several income statement and balance sheet numbers. Three kinds of multiples will be examined: common used multiples, sector-specific multiples and sum-of-the-parts multiples. Sector-specific multiples and sum-of-the-parts multiples are tested using simple multiple valuation, common used multiples are also tested using regression analysis.

It appears that sector-specific multiples do not improve the valuation accuracy of the multiple valuation method. The price-to-earnings ratio outperforms almost all sector-specific multiples. Sum-of-the-parts valuation multiples, on the other hand, do improve the accuracy of estimates on the market value of equity of insurance companies. All sum-of-the-parts multiples achieve lower valuation errors than their sector-specific counterparts. At last, nonlinear regression performs better on its valuation accuracy than linear regression. This supports the assumption that the relation between the multiple and its companion variable is nonlinear, unlike most prior literature assume.

Table of contents

List of Figures

List of Tables

1. Introduction

Multiple valuation (relative valuation) is by far the most used valuation method for business valuation. Surprisingly, there is little academic research on this topic. Multiple valuation uses the most basic concept in economics: perfect substitutes should sell for the same price (Baker and Ruback, 1999). Besides that this valuation method is less complex than a discounted cash flow (DCF) analysis, some academics claim that multiple valuation would actually be superior to discounted cash flow analysis if a truly comparable publicly traded firm were available, if the basis of substitutability could be determined, and if the multiple could be estimated reliably (Kaplan and Ruback (1995) and Baker and Ruback (1999)). Damodaran (2006) also states that multiple valuation generally yield better values that are closer to the market price than discounted cash flow valuations.

This is supported by Alford (1992) and Bhojraj and Lee (2001), who focused on the importance of choosing the right set of comparable companies. Bhojraj and Lee state that it is possible to compensate the lack of information included in multiple valuation by choosing the right comparable firms. They also argue that the set of comparable firms should depend on the variables that drive cross-sectional variation in a given valuation multiple, i.e. choosing a multiple should be based on the value drivers of companies in that specific industry.

Prior literature researched mainly common used multiples as price-to-earnings (P/E) ratios, price-to-book (P/B) ratios and price-to-sales (P/S) ratios. However, Kim and Ritter (1999) and Ely et al. (2007) suggest that taking industry specific multiples could result in more accurate valuations.

The business model of insurance companies differs significantly from the business model of industrial counterparts. They receive cash flows in the beginning of a period as premium income. Besides, for every euro of premium it writes, the firm needs to hold capital by regulation to make sure insurance it is able to meet its obligations to policyholders. This makes operations and financing heavily intertwined (Copeland et al., 1990).

Prior literature (Damodaran, 2006) argue that multiples should be tested across several markets, because when a complete market is overvalued, relative valuation leads to value

estimates that are too high. The insurance market however is a well developed and major market where the possibility of over- or undervaluation relative to the total market is very small in contrast to internet firms in the later 1990s, often given as example in the literature. As Kaplan and Ruback (1995) confirm in their paper, using multiples based on performance measures (value drivers) that are actually proportional to value improves the accuracy of estimates of the market value of equity. In the case of insurance companies the accuracy of the valuation estimate overrides the very small possibility of over- or undervaluation. For this reason the focus on the insurance market only is justified.

The meaning of 'market value' can be interpreted in several ways. So, before continuing this paper, the term market value should be defined properly. As the market value of equity of insurance companies this paper uses the definition of the International Valuation Standards Council. It defines market value as *'the estimated amount for which an asset should exchange on the date of valuation between a willing buyer and a willing seller in an arm's length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion'*. Therefore, this paper aims at finding the current value of equity of insurance companies that the market would pay for it.

Section 2 starts with a review of literature regarding the use of multiples, followed by an overview of the practical application of multiples. Section 3 will focus on the description of the activities of insurance companies and provides a literature review of the differences between life and non-life insurance. This supports the identification of the value drivers of insurance companies. The hypotheses are stated in section 4, as well as the research design. The results of the hypotheses will be provided in section 5.

2. Literature review of the multiple valuation method

Despite the frequent use of multiples for business valuation, there is much less academic research to this valuation method as to valuation methods using discounted cash flows. This tendency is partly accountable, since DCF valuation is much more complicated and many assumptions have to be made, which requires an extensive theoretical background of this valuation technique. However, a proper knowledge of the background and the application of multiple valuation improves the accuracy of this valuation method significantly.

2.1 Prior Literature

The first academics that researched multiple valuation focused on the P/E multiple, like Beaver and Morse (1978) who researched the behavior of price earnings multiple. They researched the ability of earnings growth and risk to explain P/E multiple differences across stocks using regression analysis. From this survey it appears that there is a strong correlation between the P/E multiple and earnings growth in the subsequent year. This implies that earnings growth in the following year is a determinant of the P/E ratio. Beta, in the contrary, has little explanatory power on the P/E ratio.

Boatsman and Baskin (1981) compared the valuation accuracy of P/E multiples based on two sets of comparable firms from the same industry. They find that, relative to randomly chosen firms, valuation errors are smaller when comparable firms are matched on the basis of historical earnings growth.

Alford (1992) examines the accuracy of the P/E valuation method when comparable firms are selected on the basis of industry, firm size and earnings growth, to see which factor is the most important for choosing comparable firms. Besides this he investigates the effect of adjusting P/E multiples for difference in leverage across comparable firms.

He finds that selecting comparable companies on the basis of industry is relatively effective, selecting comparable companies when risk and earnings growth are used together result in similar accuracy. This suggests that industry has the same explanatory power as risk and

earnings growth. Adjusting P/E multiples for differences in leverage across firms is not useful; the accuracy of valuation estimates decreases using this method.

Like Alford, Bhojraj and Lee (2001) researched the selection of comparable companies in multiple valuation. They presume that companies should be identified based on underlying value drivers of the multiple used. For example, when an enterprise-value-to-sales multiple is used, firms should be selected on profitability, growth and the cost of capital. Bhojraj and Lee found that selecting companies on the efficacy in predicting future enterprise-value-to-sales and price-to-book ratios result in great improvements over comparable companies selected on the basis of industry and size.

Hermann and Richter (2003) and Cooper and Cordeiro (2008) followed Alford and Bhojraj and Lee in their search to the composition of the optimal set of comparable firms. Hermann and Richter examined different sets of control factors and compare these methods to the method of selecting by industry classification. Like Bhojraj and Lee (2001), Hermann and Richter found that the valuation accuracy improves when comparable firms are selected on relevant fundamentals instead of industry classifications.

Cooper and Cordeiro studied how the accuracy of value estimates of multiple valuation changes when the number of comparable companies increases. They show that a small number of comparables (about five) performs very well when the comparables have a growth rate that is close to the target firm. This suggests that more sophisticated selection and weighting rules may be able to improve the performance of valuations using a small number of comparables even further. Adding more comparables to the valuation has the benefit of adding more information, but the cost of adding more noise.

In a more general research to the valuation of companies Kaplan and Ruback (1995) compared the valuation performance of the discounted cash flow method to alternative valuation methods like multiple valuation on high levered transactions. They found that discounted cash flow valuation and simple EBITDA provide similar accurate estimates of market value.

Even more research is done to the valuation accuracy of the multiples itself. One of the leading articles is a research of Liu Nissim and Thomas (2001), who found that forward

earnings multiples give more accurate value estimates than multiples based on historical figures. They examined the valuation performance of a comprehensive list of value drivers in the U.S. market. After forecasted earnings, historical earnings measures perform best while sales multiples result in valuation estimates with the greatest dispersion in absolute valuation errors[1].

In an earlier research, Kim and Ritter (1999) examined the use of different multiples among comparable companies to value initial public offerings (IPOs). Multiple valuation is widely recommended in valuing IPOs. Since most firms conducting IPOs tend to be younger, start-up enterprises, future cash flows are difficult to estimate. A valuation method based on comparable companies can be the solution to this problem. They found that multiples based on historical numbers have great deviations in value estimates, particularly P/E multiples, which arises from the great variation of earnings figures. The accuracy of value estimates is significantly better when forecasted earnings are used, like Liu et al. confirmed in their paper.

Yoo (2006) examined five multiples on a standalone basis and as a combination of multiples. His research contains four historical multiples and one forward earnings multiples. The simple multiple valuation method, where each of the five multiples is tested individually, provides the same results as Liu et al. (2002) and Kim and Ritter (1999). Forecasted earnings approximate the actual value with the highest accuracy and price-to-sales shows the worst valuation accuracy.

Yoo extended his research with a composite multiple valuation approach, where combinations of simple multiple valuations have been regarded. This extension is tested in two stages; (1) a combination of the four historical multiples and (2) a combination where the historical earnings multiple is replaced by forecasted earnings.

It appears that the composite approach using historical multiples reduces the valuation errors of each simple multiple valuation using a historical multiple. This result implies that each historical multiple may have incremental information useful for the improvement of the valuation accuracy. However, the composite approach using both historical and forward earnings multiples does not improve the valuation accuracy of the valuation outcome of the

[1] Absolute valuation error is calculated by the actual price less predicted price divided by actual price

forward earnings multiple. This means forecasted earnings reflect most of the information that historical multiples capture.

Bradshaw (2004) examines whether valuation estimates based on analysts' forecasts are consistent with their stock recommendations. He considered four valuation models, including the price-earnings-to-growth (PEG) model, where the PEG ratio can be defined as:

$$PEG = \frac{P/E}{LTG} \qquad (1)$$

where P/E is the forward P/E ratio and LTG is the analyst's projection of long-term annual earnings growth. He founds that valuation estimates based on the PEG model are positively related to recommendations, which indicates that forecasted earnings capture risk.

Since most researches focus on the US market, Schreiner and Spremann (2007) investigated the empirical accuracy of multiple valuation among European companies and aim to examine three hypotheses regarding this valuation method. (1) Equity value multiples outperform entity value multiples in valuation accuracy. (2) Knowledge-related multiples, which are multiples based on earnings figures complemented with 'knowledge costs' like research and development expenditures and amortization of intangible assets, outperform traditional multiples in science based industries and (3) Forward-looking multiples outperform trailing multiples. Schreiner and Spreman included knowledge-related multiples in their research because they argue that research and development is a major indicator of productivity. These hypotheses are being examined using simple multiple valuation, which means that each multiple is tested separately.

All three hypotheses have been approved by this research. The result of hypothesis 1 can be based on the uncertainty in the estimation procedure of the enterprise value, which distorts the reliability of enterprise value multiples. Hypothesis 2 can be justified by the argument stated above. But this hypothesis is only valid for science-based industries. The insurance sector cannot be categorized to these industries.

In a second research Liu, Nissim and Thomas (2007) researched valuation performance of earnings multiples compared with multiples based on two measures of cash flows; operating

cash flows and dividends. In their research from 2002, Liu et al. found that multiples based on reported earnings outperform multiples based on operating cash flow measures.

In this paper they include some extensions under which: (1) Forecasting numbers rather than reported numbers and (2) Dividends instead of operating cash flows. These extensions have been made because reported operating cash flows often reflect non-recurring payments or receipts and because dividends may be used by management as a signaling device to convey private information. Disadvantage of this extension is that not all companies pay out dividends.

They found that earnings outperform both operating cash flows and dividends in valuation accuracy in all extensions stated in their paper. Forecasting operating cash flows numbers improve the accuracy of value estimates, earnings forecasts performance improves to an even greater extent. Also when dividends are used instead of operating cash flows, earnings multiples are more accurate.

Deng, Easton & Yeo (2009) researched the valuation for firms where firm-specific detailed projections are difficult, like privately-held companies, start-ups and growth firms. This covers predominantly the same group of firms Kim and Ritter (1999) researched. As said before IPO firms are commonly young firms with high growth. This paper closely follows Liu et al. (2001) in its methodology but there are some essential differences between these articles. First, Deng et al. focused on historical based multiples only; this enables them to analyze a larger dataset. Second, they included firms with negative value drivers, which is remarkable since negative value drivers are normally excluded in multiple valuation because they are useless. The results of Deng et al. differ significantly of Liu et al. Where price-to-sales is often the worst performing multiple, Deng et al. found that compared to multiples based on historical value drivers, the sales multiple have smaller valuation errors. Second, earnings multiples do not outperform book value multiples.

Others who examined the valuation accuracy of multiples are Fernandez (2001) and Lie and Lie (2002). Fernandez tested the 14 most popular multiples by analysts, based on a Morgan Stanley Dean Witter Research, on their dispersion. He concludes that multiples almost always have broad dispersion.

Lie and Lie (2002) compared the performance of ten multiples by estimating equity and enterprise values. Among these multiples there are four multiples which are adjusted on cash and cash equivalents. This is excluded from the value drivers of these enterprise value multiples, since cash and cash equivalents are easy to value because book and market value should be equal. So, companies with a large amount of cash will be undervalued, because earnings and sales multiples yield the same value regardless of the cash level. Adjusting these multiples, however, do not improve the valuation accuracy of the estimates. Also Lie and Lie found that forward earnings multiples result in more accurate estimates than historical earnings figures and that the asset value multiple results in more precise and less biased estimates, which implies the importance of company size; larger companies provide more accurate valuations.

Besides the research to the P/E ratio and the valuation accuracy of several multiples, there is research to the valuation method itself. Baker and Ruback (1999) researched two implementation challenges of multiple valuation; (1) determining the basis of substitutability, which is basically the value driver of a multiple, such as net income, earnings before taxes or book value of equity. The second (2) implementation challenge is how to measure the industry multiple.

They considered four possible methods; simple mean, value-weighted mean, median and harmonic mean. While the simple mean and median are common used in practice, Baker and Ruback found that the harmonic mean is the best measure of multiples. In every industry the harmonic mean yields a lower value than the simple mean, which implies that the simple mean overestimates value.

