EVA/RAROC versus MCEV Earnings: A Unification Approach

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Running title: EVA/RAROC versus MCEV Earnings

Abstract: This paper compares different performance metrics used for value-based management in life and non-life insurance business. The goal is to find a consistent basis for performance measurement at the insurance group level. This is an important task since management techniques used in non-life insurance, such as economic value added (EVA) and risk-adjusted return on capital (RAROC), are at first sight very different from those used in life insurance, i.e., an analysis of market-consistent embedded value (MCEV) earnings, thus making management difficult at the group level. The contribution of this paper is to compare and contrast these concepts and to show that all approaches can be unified under a single consistent framework. All present residual cash flow concepts and can be linked under the residual income valuation theory.

Keywords: Value-Based Management; Embedded Value; Franchise Value; Goodwill

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1. Introduction

In the insurance industry, there are several measures for the analysis of corporate performance, mainly because of the differences between long- and short-term oriented insurance businesses. While life insurance contracts typically have durations of many years, non-life insurance contracts expire after one year and have to be renewed. As a consequence, non-life insurance uses performance metrics such as economic value added (EVA) and risk-adjusted return on capital (RAROC) that focus on the performance of specific periods and thus do not take into account future profits that can be expected from existing business.[1] Life insurance uses performance measures such as market-consistent embedded value (MCEV) which are especially appropriate for long-term business, since the valuation is based on the projection of future cash flows.[2] The performance measure is therefore expressed in terms of change in MCEV over time, the so-called MCEV earnings.[3]

The use of different performance measures, however, may lead to inconsistent management at the group level and, therefore, precludes integrated performance evaluation and decision-making process within insurance groups consisting of life and non-life entities. Diers *et al.*[4] have transferred the embedded value concept from life to non-life insurance business and present a detailed model of how to determine MCEV in non-life insurance. Furthermore, they use a simplified analysis to demonstrate the use of change in MCEV over time as a performance metric. In contrast, we take into account the value of new business written and extend their simplified illustration to a detailed analysis of MCEV earnings as provided by the European Insurance CFO Forum.[5] In a detailed theoretical and numerical comparison of the different performance measures (MCEV earnings, EVA, and RAROC), we then analyze

1 See Diers (2011); Worthington and West (2001).
2 See Klumpes (2005).
3 See European Insurance CFO Forum (2009a).
4 See Diers *et al.* (2009).
5 See European Insurance CFO Forum (2009a).

similarities and differences between the ratios used in life and non-life. The goal is to show that all concepts can be unified under one consistent framework and to emphasize that all represent residual cash flow models which can be linked under the residual income valuation theory. This is an important result for practitioners, since it shows that all concepts can be used together.

The contribution of this paper is twofold. First, we provide a detailed comparison between the different concepts used in life and non-life insurance business for measuring value creation. Second, we present a detailed analysis of MCEV earnings for non-life insurance which is directly comparable to the concept used in life insurance. To our knowledge, this is the first attempt to compare the different performance metrics with the overall goal to achieve a consistent concept of a single management tool at the group level.

The remainder of this paper is organized as follows. Section 2 describes different metrics used for risk-adjusted performance measurement in non-life insurance. Then a detailed illustration of the analysis of MCEV earnings for life insurance, taking into account the reconciliation of opening and closing values of MCEV over time, is provided in Section 3. Section 4 gives a theoretical and numerical comparison among EVA, RAROC and MCEV earnings and outlines similarities and differences among them. Section 5 concludes.

2. Value-Based Management using EVA and RAROC

Enterprise risk management (ERM) as a holistic approach to integrated risk management has become an increasingly important topic for academics and practitioners over the last decade.[6] Especially in the insurance industry, with a unique and complex risk landscape compared to other industries, there is a need for proper risk and capital management.[7] At the same time, capital that is provided by the insurance company's shareholders requires a particular rate of

[6] See, e.g., Dickinson (2001); Hoyt and Liebenberg (2010); Ai *et al.* (2011); Altuntas *et al.* (2011).
[7] See Drzik (2005).

return, named cost of capital, which needs to be measured within the context of performance measurement and reporting.[8]

Identifying the correct cost of capital is one of the central tasks for measuring value in the insurance industry.[9] In this context, a clear connection between risk management and value creation is the core of a solid ERM. The connection between risk and value is also highlighted in the definition of the cost of capital. Typically, the cost of capital is given as a risk-free rate (for risk-free investments) plus a risk premium (depending on the risk of the insurer). If the insurers return is above (below) the cost of capital, value is created (destroyed). Hence, value-based management in the insurance industry is typically based on risk measures that need to be risk-adjusted and set up in a consistent manner.[10] In non-life insurance, there are two commonly used concepts for value-based management: EVA and RAROC.[11]