To answer the first implementation problem, Baker and Ruback focused on the dispersion of the multiples. A narrow distribution for firms within an industry around the harmonic mean indicates a common value driver across firms in the industry. So the value driver should be selected by choosing the measure that minimizes the dispersion across multiples within an industry. They show that the basis of substitutability varies across industries.

Henschke and Homburg (2009) attempt to explain variations in value estimates by analyzing differences in underlying value drivers. All methods they investigated for controlling for differences lead to improvements in the valuation accuracy. Furthermore, they found that the

optimal multiple valuation method is a hybrid approach of selecting peers, use a set of financial ratios and adjust the valuation multiple for difference in the underlying value drivers.

Wu (2009), at last, examined the relation between forward P/E ratio and subsequent realized earnings growth. He states that if investors have appropriate expectations of earnings growth and correctly value future earnings, the forward P/E ratio will have a positive relation with realized earnings growth in subsequent periods. He finds that the forward P/E ratio has a stronger relation with subsequent sales growth than with earnings growth; it is only positively correlated with long term earnings growth, while the forward P/E ratio is positively correlated with both short-term as long-term sales growth.

2.2 Standardized multiples

To compare the values of "similar" firms in the market, Damodaran (2006) standardized values in some way by scaling them to a common variable. In general, values can be standardized relative to (1) to the earnings firms generate, (2) to the book value or replacement value of the firms themselves, (3) to the revenues that firms generate or (4) to measures that are specific to firms in a sector.

2.2.1 Earnings Multiples

One of the more intuitive ways to think of the value of any asset is as a multiple of the earnings that asset generates. When buying a stock, it is common to look at the price paid as a multiple of the earnings per share generated by the company. This price-to-earnings ratio can be estimated on several ways, namely using current earnings per share, using earnings over the last four quarters (resulting in a trailing P/E) or using an expected earnings per share in the next year (providing a forward P/E).

2.2.2 Book Value Multiples

While financial markets provide one estimate of the value of a business, accountants often provide a very different estimate of value for the same business. The accounting estimate of book value is determined by accounting rules and is heavily influenced by the original price

paid for assets and any accounting adjustments (such as depreciation) made since. Investors often look at the relationship between the price they pay for a stock and the book value of equity (or net worth) as a measure of how over- or undervalued a stock is; the price-to-book value ratio that emerges can vary widely across industries, depending again upon the growth potential and the quality of the investments in each.

2.2.3 Revenue Multiples

Both earnings and book value are accounting measures and are determined by accounting rules and principles. An alternative approach, which is far less affected by accounting choices, is to use the ratio of the value of a business to the revenues it generates. For equity investors, this ratio is the price-to-sales ratio, where the market value of equity is divided by the revenues generated by the firm. This ratio, again, varies widely across sectors, largely as a function of the profit margins in each.

The advantage of using revenue multiples, however, is that it becomes far easier to compare firms in different markets, with different accounting systems at work, than it is to compare earnings or book value multiples. The disadvantage of this multiple is that revenues do not say anything about the performance of a company, while the performance have a great influence on the market value of a company.

2.2.4 Sector-Specific Multiples

While earnings, book value and revenue multiples are multiples that can be computed for firms in any sector and across the entire market, there are some multiples that are specific to a sector. The internet industry in the later 1990s, for example, had often negative earnings. Analysts searched for other value drivers to create multiples and used the number of hits generated by that firm's web site. Firms with lower market value per customer hit were viewed as undervalued.

Damodaran emphasizes that these kind of multiples are dangerous for two reasons. First, they cannot be calculated for other industries, so these multiples can over- or undervalue an entire market. Second, it is far more difficult to relate sector-specific multiples to fundamentals, which is essential to use multiples well. For instance, does a visitor to a company's web site

translate into higher revenues and profits? The answer will not only vary from company to company, but will also be difficult to estimate looking forward.

The insurance market however is a well developed and major market where the possibility of over- or undervaluation relative to the total market is very small. As Kaplan and Ruback (1995) confirm in their paper, multiples based on performance measures (value drivers) that are actually proportional to value improves the accuracy of estimates of the market value of equity. In the case of insurance companies the accuracy of the valuation estimate overrides the very small possibility of over- or undervaluation. The second problem can be avoided by taking financial multiples that are sector-specific and are related to fundamentals. Using sector-specific wisely makes them valuable multiples.

Schreiner (2007) and Schreiner and Spremann (2007) create several multiples to search for the most accurate multiple. They divide those multiples in five categories: (1) Accrual flow multiples[2], (2) Book value multiples, (3) Cash flow multiples, (4) Alternative multiple (derivative of sector-specific multiples) and (5) Forward-looking multiples. These multiples are displayed in figure 1.

2.3 Advantages/Disadvantages of multiple valuation

As mentioned before valuation using multiples is widely used for business valuation. There are several reasons for this stated in academic literature. First, a discounted cash flow (DCF) valuation requires many more assumptions than multiples; therefore multiple valuation is easier to communicate to outsiders. According to Liu, Nissim and Thomas (2001) this is the main reason for using multiples; this method is simple to comprehend and the additional complexity associated with including an intercept may exceed the benefits of improved fit.

Second, relative valuation asserts less time and resources than a DCF approach. Due to this external users like analysts will use more often multiple valuation and discounted cash flow valuation is preferred in corporate finance and mergers and acquisitions activities. Third, multiple valuation gives a better representation of market perspectives, since it uses market prices of comparable companies which implicitly contain current market information. The

[2] At this point academics have a discrepancy, since Schreiner includes in this figure P/EBITDA, while Damodaran argues that this multiple is inconsistently defined; EBITDA is an enterprise value denominator and price is an equity value numerator

forth advantage of multiple valuation is that they are less manipulative than discounted cash flow valuation. This is indirectly a consequence of the first reason, since DCF valuation needs more assumptions which can be manipulated more easily.

Furthermore, multiple valuation has some pitfalls which are related to the advantages of this valuation method. Since multiple valuation uses comparable companies for valuation, an imperfect composition of the set of comparable companies possibly results in inconsistent value estimates. Second, multiple valuation is dependent of the valuation of comparable companies by the market. Therefore, when the market is overvaluing comparables, multiple valuation will result in estimates that are too high.

There are also some technical issues that arise with multiple valuation. One of the problems is that comparable firms might have different fiscal year ends, which can cause inconsistent measures when current P/E multiples are being used. Another problem are the differences in accounting numbers that can arise through differences in accounting standards. This probably leads to different earnings measures, which lead to incorrect P/E ratios.

UBS Warburg described the main advantages and disadvantages of multiple valuation which are described in figure 2.

Figure 2: Advantages/Disadvantages multiples

Advantages	**Disadvantages**
• Useful – multiples can be robust tools that provide useful information about relative value	• Simplistic – combine many value drivers into a point estimate. Difficult to disaggregate the effect of different value drivers
• Simple – ease of calculation and wide availability of data make multiples an appealing method for assessing value	• Static – Multiples measure value at a single point in time and do not fully capture the dynamic nature of business and competition
• Relevant – Multiples are based on key statistics that investors use	• Difficult to compare – Multiples differ for many reasons, not all relating to true differences in value. This can result in misleading 'apples-to-oranges' comparisons among multiples

Source: UBS Warburg

2.4 Application of multiple valuation

According to the proposed new international valuation standards from the International Valuation Standards Council, multiple valuation compares the subject business to similar businesses, business ownership interests and securities that have been exchanged in the market. This concept basically consists of four steps. In academic literature[3] these steps are formulated slightly different, but in the essence they are the same.

Step 1: Selection of value relevant measures

The first step of the multiple valuation method is determining the value measure which is going to be used. Since this paper aims at finding the percent pricing errors of the equity value (share price/market capitalization), it will focus on equity value multiples only. The most widespread equity value multiples are the P/E, P/BV, P/S, and P/OCF multiple, which scale the market price of common equity by the most important summary numbers in the financial statements – net income, book value of common equity, sales or revenues, and cash flow from operating activities. Besides these multiples, there are several other multiples that are useful in multiple valuation like forward-looking multiples. As mentioned in the previous section forward earnings multiples are more accurate than historical based multiples.

According to Damodaran (2006), it is important to keep an eye on the consistency of the multiple that is going to be used. The basic rule of consistency is: *If the numerator for a multiple is an equity value, then the denominator should be an equity value as well. If the numerator is a firm value, then the denominator should be a firm value as well*. Price-to-EBITDA (Earnings before interest taxes depreciation and amortization) is an example of an inconsistent multiple. When this multiple is used in multiple valuation and some firms on the list have no debt and others carry significant amounts of debt, the latter will look cheap on a price to EBITDA basis, when in fact they might be over or correctly priced.

In addition, a practitioner of multiple valuation has to be aware of the cross sectional distribution of the multiple. This has to ensure that multiples are measured the same under all companies covered. Problems like different fiscal-years ends and different accounting standards can have a negative impact on the uniformity of multiples. This paper avoids both of the problems mentioned here. All comparable companies that are going to be researched

[3] Damodaran (2006), Schreiner and Spremann (2007) and Schreiner (2007)

are European insurance companies. All firms use therefore the IFRS accounting standards and have fiscal year-ends on December 31.

Step 2: Identification of comparable companies

The peer group of a company is a group of comparable companies which is used to measure the multiple that is used to calculate the value of another firm. Baker and Ruback (1999) state that if a genuinely comparable publicly traded firm is available and if the multiple could be estimated reliably, the method of multiples would be clearly superior to discounted cash flow analysis. Selecting the right set of comparable companies can greatly improve the accuracy of this valuation method. Bhojraj and Lee (2001) researched in their paper the selection of comparable companies on the basis of profitability, growth, and risk characteristics that theory suggest should be cross-sectional drivers of a particular valuation multiple. They find that comparable firms selected using that method offer sharp improvements over comparable companies selected on the basis of other techniques, including industry and size matches. Alford (1992) found that selecting comparable companies on the basis of industry is relatively effective, selecting comparable companies when risk and earnings growth are used together result in similar accuracy.

Step 3: Estimation of synthetic peer group multiples

After the identification of the peer group and the computation of peer group multiples, step 3 involves the aggregation of the multiples into single numbers through the estimation of peer group multiples, the synthetic peer group multiple. For this estimation, statistics provide several methods. Possible multiple measures are the arithmetic mean, median and harmonic mean.

The arithmetic mean is the most common used multiple measure, however this statistical measure is heavily affected by outliers. When the distribution of multiples of the peer group is right skewed, the median will provide always lower values than the arithmetic mean, which will lead more accurate value estimates.

Several academics[4] proved that the harmonic mean gives the most accurate value estimates of equity value. Baker and Ruback showed that the superiority of the harmonic mean is also

[4] Liu et al. (2001), Baker and Ruback (1999) and Yoo (2006)

economically reasonable. The harmonic mean effectively averages the yields, which are the inverse of the multiples. By averaging the yields, the harmonic mean gives equal weight to equal dollar investments. The arithmetic mean is influenced substantially by firms that have unusually high P/E ratios, possibly due to a temporarily low value of earnings; the harmonic mean is not skewed as much by such firms since the P/E ratios are first inverted (Liu et al., 2007). Because the simple mean is always greater than the harmonic mean, using the simple mean instead of the harmonic mean will consistently over-estimate value.

Step 4: Actual valuation

The actual valuation takes place in the final step. For equity value multiples, the value of common equity, $p_{i,t}^{equity}$ of firm *i* can be calculated directly by multiplying the synthetic peer group multiple, $\lambda_{c,t}^{equity}$ by the corresponding value driver $x_{i,t}$ of firm *i*.

$$p_{i,t}^{equity} = \lambda_{c,t}^{equity} * x_{i,t} \qquad (2)$$

In this equation, *t* denotes time. This denomination requires that both the synthetic peer group multiple and the value driver refer to the same point in time or time horizon.

When applying step four of multiple valuation, it is important to understand the outcomes of the multiple (Damodaran, 2006). When an analyst wants to give an advice to buy, hold or sell a share, it needs to know what value of a multiple is high or low. Therefore it needs to know the market and the distributional characteristics of the multiple. Particularly the price-earnings multiple has problems with its distribution. Earnings vary significantly over time and are negative on a regular basis, especially in years of economic downturn.

3. Literature review of insurance companies

As mentioned in the previous section the insurance market differs substantially from industrial markets. Unlike industrial companies, insurers do not invest now to gain cash inflows later. Instead they do this because it is an integral part of their business model. Insurers borrow money (premiums) by issuing debt in the form of insurance policies that pay the lender (policyholder) financial compensation if a pre-specified uncertain event occurs. The payments the insurer agrees to make are commonly uncertain with respect to timing and size.

3.1 Business Model

Hancock, Huber and Koch (2001) describe how insurers create value. To produce insurance contracts, insurers rely on diversification and financial markets. By pooling contracts that are not perfectly correlated, aggregate losses become more predictable. By investing part of the premiums they receive, insurers are able to generate future cash flows needed to pay the expected claims.

Shareholders of insurance companies provide risk capital that is invested on their behalf in financial assets. Insurers are considered to be liability-driven financial intermediaries which underwrite insurance policies and use financial markets to bridge the gap between today's premiums and tomorrow's claims.

Like banks insurance companies hold risk capital. While pooling reduces uncertainty, unexpected losses may still arise, thereby jeopardizing the insurer's ability to meet its obligations. This is a concern for policyholders and regulators especially since insurance is usually purchased to transfer unwanted risk. Unlike bondholders who can reduce their credit risk exposure by holding a well-diversified portfolio of bonds with various issuers, policyholders can't generally mitigate insurance default risk in a cost-efficient way. For this reason policyholders tend to accumulate their credit exposure with one or a few insurers and are particularly sensitive to the financial strength of the insurer. Financial strength is determined by rating agencies and regulators.

The Economic Capital Subgroup of the Society of Actuaries Risk Management Task Force describes three main approaches that are used by insurance companies to decide how much capital they require:

1. Economic capital – Is capital that is derived from explicitly stated financial objectives or constraints which are proprietary to the company's risks.

2. Regulatory capital – Is a minimum established explicitly by the regulatory agencies that hold jurisdiction where the company has major operations.

3. Rating agency capital – Is a prescribed formula which, mainly, determines the company financial strength ratings assigned by such organizations as Moody's and Standard and Poor's.

All three approaches focus on policyholder protection. Regardless of their preferred measure of required capital, insurance companies have to ensure that they have adequate regulatory capital and maintain their credit rating. In practice, many companies will therefore calculate required capital using all three of the approaches described.

3.2 Life versus non-life insurance

Life and non-life are the two main business models in the insurance industry, both with their unique structure of cash flows and with large differences in duration for assets and liabilities. Substantial differences can be identified comparing life and non-life. The insurers' liabilities as well as the structure of the assets depend on the line of business considered with respect to duration, the amount of the risk, and risk determining factors. Life insurance is a long-term business involving a long planning horizon. The longer the time horizon the more important is the interest component (since the provisions are discounted future expected claims). For this reason the interest rates as well as products options embedded in life insurance contracts (such as minimum interest rate guarantees) are of central concern to life insurers. The long-term orientation within life insurance products will lead to a very robust structure of liabilities.

Non-life insurance is much more short-term oriented than life insurance although there are also long tail lines of business with substantial time periods between premium and claim payments. The duration is about two years for short tail business such as property insurance where claims are usually made during the term of the policy or shortly after the policy has expired. In long tail lines such as third party liability or motor third party liability the duration can be about 6 to 7 years. Claim distributions are much more volatile than benefits to life insurance policyholders, especially in lines of businesses that are exposed to catastrophes. In these lines of business underwriting risk exhibits an extremely higher dynamic and uncertainty compared to life insurance. A good example in this context is storm insurance, which typically has a very low number of claims in most years. However, in some years storms result in a high number of claims so that storm insurers have to set up adequate reserves (equalization reserves) in good years to be paid to policyholders in years with big storms. Modeling of catastrophes is thus an important issue in non-life, while product options in contracts are hardly relevant. Although the contracts are set up for one year, the yearly policy renewal is very common. The structure of liabilities in non-life is characterized by a very high fluctuation due to a short-term orientation within non-life insurance products.

Unlike non-life insurance, where a payment is linked to a concrete claim event and thus depends on the distribution and severity of claims, benefits to policyholders mainly depend on biometric risks, investment returns and cancellation of the policyholders. Life insurers have precise estimates of mortality rates so that the prediction risk and uncertainty is lower. It can be concluded that market risk is the most important type of risk with life insurers whereas in non-life, especially with respect to portfolios mainly based on catastrophe risk, underwriting risk is often more important than market risk.

3.3 Identification of value drivers

In reaching the optimal value estimate of the equity value of insurance companies a thorough understanding of the value drivers of insurance companies is required. To identify these value drivers, the business model of an insurance company is going to be analyzed. As mentioned before the business model of insurance companies differs significantly from industrial companies, which results in different key performance indicators that drives value. To identify the value drivers of a company, the profit and loss statement has to be decomposed.

A value tree is a useful tool to map the value drivers of insurance companies. This strategic analysis aims to divide the overall objective (profitability measure) of a firm in sub-objectives (value drivers) which determines the overall objective. This occurs according to the Mutually Exclusive and Collectively Exhaustive (MECE) principles, which basically implies that the choice of sub-objectives should cover the complete overall objective (collectively exhaustive) and do not have any overlap (mutually exclusive). This method enables a company to break down every value driver into a lower level of value drivers. Figure 3 shows the value tree of an insurance company.

Return on Equity is the most used and best known profitability ratio in economics and is a good performance indicator that can be used to compare different companies. Therefore this profitability measure is the basis of this value tree and is derived in five steps[5] to its value drivers. The last box of each ramification (green framed) shows a standardized value driver, where (almost) no adjustments have been made between different companies.

Gross written premiums are the actual funds received form policyholders in a period. UPR (Unearned Premium Reserves) is the amount of premiums written that are not earned yet. The difference between year t and t+1 is stated in the profit and loss statement. Reinsurance is the amount of premiums that an insurer has ceded to reinsurance companies in order to manage their risk. Gross written premium minus the change in unearned premium reserves and the reinsured amount is equal to net earned premiums.

The net claims ratio is the amount of claims paid to policyholders as a percentage of net earned premiums. The acquisition cost ratio is the expense of selling insurance contracts as a percentage of net earned premiums. This includes costs as agent's commissions, underwriting expenses and marketing costs. Administrative cost ratio is the amount of all administrative costs as a percentage of net earned premiums and other technical items ratio includes all other technical expenses as a percentage of net earned premiums. The combined ratio is the aggregate of these items.

[5] There is a possibility to derive also the last column, however, due to a lack of information disclosure, these numbers are not available for all companies

4. Research Design

4.1 Methodology

This paper aims to improve the accuracy of the multiple valuation method in estimating the market value of equity of insurance companies. Market value can be defined as *the estimated amount for which an asset should exchange on the date of valuation between a willing buyer and a willing seller in an arm's length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion.*[6] In order to get to the market value of equity, the four steps of Schreiner and Spremann described in section 2 will be followed.

First, the value measure has to be determined. For the calculation of the market value of equity, the market capitalization[7] or the share price (in case when the value driver is on a per share basis) will be used. The denominator of the multiples will be different for each multiple, however the basic formula of equity value multiple $\lambda_{i,t}^{equity}$ will be the same:

$$\lambda_{i,t}^{equity} = \frac{P_{i,t}^{equity}}{x_{i,t}} \qquad (3)$$

where $P_{i,t}^{equity}$ is the current market value of common equity and $x_{i,t}$ is the underlying value driver of firm *i* at time *t*.

Step 2 identifies the peer group that will be researched. This paper concentrates on the European insurance market. To ensure that the information availability is sufficiently, only insurance companies with a market capitalization of at least EUR 1 billion will be taken in consideration. This leads to a comparable set of 29 insurance companies. The set of comparable companies can differ between the hypotheses when information is unavailable to test that particular hypothesis. Companies where information is not available will be eliminated from the research.

[6] This is the definition stated by the International Valuation Standards Council. An extensive explanation of this definition is attached in Appendix A

[7] The end of year share price multiplied by the shares outstanding

Step 3 aggregates the individual multiples calculated in the first step into a single number. There are several statistical measures that can be used to calculate this number, like the mean, median and harmonic mean. As discussed before, this research will use the harmonic mean to calculate the firm multiple. The harmonic mean *H* can be calculated by dividing the number of firm multiples, *n,* by the inverse of each equity value multiple, $x_1, x_2, \ldots, x_n$:

$$H = \frac{n}{\frac{1}{x_1}+\frac{1}{x_2}+\frac{1}{x_3}+\cdots+\frac{1}{x_n}} \tag{4}$$

The last step is calculating the value estimate of the market value of equity. This is easily done by multiplying the harmonic mean $\hat{\lambda}_{c,t}^{equity}$ of all equity multiples of the set of comparable companies (synthetic peer group multiple) by the concerning value driver $x_{i,t}$:

$$\hat{P}_{i,t}^{equity} = \hat{\lambda}_{c,t}^{equity} * x_{i,t} \tag{5}$$

The valuation accuracy of $\hat{P}_{i,t}^{equity}$ can be evaluated by calculating scaled absolute valuation errors:

$$\left|\frac{e_{i,t}}{P_{i,t}^{equity}}\right| = \left|\frac{\hat{P}_{i,t}^{equity} - P_{i,t}^{equity}}{P_{i,t}^{equity}}\right| \tag{6}$$

To compare the performance of different multiples in terms of valuation accuracy, the mean and median of all valuation errors will be calculated. To make them comparable to prior research like Yoo (2006) and Schreiner (2007), the fraction of absolute valuation errors below 15 percent of observed market values will be measured as well. Any performance indicator is first calculated for each year. Then, the yearly numbers are aggregated using the average.

4.2 Hypotheses

4.2.1 Sector-Specific Multiples

In most academic research, equity valuation is measured across several industries with common multiples, like P/E, P/BV or P/S multiples. However, there are some academics who discuss the presence of sector-specific multiples. Schreiner (2007) states that the majority of

firms practice earnings guidance, whereas investment and dividend policies, which affect the level of free cash flow and dividends, the most prominent measures of cash flow, differ significantly across firms. Hereby P/E multiples are measured differently and will result in less accurate estimates.

In addition, there is also the possibility of negative numbers with cash flow measures. Frequently, firms in young or cyclical industries have negative or only meager profits. In a situation where the target firm or several firms within the peer group make (net) losses, the P/E multiple cannot be used. To avoid this problem one have to move upwards in the income statement to identify an appropriate accrual flow measure. The problem with moving upwards in the income statement is that with every step, valuable information is left out.

Besides the income statement, the balance sheet can provide additional information on a firm's value, which measures of accrual flow do not capture. Especially for firms in capital intensive industries (e.g. oil & gas, utilities and financials), the book value multiple can be useful. Because firms in the financial industry (like insurers and other investment firms) face comprehensive fair value accounting regulations, applying book value multiples makes sense.

Damodaran (2006) warns for pitfalls of using sector-specific multiples. They cannot be calculated for other industries, so these multiples can over- or undervalue an entire market and it is far more difficult to relate sector-specific multiples to fundamentals, which is essential in using multiples well.

As the value tree in section 3 shows, the technical result is a large driver of profit before tax and therefore of net income. The technical result on insurance activities is formed by the net earned premiums (NEP) minus net claims. These numbers are available for all insurance companies and are good performance indicators, so a measure based on net earned premiums-net claims will probably be a multiple that indicates value well and will therefore be included in this analysis.

Despite the pitfalls mentioned by Damodaran, sectors-specific multiples can be very useful for insurance company valuation. The insurance market is a well developed and major market where the possibility of over- or undervaluation relative to the total market is very small. In

addition, when sector-specific multiples are only based on financial fundamentals, these pitfalls can be avoided.

Because sector-specific multiples have several advantages and the exposure of undervaluation is very small, these kind of multiples are justified for being used in multiple valuation. This leads to hypothesis 1:

H1: Sector-specific multiples outperform common used multiples on the valuation accuracy of estimating the equity value of an insurance company.

4.2.2 Sum-of-the-Parts Valuation

As mentioned in section three, the non-life and life insurance business lines are very different from each other. Life insurance is a long-term business involving a long planning horizon. Since insurance companies have longer access to the premiums policyholders pay, the investment behavior of insurance companies is an important component of life insurance business.

In the recent financial crisis the financial market collapsed, whereby the investments of insurance companies extremely decreased in value. Every insurance company had to take losses on the fair value of its financial assets, which led to very low or even negative earnings figures of these companies. Non-life insurance on the contrary is less affected by the consequences of the financial crisis. This is showed in the fragments of the income statements of Helvetia, a Swiss insurance company, and Allianz from Germany. These firms cover both life and non-life insurance products. The losses on investments of life insurance business in 2008 are significantly greater than the losses on non-life insurance business:

Figure 4: Income statement of Helvetia and Allianz

in CHF million	Life 2009	Life 2008	Non-life 2009	Non-life 2008
Income				
Gross premiums written	3 676.5	3 061.1	2 386.5	2 351.1
Reinsurance premiums ceded	–60.1	–55.0	–319.2	–265.6
Net premiums written	3 616.4	3 006.1	2 067.3	2 085.5
Net change in unearned premium reserve	0.9	1.0	–38.2	5.7
Net earned premiums	3 617.3	3 007.1	2 029.1	2 091.2
Interest and dividend income	689.0	643.7	106.7	124.6
Gains and losses on investments (net)	259.2	–807.6	14.3	–153.5
Income on investment property	208.6	312.5	13.9	12.2
Other income	45.3	37.0	20.7	26.6
Total operating income	4 819.4	3 192.7	2 184.7	2 101.1

Source: Helvetia annual report 2009

	Property-Casualty 2009 € mn	Property-Casualty 2008 € mn	Property-Casualty 2007 € mn	Life/Health 2009 € mn	Life/Health 2008 € mn	Life/Health 2007 € mn
Total revenues [1)]	42,523	43,387	44,289	50,773	45,615	49,367
Premiums earned (net)	37,828	38,213	38,553	22,029	22,231	20,809
Interest and similar income	3,612	4,477	4,473	13,971	13,772	13,417
Operating income from financial assets and liabilities carried at fair value through income (net)	118	9	178	716	(309)	(1,135)
Operating realized gains/losses (net)	57	37	46	1,755	874	3,579
Fee and commission income	1,075	1,247	1,178	491	571	701
Other income	19	271	122	17	140	182
Claims and insurance benefits incurred (net)	(26,320)	(25,986)	(25,485)	(19,326)	(19,673)	(17,637)
Change in reserves for insurance and investment contracts (net)	(355)	3	(339)	(8,299)	(5,122)	(10,268)
Interest expenses, excluding interest expenses from external debt	(104)	(295)	(402)	(127)	(283)	(374)
Loan loss provisions	(18)	(17)	(6)	(75)	(13)	3
Operating impairments of investments (net)	(75)	(437)	(67)	(1,663)	(5,747)	(824)
Investment expenses	(238)	(254)	(300)	(622)	(583)	(640)
Acquisition and administrative expenses (net), excluding acquisition-related expenses	(10,540)	(10,478)	(10,631)	(5,798)	(4,391)	(4,591)
Fee and commission expenses	(995)	(1,141)	(967)	(246)	(253)	(209)
Operating restructuring charges	—	—	—	(15)	1	(16)
Other expenses	—	(2)	(13)	—	(7)	(2)
Reclassification of tax benefits	—	—	—	—	—	—
Operating profit (loss)	4,064	5,647	6,340	2,808	1,208	2,995