2.1 Economic Value Added (EVA)

The EVA was developed by the consulting firm Stern Stewart & Co. It presents an estimate of economic profits to determine the value created by the company.[12] The methodology is based on a concept called residual income,[13] which is equal to the annual accounting profit less the required return on capital employed, i.e., an interest charge on the book value of assets.[14] As an accounting-based periodic performance measure, residual income has a long history and can be traced back to Marshall[15] and Solomon.[16] For a multi-period business valuation process, however, the residual income valuation model only emerged in the 1990s and is now

8 See Exley and Smith (2006).
9 See, e.g., Hancock *et al.* (2001); Walhin (2006).
10 See Liebwein (2006).
11 See Diers (2011).
12 See Stewart (1991).
13 See Worthington and West (2001).
14 See, e.g., Bromwich and Walker (1998); O'Hanlon and Peasnell (1998; 2002).
15 See Marshall (1890).
16 See Solomon (1965).

essential in accounting-based valuation.[17] The EVA is defined as the net operating profit after tax (NOPAT) less the cost of capital employed, which is necessary to produce the NOPAT:[18]

$$\text{EVA} = (\text{ROC} - \text{COC}) \cdot \text{Capital Employed} = \text{NOPAT} - \text{COC} * \text{Capital Employed} \quad (1)$$

In this paper, the rate of return on capital employed (ROC) is the traditional accounting-based measure of return ($\text{ROC} = \text{NOPAT}/\text{Capital Employed}$) and COC is the cost of capital rate applied to the capital that is employed. Value creation is thus based on the comparison between the productivity of the capital employed and the cost of capital employed.

Beyond the use of EVA as a single-period performance measure, for valuation purposes one can also calculate the so-called market value added (MVA) which is defined as the excess of market value over capital employed:

$$\text{MVA} = \text{Market Value} - \text{Capital Employed} \quad (2)$$

According to Stewart[19] the MVA precisely tells whether or not value for the shareholders has been added. Therefore MVA is equal to the present value of all future EVAs:[20]

$$\text{MVA} = \sum_{t=1}^{\infty} \frac{\text{EVA}_t}{(1+\text{COC})^t} = \sum_{t=1}^{\infty} \frac{\text{NOPAT}_t - \text{COC} * \text{Capital Employed}_{t-1}}{(1+\text{COC})^t} \quad (3)$$

Thus, in conjunction with MVA, EVA can be used to calculate the market value of the company. The latter is then defined as the sum of projected and discounted future EVAs (i.e., the MVA) and the currently invested capital.

For (non-life) insurance companies a specific capital structure applies: the insurance premiums are typically received in advance and thus the insurance company has no need for

[17] See O'Hanlon and Peasnell (2002). The connection between discounted cash flow-based valuation models and accounting-based residual income can be traced back to Preinreich (1937). A first formal link, however, was given in Peasnell (1982). Accordingly, the present value of future cash flows can be written as the sum of current book value and the present value of future profits (see O'Hanlon and Peasnell, 1998). Beyond the residual income valuation model, recently the academic literature has focused on the so-called abnormal earning growth model. For a detailed comparison we refer to Brief (2007).

[18] See Stewart (1991).

[19] See Stewart (1991).

[20] It is not essential for the cost of capital rate to be constant over the whole projection horizon. This is rather a simplifying assumption very often made when using the residual income valuation theory. In a more general setup one could make allowance for a time-varying cost of capital rate (see O'Hanlon and Peasnell, 1998).

debt financing.[21] Even among financial institutions themselves there are still significant differences in terms of the structure of liabilities.[22] Thus, capital employed, i.e., invested capital, in the insurance industry is typically composed by equity capital. Consequently the cost of capital rate can be interpreted as the minimum rate of return on equity capital that is required by the shareholders to make it worthwhile to invest in the company.[23] For practical applications, the most widely used model to determine the cost of capital rate is the capital asset pricing model (CAPM).[24] Accordingly, the cost of capital rate corresponds to the expected return on firm i given by:

$$E[r_i] = r_f + \beta_{i,m} \cdot [r_m - r_f] \quad (4)$$

where r_f equals the expected risk-free rate of return, r_m equals the expected market rate of return and $\beta_{i,m}$ corresponds to the systematic (market) risk, defined as the covariance of r_i and r_m divided by the variance of r_i. The latter term, the beta coefficient multiplied by the expected market risk premium, corresponds to the risk premium. We can therefore see that the cost of capital rate is composed by a risk-free rate and a risk premium.[25]

The cost of capital very much varies across industries and especially across different lines of business in the insurance industry. It is a very important factor when the EVA concept is applied. Zanjani[26] presents a model of multi-line pricing and capital allocation for insurance companies and shows the effect of the cost of capital rate on catastrophe insurance markets. Cummins and Phillips[27] present different models for estimating the cost of equity capital for property-liability insurers with different business line compositions. Froot[28] presents a