Source: Allianz annual report 2009

As can be seen the losses on investments are much higher for life insurance than it is for non-life insurance. Therefore, when the value of insurance companies is estimated using multiples that cover life and non-life insurance business, companies with predominantly life insurance business will have very high multiples while companies with predominantly non-life insurance have compared to life insurance companies lower multiples and will therefore be undervalued. From this analysis the second hypothesis can be formulated:

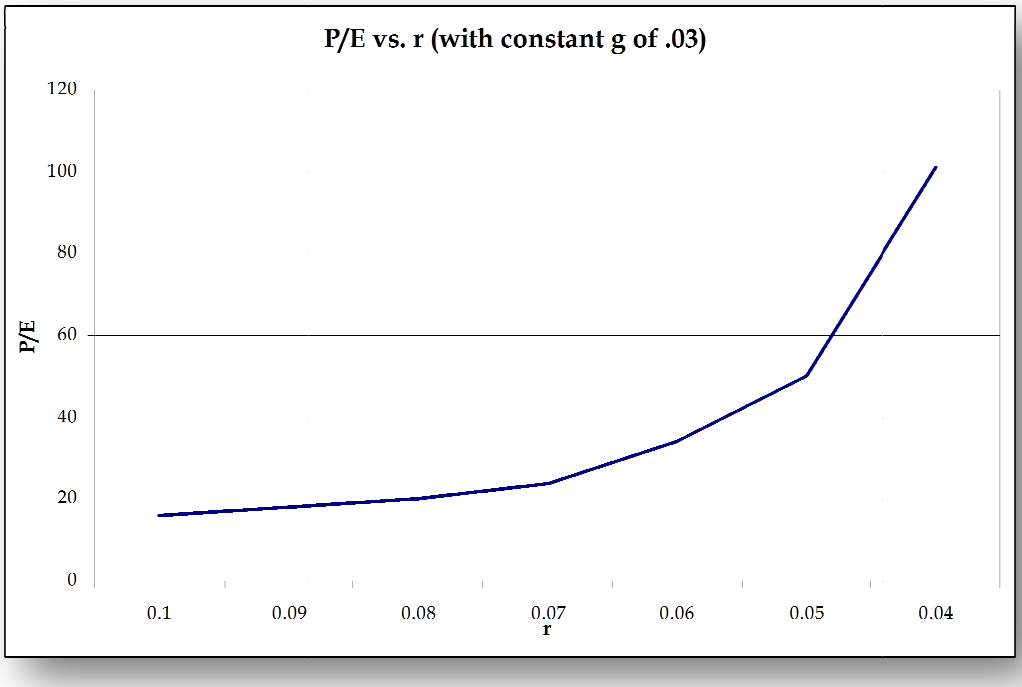
H2: Using a sum-of-the-parts multiple valuation increases the valuation accuracy of value estimates of the equity value of an insurance company.

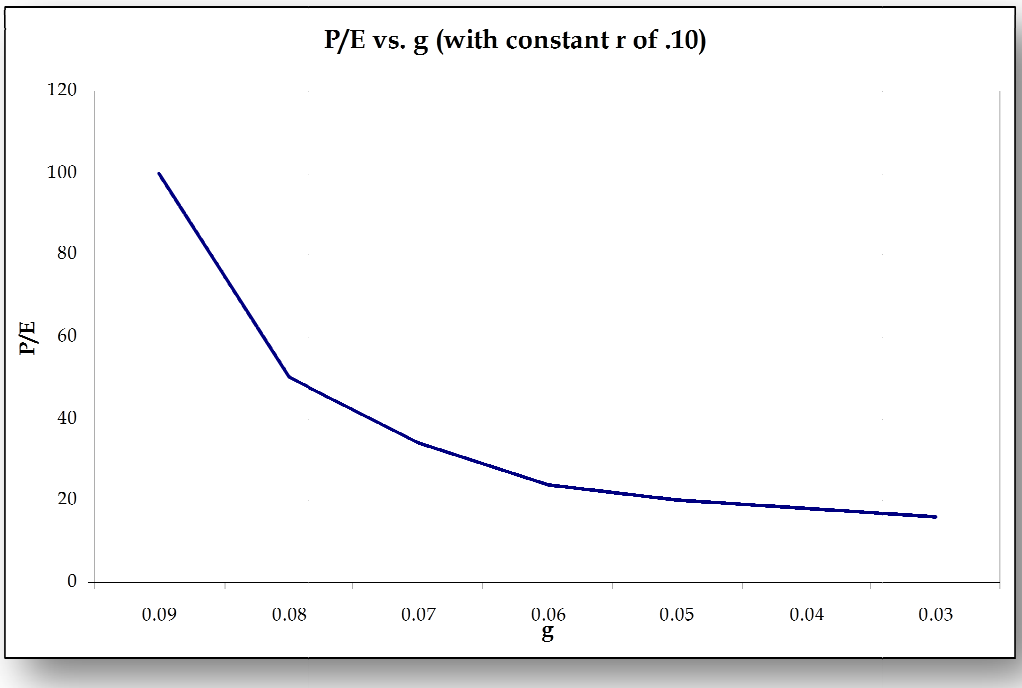
4.2.3 Multiples based on nonlinear regression

Prior literature as Penman (1997), Yoo (2006) and Schreiner (2007) discussed the use of regression in equity valuation using multiples. They found that using regression improves the valuation accuracy of multiple valuation. Regression analysis has some advantages over calculating the (harmonic) mean of the multiples of a set of comparable companies: first, the output of regression gives a measure of how strong the relationship is between the multiple and the variable being used and second, regression can be extended to allow for more than one dependent variable. However, all researches applied only linear regression models.

Although linear regression improves the valuation accuracy it is surprisingly that non-linear regression is hardly used. Several academics state that the relationship between a multiple and its value driver is not linear. Damodaran (2006) named, for instance, the price-earnings-growth (PEG) ratio, which is the ratio of the P/E to the expected growth rate of a firm and widely used to analyze high growth firms. This ratio implicitly assumes that P/E ratios and expected growth rates are linearly related. Like Wu (2009), Ely et al. (2007) show that this relationship is non-linear (Figure 5).

Figure 5: P/E vs. annualized discount rate (r) and expected annualized growth rate





Source: Ely et al. (2007)

Also Yoo (2006) used regression analysis in order to get simple multiples for equity valuation. Although he used only linear regression for the simplicity (which is one of the reasons for the popularity of multiple valuation), he admits that non-linear regression might improve the valuation accuracy of the simple multiple valuation method. In 2003, Hermann and Richter, studied already an alternative approach of regression analysis that uses logged multiples and fundamentals. This leads to the last hypothesis:

H3: Implied multiples based on a non-linear relationship between the multiple and its companion variable outperforms multiples based on a linear relationship.

4.3 Data and Sample

As mentioned previously, the set of comparable companies to test the hypotheses consists of 29 insurance companies. Although there are some other companies with a market capitalization that exceeds EUR 1 billion, these companies are not included in the comparable set, due to a lack of information availability. The companies used in this research and several descriptive statistics are provided in table 1. There are some companies that satisfy the requirements of the dataset, namely originated in Europe and having a market capitalization of at least EUR 1 million. However these companies, Ageas, Delta Lloyd and Old Mutual, have either a short and turbulent history (Ageas) or are useless due to a lack of information availability (Delta Lloyd, Old Mutual), which leads to the inability of calculating the required multiples. This results in the current dataset, where 29 companies from 11 countries are assembled.

From the table it appears that CNP Assurance is the largest public European insurance company in terms of economic value, while Helvetia is the smallest of this dataset. The dataset has a median market capitalization is EUR 4,814 million, net earned premiums of EUR 19,480 million, annual net income of EUR 1,063 million and a book value of shareholders' equity of EUR 10,708 million.

While the multiples of 2009 are almost all positive, accounting numbers used to measure multiples are frequently negative in 2008. Due to the financial crisis many insurance companies, particularly life insurance made losses. Since negative multiples are useless, the

dataset used to calculate multiples over 2008 is reduced heavily. These multiples tend to be much more volatile than multiples from more stable years. Therefore the market value of equity of insurance companies will be much more difficult to estimate.

In order to examine the hypotheses stated in the previous paragraph, four different sources of financial information will be consulted: (1) analyst forecasts from I/B/E/S, (2) detailed historical company information from Worldscope, (3) historical share prices and indexes from Datastream and (4) extended historical accounting numbers researched from annual reports of the relevant insurance company for the period 2005-2009. In despite of the extended information from the financial databases, there still has to be done intensive research in the annual reports, which is caused by the choice of the hypotheses. For instance sector-specific multiples requires non-standardized information while financial databases are standardized over all different industries.

Table 2 presents the nine multiples that have been used to estimate the equity value of insurance companies. The first three multiples from the table are common used multiples for this valuation method, which are used as comparison for the sector-specific multiples. The price-to-net earned premiums multiple (P/NEP) and the price-to-book value (P/BV) multiple are a combination of common used and sector-specific multiples. Net earned premiums are specifically used in insurance business but technically it is the equivalent of sales or revenues of firms from other markets. Although price-to-book value is normally a common used multiple, in capital intensive markets like the insurance business it is even more applicable, which makes it partly sector-specific. These multiples are included in the analysis to determine if the results of these multiples correspond with the traditional price-to-book value and price-to-sales multiples.

Besides these (common) multiples this research includes four sector-specific multiples. The first sector-specific multiple is the price-to-embedded value multiple. Embedded value is an estimate of the economic worth of a life insurance business, excluding any value, which may be attributed to future new business.[8] Since it estimates the economic value of life insurance business it is a perfect estimator of the market value of equity of an insurance company. The next multiple is price-to-net result on insurance activities (P/NRI), which measures the

[8] The definition of embedded value is provided in Appendix B

revenues minus the costs on insurance contracts. This multiple is included in the analysis since it is a performance measure of insurance activities and makes it possibly a determinant of market value.

The price-to-net income on operations (P/NIO) and the price-to-net result on operations (P/NRO) correct the insurance activities for the return on the investment portfolio of insurance companies. These multiples are included on account of the importance of investments for insurers and particularly life insurers. The P/NRO is the net return on insurance activities (net earned premiums-net claims) added (deducted) by the net investment return, which is the aggregate of investment income and the net gains (losses) on financial instruments at fair value through profit or loss. P/NIO is included to increase positive multiples. Due to the financial downturn, several multiples based on the net result on operations are negative and therefore useless.

For the sum-of-the-parts valuations, sector-specific multiples will be adjusted for the concerning line of business. As mentioned before, P/Emva is the only value measure of life insurance. For non-life business on the other hand four sector-specific multiples will be used to estimate the market value. Since the sector-specific multiples of hypothesis 1 covers both business lines, they have to be adjusted for non-life insurance only. In order to get a total valuation, the value estimates of life and non-life insurance will be multiplied by the weights of these business lines. The weights are calculated by dividing the concerning net earned premiums by the total net earned premiums.

Hypothesis 3 researched the relation between the multiple and its companion variable. The companion variable is the variable that dominates the other variables when it comes to explaining each multiple (Damodaran, 2006). This variable is critical to using multiples wisely in making valuation judgments and can be identified by looking for the variable that best explain differences across firms using a particular multiple. This hypothesis is tested using the three most used multiples, namely P/E, P/BV and P/NEP. These multiples are selected since the availability of these multiples is the highest while adding sector-specific multiples will probably not increase the quality of the results.

5. Empirical Results

Table 3 provides summary statistics of nine multiples used for this research. This table includes common used, sector-specific and a combination of common used and sector-specific multiples. It appears that the mean is always greater than the median and the median exceeds almost always the harmonic mean, which indicates that the multiples are right skewed. This tendency is predictable in multiple valuation, since multiples can reach values from zero to infinite. When the mean is used as measure for synthetic peer group multiple, this would result in a high average. Although the median partly mitigate the problem of positive outliers, the fat tail still influences this statistical measure. The harmonic mean implicitly deals with the outliers of a sample and therefore result in a lower synthetic peer group multiple.

5.1 Sector-specific Multiples

Although the use of sector-specific multiples is discussed several times, these kind of multiples are tested sporadically. Damodaran (2006) argued the use of sector-specific multiples in theory and Schreiner and Spremann (2007) examined knowledge-related multiples, which are partially related to sector-specific multiples.

Table 4 Panel A displays the outcomes of the research to sector-specific multiples. The numbers below ‘ Analysis of absolute valuation errors’ show the median, mean, first quartile and third quartile of the absolute valuation errors of common used and sector-specific multiples are presented. The columns below ‘Fractions’ displays the portion of absolute valuation errors that are below respectively 15 and 25 percent. It appears that the multiple valuation method has difficulties to estimate the market value of equity of insurance companies. Only one multiple yields median absolute valuation errors of less than 25 percent, in contrary to Schreiner and Spremann (2007) where five multiples yield median absolute valuation errors of less than 25 percent. In addition, the fraction of absolute valuation errors within 15 percent of actual market values varies from 15.5 percent to 35.6 percent, where Lie and Lie (2002) have fractions varying from 34.1 to 83.1 percent on large financial companies.

While other studies argue that P/E always outperform other historical multiples like P/BV and P/NEP, these outcomes show that the absolute valuation errors of P/BV and P/NEP are slightly lower than P/E. Although these results are not statistically significant, the P/E ratio is not simply the most accurate historical based multiple. This result supports the reasoning that P/BV multiples are more appropriate to financial companies.

The results of sector-specific multiples are also showed in Table 4. The valuation errors of these multiples are even higher than the valuation errors of the P/E, P/BV and P/NEP multiples. All multiples have higher median absolute valuation errors than 34 percent and only one multiple (P/NRO) has a portion of more than 20 percent of absolute valuation errors below 15 percent.

Panel B presents the t-statistics of sector-specific multiples. Obviously none of these multiples are statistically significant. The sector-specific multiples are compared to P/E and P/EPS1. P/EPS1 even performs statistical significantly better than P/NIO and P/NRI.

It declares that sector-specific multiples have no additional incremental information, useful for the improvement of the valuation accuracy of the total business. This suggests that all operations have influence on the market value of the company, while sector-specific multiples cover, regarding insurance companies, only a portion of the business. These results indicate that hypothesis 1 cannot be confirmed.

5.2 Sum-of-the-Parts valuation

The second hypothesis states that a sum-of-the-parts (SOTP) valuation improves the valuation accuracy of multiples compared to valuations of the total business. There are two lines of business identified in the literature review of insurance companies: non-life insurance and life insurance. In order to test the SOTP valuation, two multiples will be used which will be combined to achieve the total business valuation. Table 9 provides the distribution of non-life insurance of each firm in the dataset. This percentage is calculated by dividing each year's net earned premiums of non-life business by the total net earned premiums of the period 2005-2009.

Embedded value is an economic value measure of the worth of life insurance business. Since this research is aimed at estimating the market value, embedded value is used as the only multiple to estimate the life business of an insurance company. The non-life business is measured using several multiples, which are already used as sector-specific multiples. These multiples are adjusted for non-life business accounting figures.

Table 5 panel A displays the results of the SOTP valuation. This valuation method performs considerable better than valuing the total business at once. Three out of four multiples yield absolute median valuation errors smaller than 25 percent. Also the fraction of valuation errors within 15 percent of actual market values has increased greatly; the lowest rises from 15.5 to 28 percent and the highest from 35.6 to 46.3 percent.

All sum-of-the-parts multiples outperform the other historical multiples. Where the worst median absolute valuation errors of the SOTP multiples is 26.2 percent, the best historic 'all-in-one' multiple have median absolute valuation errors of 31.1 percent. Particularly SOTP P/Emva and P/BV yields very accurate value estimates. With median absolute valuation errors of 18.3 percent, it is almost 13 percent more accurate than the best historic multiple.

As panel B of Table 5 shows, all median and mean absolute valuation errors of sum-of-the-parts multiples compared to sector-specific multiples, except for P/NRI and SOTP P/Emva and P/NRI, are statistically significant. The fraction below 15 and 25 percent are all statistically significant compared to P/Emva, while the fraction below 15 percent of SOTP P/Emva & P/BV (SOTP P/Emva & P/NIO) are statistically significant compared to P/BV (P/NIO).

The results presented in Table 5 prove that sum-of-the-parts multiples exhibit higher valuation accuracy compared to multiples that estimate the value of the total company. This supports the assumption that the business lines of insurance companies should be valued separately; there is not one multiple that covers all incremental information of insurance companies. According to the results of hypothesis 2, sum-of-the-parts multiples do increase the valuation accuracy of value estimates of the equity value of an insurance company.

5.3 Nonlinear regression

Several articles argued the use of nonlinear regression to improve the valuation accuracy of multiples. Damodaran (2006) states that a large number of valuation analyses are based upon the assumption that there is a linear relationship between multiples and fundamentals, while there is often a nonlinear relationship. Henschke and Homburg (2009) imply a nonlinear relation between price-to-value driver ratios and risk, growth and profitability and Hermann and Richter (2003) study an alternative approach that used logged multiples and fundamentals (which assumes a nonlinear relationship).

The relationship is tested on three common used multiples: price-to-earnings multiple, price-to-book value multiple and price-to-net earned premiums (price-to-sales) multiple. Figure 6 shows the multiples and the fundamentals that should affect them. The underlined fundamentals are the companion variables.

Figure 6: Fundamentals determining equity multiples

Multiple	**Fundamental Variables**
Price-to-earnings multiple	Expected Growth, Payout, Risk
Price-to-book value multiple	Expected Growth, Payout, Risk, ROE
Price-to-net earned premiums multiple	Expected Growth, Payout, Risk, Net Margin

Source: Damodaran (2006)

The fundamental variable expected growth is determined by calculating the compounded annual growth rate (CAGR) of the one-year forecasted earnings per share and the two-year forecasted earnings per share from the I/B/E/S database[9]. The CAGR is calculated by the following equation:

$$CAGR = \frac{2\text{-}year\ EPS}{1\text{-}year\ EPS}^{\frac{1}{2}} - 1 \qquad (7)$$

[9] If the earnings forecasts are available, otherwise CAGR is calculated over the actual EPS and the one-year forecasted EPS or two-year forecasted EPS

Return on equity is measured by dividing net income of period *t* by the shareholders' equity of period *t*. Net margin is calculated similarly as the return on equity, only for net margin the net income of period *t* will be divided by the net earned premiums of period *t*.

The relation between the multiples and its companion variable are displayed in figures 7, 8 and 9. It appears that P/BV and P/NEP have a nonlinear relationship with its fundamentals. These figures indicate an exponential relationship between the multiple and its companion variable. However, figure 7 shows that there is not any relation between P/E and its fundamental expected growth. The observations are fully dispersed over the graph, which implies that regression is not useful for this multiple. This contradicts with Beaver and Morse (1978), who found in their paper that earnings growth is a determinant of the P/E ratio. Since regression analysis is useless if there is not any relation between the dependent and independent variable, P/E is excluded from further analysis.

The relations between the multiples and its fundamentals are analyzed by a yearly regression. This is in line with the analysis of hypothesis 1 and 2, where of each separate year the multiples are calculated. This makes the analysis consistent and the outcomes more accurate. The statistics of the linear and nonlinear regression of P/BV versus return on equity and P/NEP versus return on net earned premiums are provided in table 8 and 9. The P/NEP versus return on net earned premiums regression indicates that return on net earned premiums explains the variability of the price-to-net earned premiums multiple very well. The R^2 of linear regression lies in the range of 74.3 percent and 92.5 percent. The R^2 of nonlinear regression varies between 72.6 percent and 85.5 percent, which are both very high percentages. The range of R^2 of the regression of P/BV versus return on equity is for respectively linear and nonlinear 34.8 to 54.3 percent and 24.3 to 48.5 percent, which are still acceptable numbers.

Table 6 Panel A shows the absolute valuation errors of the linear and nonlinear regression method of P/BV and P/NEP. It appears that in both cases the multiple based on nonlinear regression achieves lower valuation errors than multiples based on linear regression. Where the median absolute valuation error of P/BV linear regression is 41.2 percent, the median absolute valuation error of nonlinear regression is 35.5 percent, an improvement of almost six percent. P/NEP regression outperforms P/BV on its valuation accuracy. P/NEP has a median

absolute valuation error of 39.9 percent based on linear regression and nonlinear regression achieves a median absolute valuation error of 26.9 percent, an improvement of 13 percent.

As can be seen from Table 6 Panel B, the mean absolute valuation errors of nonlinear regression are both statistically significant compared to linear regression by using an independent t-test.

Although nonlinear regression does not achieve the same absolute valuation errors as sum-of-the-parts (all SOTP valuations have lower value valuation errors than the best nonlinear regression valuation P/NEP vs. RONEP) it obviously outperforms linear regression.
These results justify hypothesis 3: *Implied multiples based on a non-linear relationship between the multiple and their companion variables outperform multiples based on a linear relationship*.

5.4 Evaluation

This research demonstrates that sum-of-the-parts valuation improves the valuation accuracy of the multiple valuation method and that nonlinear regression outperforms linear regression. Sector-specific do not improve the valuation estimates of the market value of equity of insurance companies. Only the sector-specific related multiples P/NEP and P/BV have slightly lower valuation errors than the P/E multiple. However these improvements are far from statistically significant.

The weak performance of sector-specific multiples can be explained by the fact that insurance companies have more than one business line. Since life and non-life insurance are very different from each other, there is probably not one multiple that covers the total business. This assumption is supported by the results of SOTP valuation. The superiority of this valuation method emphasizes that splitting life and non-life business is crucial to achieve accurate valuation estimates. Moving upwards on the income statement does not have any effect; when focusing on the total business, P/E captures most information of the performance of insurance companies.

Sector-specific multiples do improve the valuation estimates when the business lines are valued separately. Particularly embedded value is an important measure of value for life

insurance business. This is obvious, since it is already an economic value measure and should therefore always be used to value life insurance business. That P/BV outperforms other sector-specific multiples is somewhat more surprising, since it is more axiomatic that income statement multiples are better indicators for performance. However it is in line with prior literature, which states that P/BV is particularly appropriate for capital intensive firms, like insurance companies.

In addition it appears that nonlinear regression outperforms linear regression in terms of mean and median valuation errors. Also this result is not striking, looking at the graphs of the relation between the multiples and value drivers. Except for P/E and expected growth, there is a clearly exponential relationship between P/BV and return on equity and P/NEP and return on net earned premiums. It is on the contrary remarkable that both linear and nonlinear regression perform poorly compared to simple multiple valuation methods.

5.5 Recommendations

Compared to other articles this research has somewhat high absolute valuation errors. The financially turbulent years included in this period probably cause these higher valuation errors. Particularly 2008 and 2009 are difficult years to estimate market value with multiples. In those years earnings are heavily decreased and are therefore close to zero or even negative. This leads to very high (negative) multiples, which make them less suitable (useless) for multiple valuation. When the multiple analysis is performed in financially more stable years, this valuation method would probably achieve more accurate results.

Although sum-of-the-parts valuation achieve high valuation accuracy on the market value of equity of insurance companies, it could be improved even more. Most insurance companies cover besides life and non-life business a third business line: asset management. This line of business manages the investment portfolio of insurance companies. Like life and non-life business, asset management has its own specific multiples. In addition, adding forward-looking multiples to sector-specific and sum-of-the-parts valuation would increase the valuation accuracy of both kinds of multiples as well. These possibilities are still open for further research when more specific information of the company performance and future market trends are available.

Nonlinear regression performed reasonably well on valuation accuracy and performs definitely better than linear regression. P/E versus expected growth was useless in this analysis, since there was no relationship between the multiple and its companion variable. The financially turbulent years may have caused this, 57 percent of expected earnings growth numbers are negative. Usually the majority is positive and expected growth could be related to the P/E multiple. Like sector-specific multiples and SOTP valuation, regression analysis could be improved by adding forward-looking fundamentals to the analysis.

Nevertheless, nonlinear regression would not be recommended for multiple valuation. Multiples are often used because of their simplicity and openness. Applying regression on this method makes it more difficult to comprehend and to justify it. Only when regression yields much more accurate valuation errors, simple multiple valuation or sum-of-the-parts valuation should be preferred above regression analysis.

6. Conclusion

The goal of this paper is to improve the multiple valuation method in order to decrease the absolute valuation errors of valuation estimates of the market value of equity of insurance companies. Three hypotheses are tested for the period 2005-2009 among 29 public insurance companies. The firms are selected on a minimum market capitalization of EUR 1 billion. This paper focuses on the insurance market only, because these firms are very different from traditional firms and therefore need a separate approach for the valuation of equity value.

The multiple valuation method is tested using sector-specific multiples, a sum-of-the-parts valuation and nonlinear regression to imply firm multiples. The results show that sector-specific multiples do not decrease the absolute valuation errors of multiple valuation compared to common used multiples. All common used multiples outperform sector-specific multiples on valuation accuracy.

Sum-of-the-parts valuation on the other hand does improve the valuation accuracy compared to multiples that value the total business. All SOTP valuation errors are smaller than all-in-one valuation errors and statistically significant as well. Also multiples where the relation between the multiple and its fundamental is based on nonlinear regression outperforms multiples where the relationship is based on linear regression. Here the mean valuation errors are also statistically significant.

Multiple valuation performs reasonably well on valuation accuracy with median absolute valuation errors around twenty percent and fractions of errors below 15 percent of almost thirty percent. Although multiple valuation is often considered as a ‘shortcut’ of discounted cash flow valuation, it is a good alternative of that valuation method.

This study could be extended in further research to increase the valuation accuracy of equity valuation. For instance, adding forward-looking multiples in sum-of-the-parts valuation and regression analysis could decrease the valuation errors. Especially equity analysts who have knowledge of the market and a great accessibility to data of the companies can easily improve the valuation outcomes.

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Appendix A: Paragraph 7 of the International Valuation Standard 103

7. The definition of *market value* should be applied in accordance with the following conceptual framework:

a) *"the estimated amount"* refers to a price expressed in terms of money payable for the asset in an arm's length market transaction. *Market value* is measured as the most probable price reasonably obtainable in the market on the date of valuation in keeping with the *market value* definition. It is the best price reasonably obtainable by the seller. This estimate specifically excludes an estimated price inflated or deflated by special terms or circumstances such as atypical financing, sale and leaseback arrangements, special considerations or concessions granted by anyone associated with the sale, or any element of *special value*.

b) *"an asset should exchange"* refers to the fact that the value of an asset is an estimated amount rather than a predetermined amount or actual sale price. It is the price at which the market expects a transaction that meets all other elements of the *market value* definition should be completed on the date of valuation.

c) *"on the date of valuation"* requires that the estimated *market value* is time-specific as of a given date. Because markets and market conditions may change, the estimated value may be incorrect or inappropriate at another time. The valuation amount will reflect the actual market state and circumstances as of the effective *valuation date*, not as of either a past or future date. The definition also assumes simultaneous exchange and completion of the contract for sale without any variation in price that might otherwise be made.

d) *"between a willing buyer"* refers to one who is motivated, but not compelled to buy. This buyer is neither over eager nor determined to buy at any price. This buyer is also one who purchases in accordance with the realities of the current market and with current market expectations, rather than in relation to an imaginary or hypothetical market that cannot be demonstrated or anticipated to exist. The assumed buyer would not pay a higher price than the market requires. The present owner is included among those who constitute "the market".

e) *"and a willing seller"* is neither an over eager nor a forced seller, prepared to sell at any price, nor one prepared to hold out for a price not considered reasonable in the current market. The willing seller is motivated to sell the asset at market terms for the best price attainable in the open market after proper marketing, whatever that price may be. The factual circumstances of the actual owner are not a part of this consideration because the willing seller is a hypothetical owner.

f) *"in an arm's length transaction"* is one between parties who do not have a particular or special relationship, eg, parent and subsidiary companies or landlord and tenant, that may make the price level uncharacteristic of the market or inflated because of an element of s*pecial value*. The *market value* transaction is presumed to be between unrelated parties, each acting independently.

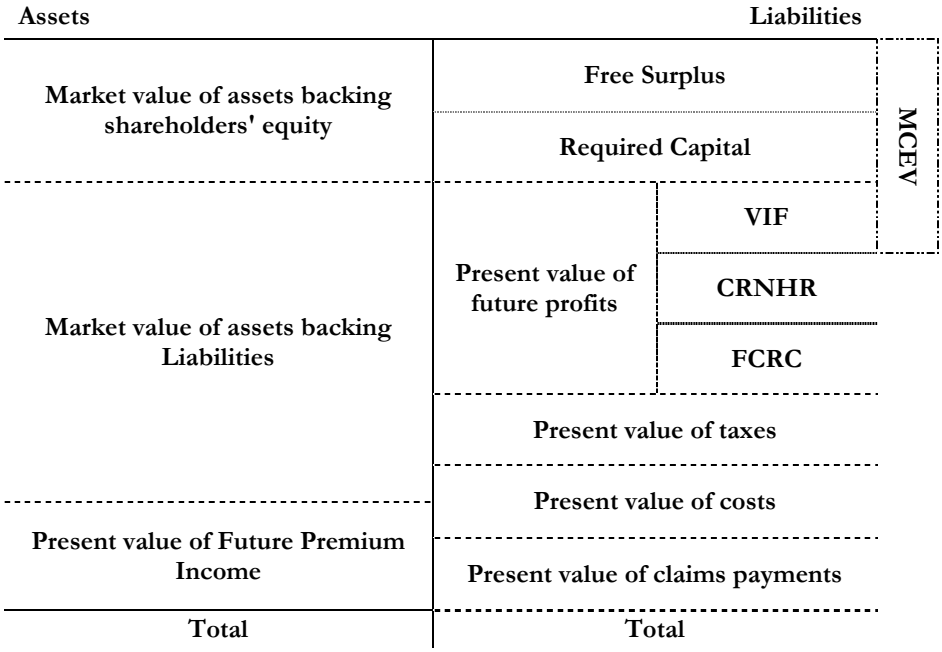
g) *"after proper marketing"* means that the asset would be exposed to the market in the most appropriate manner to effect its disposal at the best price reasonably obtainable in accordance with the *market value* definition. The method of sale is deemed to be that most appropriate to obtain the best price in the market to which the seller has access. The length of exposure time is not a fixed period but will vary according to the type of asset and market conditions. The only criterion is that there must have been sufficient time to allow the asset to be brought to the attention of an adequate number of market participants. The exposure period occurs prior to the *valuation date*.

h) *"wherein the parties had each acted knowledgeably, prudently"* presumes that both the willing buyer and the willing seller are reasonably informed about the nature and characteristics of the asset, its actual and potential uses and the state of the market as of the date of valuation. Each is further presumed to act for self-interest with that knowledge and prudently seek the best price for their respective positions in the transaction. Prudence is assessed by referring to the state of the market at the date of valuation, not with benefit of hindsight at some later date. For example, it is not necessarily imprudent for a seller to sell assets in a market with falling prices at a price that is lower than previous market levels. In such cases, as is true for other exchanges in markets with changing prices, the prudent buyer or seller will act in accordance with the best market information available at the time.

i) *"and without compulsion"* establishes that each party is motivated to undertake the transaction, but neither is forced or unduly coerced to complete it.

Appendix B: Definition of Embedded value

Note: Market consistent embedded value balance sheet. VIF is the value of In-Forced Business, CRNHR are Costs of residual and non hedgeable risks and FCRC are frictional costs of required capital.



Source: Diers et al. (2009)

Embedded Value (EV) is an estimate of the economic worth of a life insurance business, excluding any value, which may be attributed to future new business. The EV is the sum of the value placed on the Shareholders' Equity and the value of the in- force business.

The purposes of performing EV calculations are:

a) To provide information on the value of the Company to analysts and the rest of the investment community.
b) To provide information with which to manage the Company, specifically operations that are creating value or destroying value. Also to provide information on where the value actually resides.
c) To provide information for the determination of the value added by the New Business written during a reporting period.

d) To provide information on risk exposures through the use of sensitivity, stress and scenario tests as well as stochastic measures of risk to the EV of the company. From a risk management perspective, EV can become an important metric that combines the economic impact of many of the risk exposures of a company. For example, through the use of the projection models that are used to derive EV, the impact of various risks can be measured on the economic worth of the company. As more types of risks (e.g. credit, market, operational, etc.) are modeled, more sensitivity, stress, and scenario tests on EV can be used as tools to develop risk management metrics.

Source: Risk Management Metrics Subgroup (2001)

Figure 1: Categorization of multiples

Note: Enterprise value multiples are not displayed, since this research focus on equity value multiples only. P = (stock) price/market capitalization, SA = sales/revenues, GI = gross income, EBITDA = earnings before interest, taxes, depreciation and amortization, EBIT = earnings before interest and taxes, EBT = earnings before taxes/ pre-tax income, E = earning/net income available to common shareholders, TA = total assets, IC = invested capital, B = book value of common equity, OCF = operating cash flow, D = (ordinary cash) dividend, R&D = research & development expenditures, AIA = amortization of intangible assets and KC = knowledge costs = R&D + AIA. Forward-looking multiples are based on mean consensus analysts' forecasts for the next two years (1 = one year, 2 = two years) provided by I/B/E/S. The multiples shown in within this two dimensional categorization framework are just a selection of the universe of possible multiples. However, any multiple can be classified within this framework.

	Traditional/trailing multiples				
	Accrual flow multiples	**Book value multiples**	**Cash flow multiples**	**Alternative multiples**	**Forward-looking multiples**
Equity value multiples	P/SA	P/TA	P/OCF	P/(EBIT+R&D)	P/SA 1
	P/GI	P/IC	P/D	P/(EBIT+AIA)	P/SA 2
	P/EBITDA	P/B		P/(EBIT+KC)	P/EBITDA 1
	P/EBIT			P/(E+R&D)	P/EBITDA 2
	P/EBT			P/(E+KC)	P/EBIT 1
	P/E				P/EBIT 2
					P/EBT 1
					P/EBT2
					P/E 1
					P/E 2

Source: Schreiner (2007)

Figure 3: Value tree of an insurance company

Note: This a (simplified) value tree of the operations of an insurance company. Analysis is done on a Mutually Exclusive Collectively Exhaustive (MECE) basis, which means that the choice of sub-objectives should cover the complete overall objective (collectively exhaustive) and do not have any overlap (mutually exclusive). PBT = profit before taxes, UPR = unearned premiums reserve.

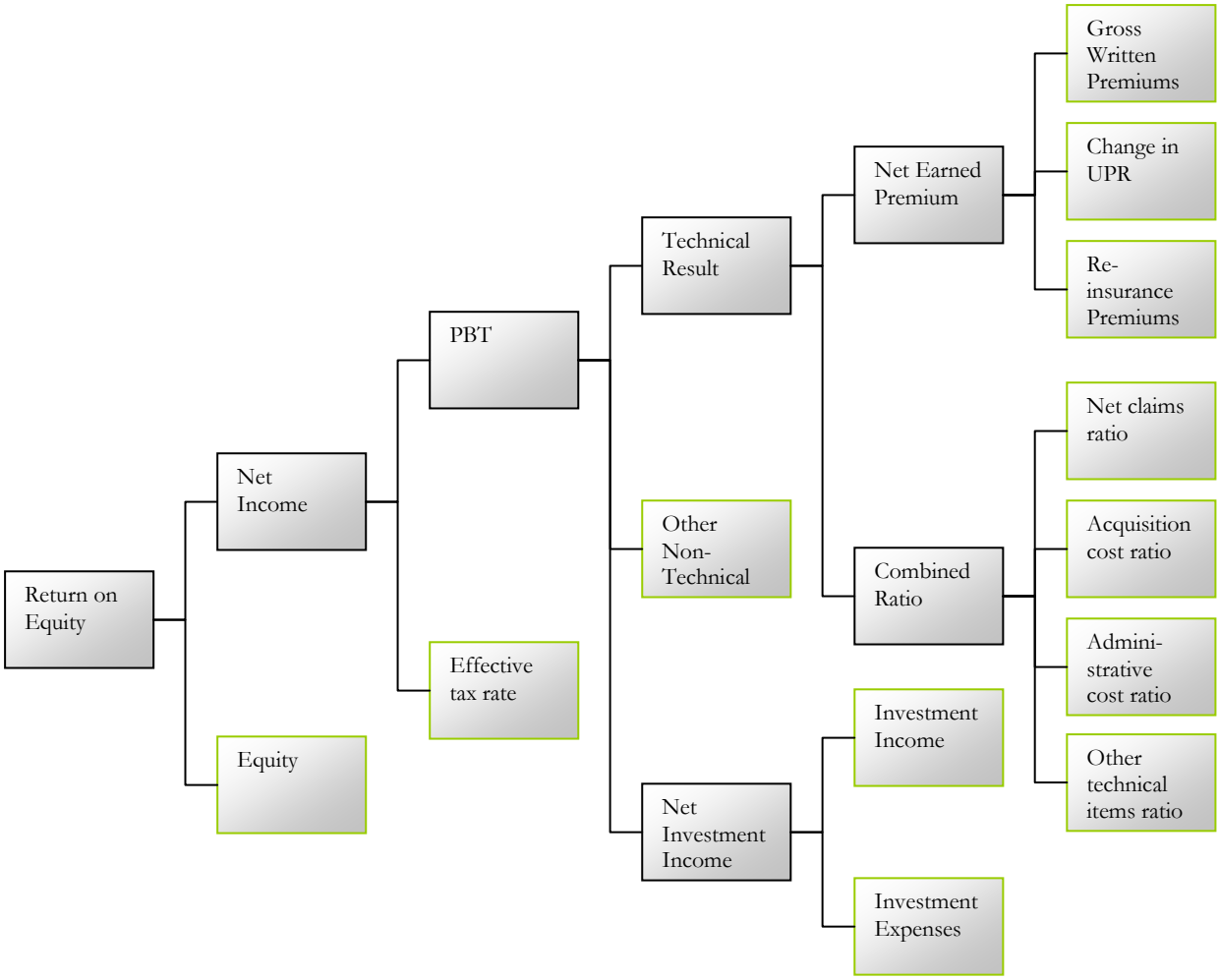


Figure 7: Price-to-earnings multiple vs. Expected growth

Note: X-axis shows the expected growth of the firms based on one and two-year forecasted earnings growth estimates from I/B/E/S. The expected growth rate is calculated using the compounded annual growth rate formula. The Y-axis displays the price-to-earnings ratio of the firms during the period 2005-2009.

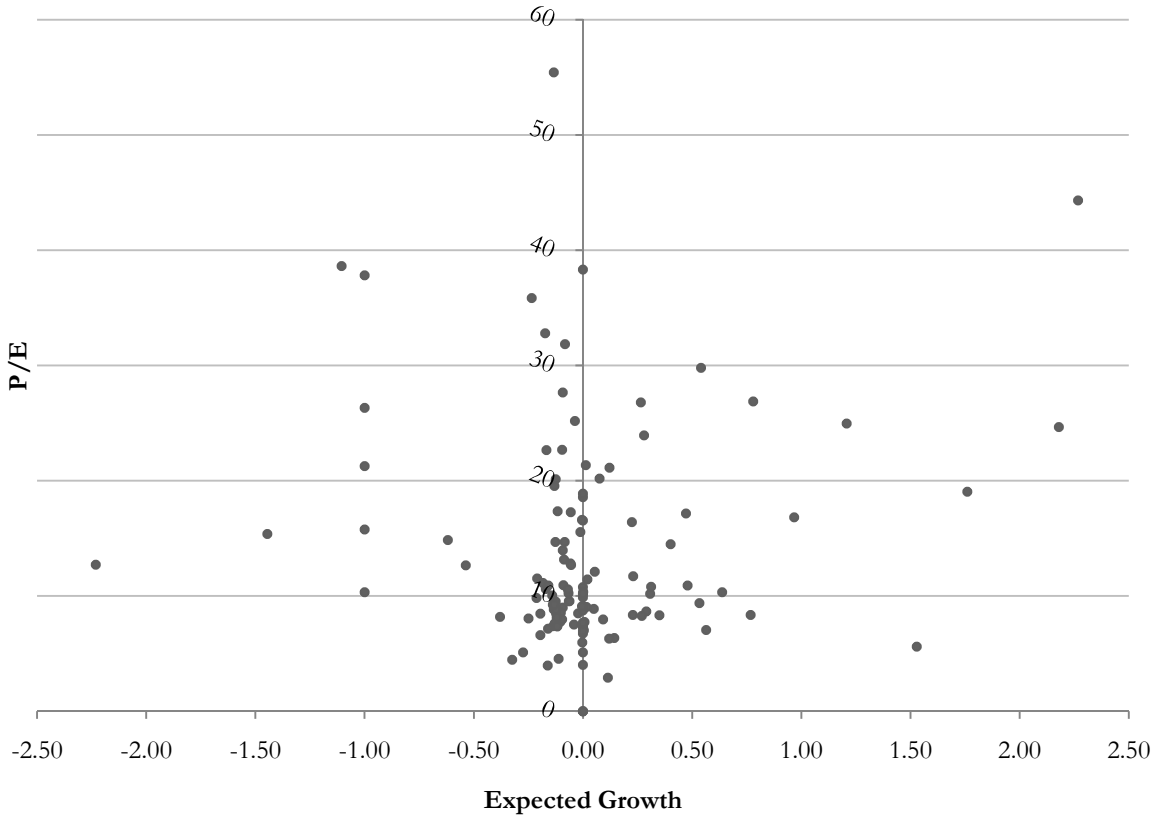


Figure 8: Price-to-book value multiple vs. Return on equity

Note: X-axis shows the return on equity of each firm during the period 2005-2009. Return on equity is calculated by dividing net income of each firm in period *t* by the firms' shareholders' equity of period *t*. The price-to-book value of each firm of the covered period is displayed on the Y-axis.

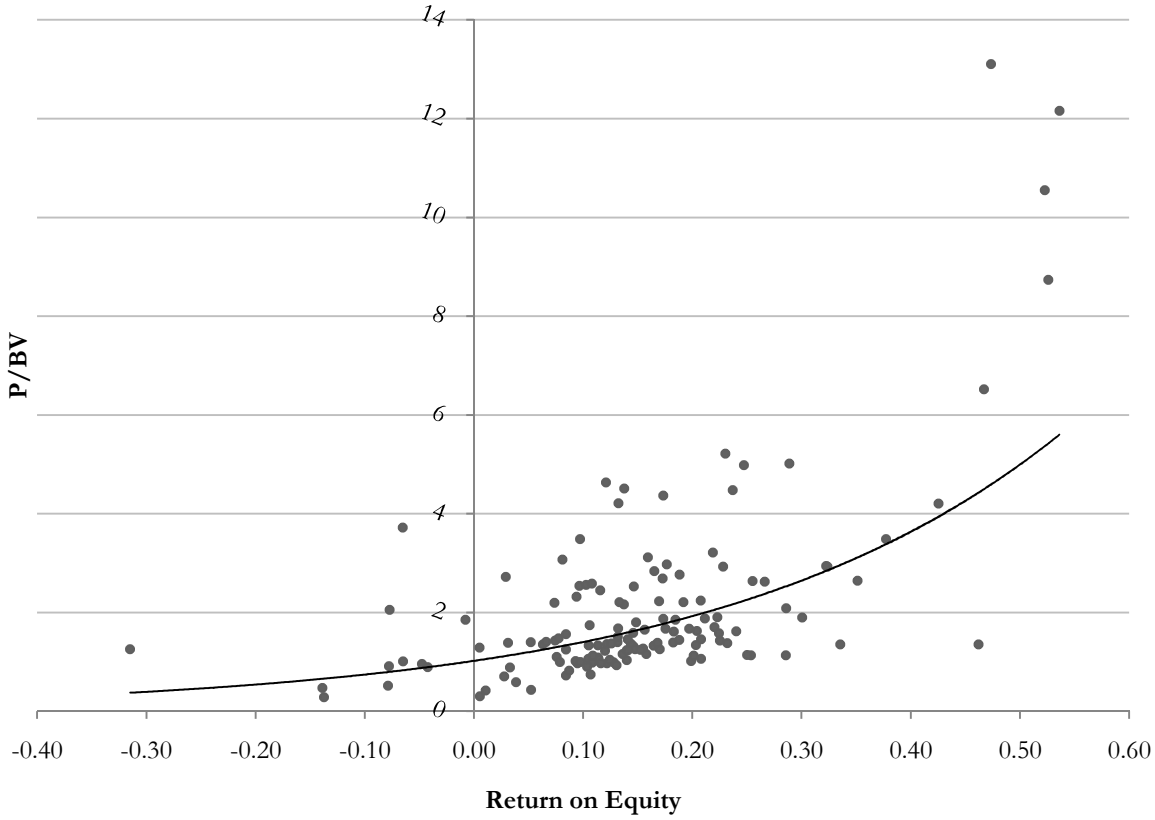


Figure 9: Price-to-net earned premiums vs. Return on Net earned premiums

Note: X-axis shows the return on net earned premiums of each firm during the period 2005-2009. Return on net earned premium is calculated by dividing net income of each firm in period *t* by the firms' net earned premium of period *t*. The price-to-book value of each firm of the covered period is displayed on the Y-axis.

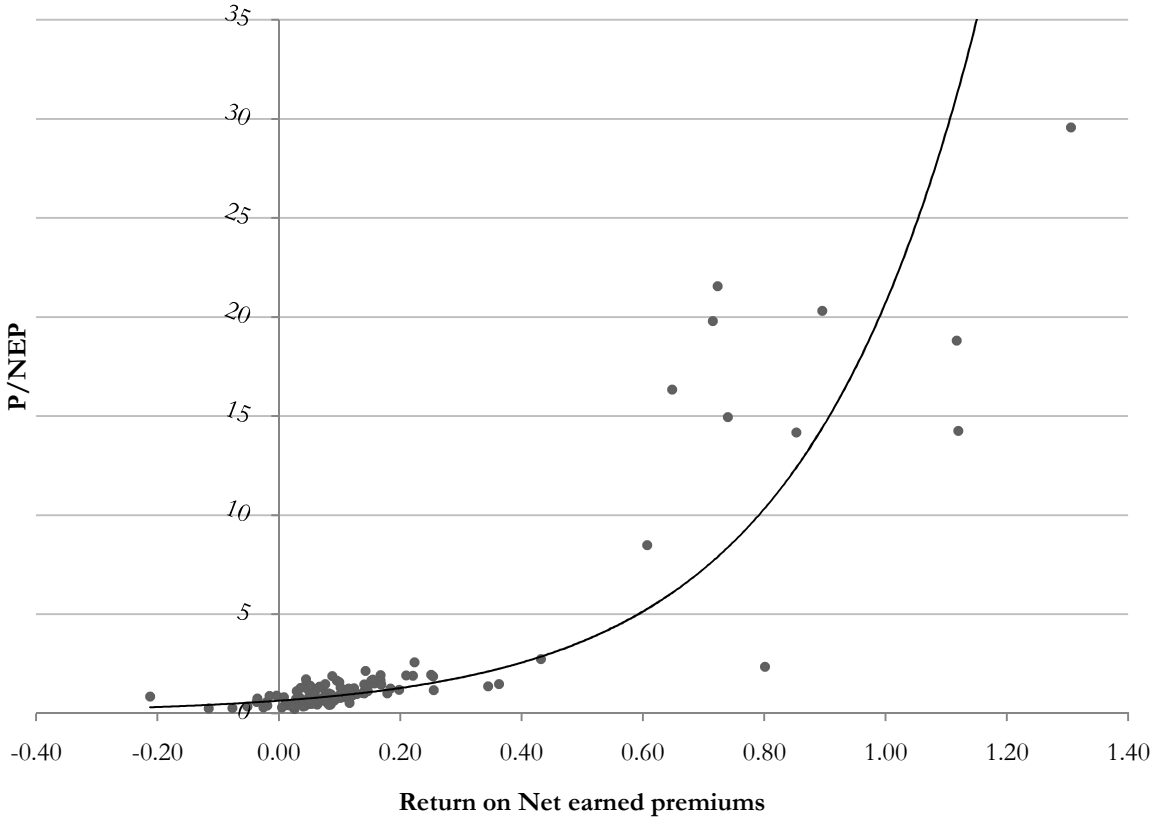


Table 1: Descriptive statistics and multiples of dataset

Note: Ageas, Delta Lloyd, Ergo and Old Mutual are excluded from the dataset due to a short and very turbulent history (Ageas) or due to a lack of information availability (Delta Lloyd, Ergo and Old Mutual). All numbers are calculated as end-of-year figures of 2009. All accounting numbers are in millions of the local currency. The market capitalization is reported in EUR million, so they are comparable to each other. It can be seen that CNP Assurances it the insurance company with the highest economic value and Helvetia has the smallest market capitalization of this dataset. The bottom rows contain the mean and median for the company financials and the harmonic mean for the unselected[10] firm multiples displayed in this table.

	Company Name	Country	Market Cap (EUR mln)	Net Earned Premiums	Net Income	Shareholders' Equity	P/E	P/EPS1	P/EPS2	P/BV	P/NEP
1	Admiral	United Kingdom	3,568	212	157	300	20.19	21.16	19.67	10.55	14.95
2	Aegon	The Netherlands	7,882	17,746	204	18,873	38.64	-	131.15	0.42	0.44
3	Allianz	Germany	39,557	59,857	4,345	40,166	9.10	8.56	8.60	0.98	0.66
4	Amlin	United Kingdom	2,028	1,317	455	1,593	3.96	7.85	9.37	1.13	1.37
5	Aviva	United Kingdom	12,395	32,673	1,315	10,556	8.37	10.20	5.77	1.04	0.34
6	AXA	France	37,876	81,072	4,033	46,229	9.39	10.26	6.69	0.82	0.47
7	Baloise	Switzerland	2,900	6,651	421	4,315	10.22	-	6.42	1.00	0.65
8	CNP	France	40,260	31,467	1,122	11,548	35.87	9.22	12.06	3.49	1.28
9	Generali	Italy	28,999	64,036	1,766	16,652	16.42	16.19	13.22	1.74	0.45
10	Hannover Re	Germany	3,945	9,307	772	3,712	5.11	7.22	9.95	1.06	0.42
11	Helvetia	Switzerland	1,871	5,909	321	3,092	8.66	10.50	8.14	0.90	0.47
12	Hiscox	United Kingdom	1,439	1,098	280	1,121	4.56	8.40	9.46	1.14	1.16
13	Legal and General	United Kingdom	5,320	4,712	844	4,196	5.60	19.51	7.71	1.13	1.00

[10] In contrary to the harmonic means from table 3, these harmonic means are calculated over the complete dataset, including outliers. Therefore these numbers can differ from those in table 3.

14	Mapfre	Spain	8,564	13,714	1,036	6,166	8.27	9.17	7.22	1.39	0.62
15	Mediolanum	Italy	3,191	9,641	217	992	14.68	18.18	19.83	3.21	0.33
16	Munich Re	Germany	21,452	39,526	2,564	22,049	8.37	9.13	7.43	0.97	0.54
17	Prudential	United Kingdom	18,248	19,976	677	6,271	23.94	20.51	16.02	2.58	0.81
18	RSA	United Kingdom	4,814	6,753	419	3,491	10.20	8.93	6.83	1.22	0.63
19	Sampo	Finland	9,531	4,479	641	7,613	14.87	3.25	8.51	1.25	2.13
20	SNS Reaal	The Netherlands	1,220	4,254	22	4,043	55.43	-	-	0.30	0.29
21	St. James's Place	United Kingdom	1,335	55	40	540	29.79	28.60	18.57	2.20	21.56
22	Standard Life	United Kingdom	5,452	3,467	180	3,457	26.90	31.06	17.45	1.40	1.40
23	Storebrand	Norway	2,144	26,475	934	12,043	19.06	36.29	13.14	1.48	0.67
24	Swiss Life	Switzerland	2,875	11,867	277	7,208	15.40	11.52	-	0.59	0.36
25	Swiss Re	Switzerland	12,471	25,501	723	26,201	25.59	56.72	5.82	0.71	0.73
26	Topdanmark	Denmark	1,464	11,253	1,446	4,117	7.53	11.05	11.52	2.65	0.97
27	Trygvesta	Denmark	2,912	17,426	2,008	9,666	10.79	12.77	9.73	2.24	1.24
28	Vienna Insurance Group	Austria	4,608	7,242	364	4,629	12.67	5.29	11.39	1.00	0.64
29	Zurich Fin Services	Switzerland	23,187	47,227	3,236	29,678	10.32	7.76	4.74	1.13	0.71
	(Harmonic) Mean		10,742	19,480	1,063	10,707	10.66	10.45	9.39	1.06	0.64
	Median		4,814	11,253	677	6,166					

Table 2: Description of multiples used for research

Note: Market capitalization is calculated as the end of year share price multiplied by the shares outstanding. NEP=Net earned premiums, IR=Investment Result, NC=Net claims and NG on FI=Net gains/losses on financial instruments at fair value through profit or loss.

Multiple	Full Name	Description	Equation
P/E	Price-to-earnings	Traditional multiple, based on reported net income or earnings per share	$\frac{Market\ capitalization\ (Share\ price)}{Net\ income\ (Earnings\ per\ share)}$
P/EPS1	One year forward price-to-earnings	Earnings multiple based on one year forecasted earnings per share based on analysts' forecasts from the I/B/E/S database	$\frac{Share\ price_t}{Forecasted\ earnings_{t+1}}$
P/EPS2	Two year forward price-to-earnings	Earnings multiple based on two year forecasted earnings per share based on analysts' forecasts from the I/B/E/S database	$\frac{Share\ price_t}{Forecasted\ earnings_{t+2}}$
P/BV	Price-to-book value	Multiple based on the book value of common shareholders' equity reported in accounting statements	$\frac{Market\ capitalization}{Shareholders'\ equity}$
P/NEP	Price-to-net earned premiums	Insurance equivalent of the common used price-to-sales multiple. Net earned premiums are the insurance policies sold correct for reinsured premiums, i.e. the premiums for own account	$\frac{Market\ captilaztion}{Net\ earned\ premiums}$
P/Emva	Price-to-embedded value	Multiple based on the consolidated value of shareholders' interests in the covered business	$\frac{Market\ capitalization}{Embedded\ value}$
P/NRI	Price-to-net result on insurance activities	Multiple based on the result on insurance activities of the company. Calculated as the net earned premiums minus the net claims	$\frac{Market\ captilaztion}{Net\ earned\ premiums - Net\ claims}$
P/NIO	Price-to-net income on operations	Multiple based on the revenues corrected for the investment return and the net gains/losses on financial instruments at fair value through profit or loss	$\frac{Market\ captilaztion}{NEP + IR + NG\ on\ FI}$
P/NRO	Price-to-net result on operations	Multiple based on the result of the total operations of insurance companies. Is a combination of the P/NRI and P/NIO	$\frac{Market\ captilaztion}{NEP - NC + IR + NG\ on\ FI}$

Table 3: Equity value multiple summary statistics

Note: This table displays summary statistics of each common used, sector-specific and sum-of-the-parts multiples. The first column of numbers shows the harmonic mean of the selected companies from the dataset over the total covered period. The second to fifth column present respectively the median, mean, first quartile and third quartile of the selected companies from the dataset. The numbers in the last column show the size of the dataset that is used to calculate the other statistical measures in the other columns. These numbers are different of height, because not all firm multiples are useful for further valuation analysis (e.g. negative multiples or extreme outliers).

	Harmonic Mean	Median	Mean	1st quartile	3rd quartile	Size of dataset
Common used multiples						
P/E	10.49	10.81	12.76	8.59	16.08	120
P/EPS1	11.68	12.38	13.66	9.78	16.94	109
P/EPS2	9.84	11.52	12.23	8.46	15.49	118
Both common and sector-specific multiples						
P/BV	1.49	1.44	1.86	1.15	2.26	128
P/NEP	0.78	0.88	0.99	0.64	1.27	124
Sector-specific multiples						
P/Emva	1.36	1.44	1.69	1.11	2.04	80
P/NIO	0.63	0.64	0.89	0.51	1.11	129
P/NRO	2.19	2.24	2.77	1.76	3.68	115
P/NRI	2.96	3.38	4.38	2.28	5.57	89

Table 4: Absolute valuation errors of sector-specific multiples

Note: Panel A represents the results of Hypothesis 1. The numbers below 'Analysis of absolute valuation errors' show the median, mean, Q1 and Q3 of the absolute valuation errors of the complete dataset over the covered period. The absolute valuation errors are calculated by equation (6). The numbers below 'Fractions' show the portion of valuation errors that are below 15 and 25 percent. Panel B presents the t-statistics for the valuation errors comparison between sector-specific multiples and common used multiples. The t-statistic for mean difference is based on the pair-wise comparison. The t-statistics for median, <0.15 and <0.25 are based on bootstrap-type analysis. Ideally, the t-statistics in columns below mean and median should be positive and the t-statistics in the columns below fraction <0.15 and fraction <0.25 should be negative, since the difference is calculated by subtracting the row of the column.

	Analysis of absolute valuation errors				Fractions	
	Median	Mean	1st quartile	3rd quartile	Fraction < 0.15	Fraction < 0.25
Panel A:						
Common used multiples						
P/E	0.3233	0.3546	0.1510	0.5049	0.2417	0.3833
P/EPS1	0.2817	0.3055	0.1378	0.4126	0.2569	0.4404
P/EPS2	*0.2334*	*02716*	*0.1096*	*0.3838*	*0.3559*	*0.5254*
Both common and sector-specific multiples						
P/BV	0.3111	0.3364	0.1392	0.4890	0.2734	0.4531
P/NEP	0.3189	0.3450	0.1273	0.5043	0.2903	0.3871
Sector-specific multiples						
P/Emva	0.3644	0.3653	0.1978	0.5578	0.2000	0.3250
P/NIO	0.3486	0.4172	0.1944	0.5917	0.1550	0.3333
P/NRO	0.3446	0.3831	0.1798	0.5425	0.2174	0.3391
P/NRI	0.3025	0.3535	0.1954	0.5105	0.2162	0.3919

	Mean		Median		Fraction <0.15		Fraction <0.25	
	P/E	P/EPS1	P/E	P/EPS1	P/E	P/EPS1	P/E	P/EPS1
Panel B:								
T-statistics								
P/BV	0.4534	-1.3085	0.2653	-0.4023	-0.6130	-0.3818	-0.9932	-0.3089
P/NEP	0.5016	-1.5761	-0.8432	-1.6173	1.5065	1.6486	0.7068	1.3357
P/Emva	-0.4123	-0.4201	-0.8422	-1.7640	1.3709	1.5782	0.5637	1.2769
P/NIO	-1.0472	-2.7961	-0.9435	-1.8734	1.4082	1.8088	0.6584	1.5701
P/NRO	-0.3325	-1.4900	-0.4308	-1.2869	0.3896	0.5626	0.5498	1.2078
P/NRI	0.7120	0.0092	0.6858	0.0237	-0.3436	-0.1184	-0.9373	-0.3198

Table 5: Absolute valuation errors of sum-of-the-parts valuation multiples

Note: Panel A represents the results of Hypothesis 2. The numbers below 'Analysis of absolute valuation errors' show the median, mean, Q1 and Q3 valuation errors of the dataset over the covered period. The absolute valuation errors are calculated by equation (6). The numbers below 'Fractions' show the portion of valuation errors that are below 15 and 25 percent. Panel B presents the t-statistics for the valuation errors comparison between sum-of-the-parts multiples and sector-specific multiples. In addition it shows the significance level of the t-statistics, where *, **, *** indicates a significance level of respectively ten, five and one percent. The numbers below 'sector-specific' present the t-statistic of the SOTP multiples from the rows compared to its sector-specific multiple (e.g. sector-specific of P/Emva and P-BV is the P/BV multiple). The t-statistic for mean difference is based on the pair-wise comparison. The t-statistics for median, <0.15 and <0.25 are based on bootstrap-type analysis. Ideally, the t-statistics in columns below mean and median should be positive and the t-statistics in the columns below fraction <0.15 and fraction <0.25 should be negative, since the difference is calculated by subtracting the row of the column.

	Analysis of absolute valuation errors				Fractions	
	Median	Mean	1st quartile	3rd quartile	Fraction < 0.15	Fraction < 0.25
Panel A: **Sum-of-the-parts multiples**						
P/ Emva and P/BV	*0.1828*	*0.2414*	*0.0656*	*0.3609*	*0.4630*	*0.6296*
P/ Emva and P/NIO	0.2314	0.2909	0.0816	0.4124	0.3551	0.5327
P/ Emva and P/NRO	0.2460	0.3064	0.1189	0.4090	0.2885	0.5096
P/ Emva and P/NRI	0.2617	0.3000	0.1267	0.4025	0.2800	0.4600

	Mean		Median		Fraction <0.15		Fraction <0.25	
	P/Emva	Sector-specific	P/Emva	Sector-specific	P/Emva	Sector-specific	P/Emva	Sector-specific
Panel B: **T-statistics**								
P/Emva and P/BV	4.8073***	3.2908***	4.0944***	2.5716**	-5.0196***	-2.7824***	-4.3443***	-2.6277**
P/Emva and P/NIO	2.9500***	3.5103***	2.4533**	2.8632***	-3.1221***	-3.2444***	-2.8171***	-2.7646**
P/Emva and P/NRO	4.2072***	2.6480***	2.2606**	2.3518**	-2.2196**	-0.8106	-2.2737**	-2.2266**
P/Emva and P/NRI	3.3781***	0.5926	2.5491**	0.4637	-2.1429**	-.01137	-1.9026*	0.0844

Table 6: Absolute valuation errors regression analysis

Note: Panel A represents the results of Hypothesis 2. The numbers below 'Analysis of absolute valuation errors' show the median, mean, Q1 and Q3 valuation errors of the dataset over the covered period. The absolute valuation errors are calculated by equation (6). The numbers below 'Fractions' show the portion of valuation errors that are below 15 and 25 percent. Panel B presents the t-statistics for the valuation errors comparison between linear (columns) and nonlinear (rows) regression. The t-statistic for mean difference is based on the pair-wise comparison. The t-statistics for median, <0.15 and <0.25 are based on bootstrap-type analysis. Ideally, the t-statistics in columns below mean and median should be positive and the t-statistics in the columns below fraction <0.15 and fraction <0.25 should be negative, since the difference is calculated by subtracting the row of the column.

	Analysis of absolute valuation errors				Fractions	
	Median	Mean	1st quartile	3rd quartile	Fraction < 0.15	Fraction < 0.25
Panel A:						
Linear regression						
P/BV vs. ROE	0.4120	0.5288	0.2247	0.5926	0.1449	0.2754
P/NEP vs. RONEP	0.3991	0.6559	*0.1185*	0.8686	0.2833	0.3667
Nonlinear regression						
P/BV vs. ROE	0.3550	0.3928	0.1687	0.5408	0.2357	0.4071
P/NEP vs. RONEP	*0.2685*	*0.3302*	0.1190	*0.4385*	*0.3143*	*0.4500*

	Mean		Median		Fraction <0.15		Fraction <0.25	
	P/BV	P/NEP	P/BV	P/NEP	P/BV	P/NEP	P/BV	P/NEP
Panel B:								
T-statistics								
P/BV vs. ROE (nl)	6.865***		0.0338		-0.1035		-0.1082	
P/NEP vs. RONEP (nl)		4.172***		0.1284		-0.1260		-0.2698

Table 7: Distribution of business lines 2005-2009

Note: Table reports the percentage of non-life insurance business of total net earned premiums per year over the period 2005-2009. N/A=Not available and N/P=Not Public.

		2005	*2006*	*2007*	*2008*	*2009*
1	Admiral	100.0	100.0	100.0	100.0	100.0
2	Aegon	N/A	N/A	N/A	N/A	N/A
3	Allianz	65.3	64.6	64.9	63.2	63.2
4	Amlin	100.0	100.0	100.0	100.0	100.0
5	Aviva	N/A	N/A	N/A	N/A	N/A
6	AXA	30.1	28.6	30.0	31.5	31.8
7	Baloise	43.2	44.3	45.3	44.9	44.3
8	CNP	N/A	N/A	N/A	N/A	N/A
9	Generali	25.3	27.0	30.4	32.2	31.1
10	Hannover Re	63.5	66.5	61.7	60.6	56.2
11	Helvetia	43.5	43.7	44.8	41.0	35.9
12	Hiscox	100.0	100.0	100.0	100.0	100.0
13	Legal and General	0.0	0.0	0.0	0.0	0.0
14	Mapfre	N/P	72.9	70.9	71.7	72.3
15	Mediolanum	0.0	0.0	0.0	0.0	0.0
16	Munich Re	48.9	49.8	50.1	50.9	47.3
17	Prudential	0.0	0.0	0.0	0.0	0.0
18	RSA	100.0	100.0	100.0	100.0	100.0
19	Sampo	85.1	85.1	86.0	87.8	82.1
20	SNS Reaal	N/P	N/P	N/P	17.4	18.7
21	St. James' Place	0.0	0.0	0.0	0.0	0.0
22	Standard Life	N/P	0.0	0.0	0.0	0.0
23	Storebrand	0.0	0.0	0.0	0.0	0.0
24	Swiss Life	0.0	0.0	0.0	0.0	0.0
25	Swiss Re	62.9	62.8	60.0	56.5	56.5
26	Topdanmark	76.7	73.6	71.4	69.2	73.0
27	Trygvesta	100.0	100.0	100.0	100.0	100.0
28	Vienna Ins Group	43.3	44.9	46.2	48.5	47.7
29	Zurich Fin Services	73.7	74.5	94.8	75.5	71.3

Table 8: Regression for Price-to-book value

This table reports the results from the following annual estimation regression:

Linear: $PBV = \alpha + b1 * ROE$

Nonlinear: $PBV = \alpha * e^{b1*ROE}$

where the dependent variable, PBV, is the price-to-book value ratio as of December 31th of each year. The explanatory variable is ROE is net income as a percent of shareholders' equity. P-values are provided in parentheses. The r-square (R^2) and number of firms (# of obs) are also reported.

Year	*Intercept*	*ROE*	*R^2*	*# of obs*
Linear Regression				
2005	0.409	10.700 (0.000)	50.2	26
2006	-0.517	15.911 (0.000)	42.2	28
2007	-0.319	12.320 (0.593)	34.8	28
2008	1.379	6.763 (0.000)	38.6	29
2009	-0.033	12.546 (0.000)	54.3	29
Nonlinear Regression				
2005	0.999	3.853 (0.000)	45.5	26
2006	1.029	15.911 (0.001)	36.5	28
2007	1.043	2.708 (0.509)	1.8	26
2008	1.140	2.571 (0.003)	28.4	29
2009	0.711	4.332 (0.000)	48.5	29

Table 9: Regression for Price-to-net earned premiums

This table reports the results from the following annual estimation regression:

Linear: $PNEP = \alpha + b1 * RONEP$

Nonlinear: $PNEP = \alpha * e^{b1*RONEP}$

where the dependent variable, PNEP, is the price-to-net earned premiums ratio as of December 31th of each year. The explanatory variable is RONEP is net income as a percent of net earned premiums. P-values are provided in parentheses. The r-square (R^2) and number of firms (# of obs) are also reported.

Year	*Intercept*	*ROE*	*R^2*	*# of obs*
Linear Regression				
2005	-0.677	19.592 (0.000)	84.7	26
2006	-1.396	23.251 (0.000)	91.8	28
2007	-0.787	15.570 (0.000)	74.3	28
2008	0.629	12.796 (0.000)	92.5	28
2009	-0.861	22.915 (0.000)	83.5	29
Nonlinear Regression				
2005	0.630	4.708 (0.000)	85.5	26
2006	0.774	3.182 (0.000)	83.9	28
2007	0.708	2.825 (0.008)	78.8	28
2008	0.576	3.205 (0.000)	72.6	28
2009	0.465	4.857 (0.000)	83.3	29