[21] See Danhel and Sosik (2004).
[22] See, e.g., Beltratti and Corvino (2008).
[23] See Danhel and Sosik (2004).
[24] See Sharpe (1964); Lintner (1965).
[25] According to Cummins and Phillips (2005), the CAPM is the most widely used asset pricing model, and recent developments such as the Fama-French three-factor model and the full-information beta technique only provide generalizations and extensions. In practical applications of the CAPM, the beta coefficient very often comes from regression analysis using historical data (see Cummins and Phillips, 2005).
[26] See Zanjani (2002).
[27] See Cummins and Phillips (2005).
[28] See Froot (2007).

framework for analyzing the risk allocation, capital budgeting and capital structure decisions of insurance and reinsurance companies.

2.2 Risk-Adjusted Return on Capital (RAROC)

Traditional accounting-based performance measures such as return on equity or return on investment evaluate performance without any consideration of risk and uncertainty components. This can lead to misleading indications for relative performance measurement and value creation.[29] As a consequence, insurance companies have adopted risk-adjusted performance measures such as RAROC. The RAROC is defined as:[30]

$$\text{RAROC} = \frac{\text{NOPAT}}{\text{Risk}-\text{Adjusted Capital}} \tag{5}$$

Risk-adjusted capital is usually calculated by deriving the so-called economic capital (EC), which is the amount of capital that is required to ensure survival in a worst-case scenario.[31] EC is often calculated using quantile-based risk measures such as value at risk (VaR) or expected shortfall (ES).[32] The big challenge with the use of RAROC measures, however, is finding appropriate capital allocation methods in order to assign the proper amount of capital to a single line of business.[33]

2.3 Discussion

Within the context of value-based management, different objectives that would lead to a value creation process need to be determined.[34] Generally speaking, we have to distinguish forward-looking objectives such as target setting and decision making, from backward-looking objectives such as performance evaluation and compensation schemes. This leads to a natural

[29] See Goldfarb (2006).

[30] See, e.g., Nakada *et al.* (1999); Ward and Lee (2002); Goldfarb (2006). Since we actually calculate a return on risk-adjusted capital, which means that the denominator is risk-adjusted, this formula is also often denoted by return on risk-adjusted capital (RORAC). RAROC, however, is often referred to a formula, where the risk-adjustment is made for the income component, which means that the numerator is risk-adjusted. For details we refer to Goldfarb (2006).

[31] See Porteous and Tapadar (2008).

[32] See, e.g., Dowd and Blake (2006).

[33] See Cummins (2000). An appropriate model for capital allocation in the insurance industry can be found in Myers and Read (2001). A critical analysis of this model and an alternative approach can be found in Gründl and Schmeiser (2007).

[34] See Malmi and Ikäheimo (2003).

split between ex-ante (evaluation before the performance actually has incurred) and ex-post (evaluation after the performance has taken place) performance metrics. In practice, however, EVA and RAROC are both used for ex-ante and ex-post analysis.[35]

EVA versus RAROC

In order to create shareholder value, the goal for the insurance company should be to maximize RAROC and EVA, i.e., the company will create value should the rate of return exceed the cost of capital rate. The RAROC must then meet a prescribed minimum target rate of return, called the hurdle rate.[36] As already mentioned, this is the case if the rate of return exceeds the cost of capital rate. Thus, the hurdle rate is the same as the cost of capital rate, and in order to increase shareholder value the following inequalities must hold:[37]

$$\text{RAROC} > COC \Leftrightarrow EVA > 0 \tag{6}$$

This equivalence only holds true, if for the capital employed, within the definition of EVA, the same accounting standard is used. For example, risk-adjusted capital, such as EC, or allocated risk-adjusted capital to one line of business can be used for the capital employed.[38] In a more general setup, the return on capital has to be compared with the cost of capital rate, i.e., $\text{ROC} > COC \Leftrightarrow EVA > 0$. In the current setup, however, EVA can be transformed into RAROC using the following equation:

$$\text{RAROC} = \frac{\text{NOPAT}}{\text{Risk}-\text{Adjusted Capital}} = \frac{\text{EVA}}{\text{Risk}-\text{Adjusted Capital}} + \text{COC} \tag{7}$$

Franchise Value

Within a given accounting framework, the insurance company is able to calculate the corresponding book value of assets, book value of liabilities, and hence the book value of equity. For example, if the underlying accounting framework corresponds to local GAAP, then the book value of equity is equal to the difference between the book value of assets and

[35] See, e.g., Bromwich and Walker (1998); Culp (2000).
[36] See, e.g., Guill (1999); Cummins (2000).
[37] See Cummins (2000).
[38] See Cummins (2000).

the book value of liabilities, each valued according to local GAAP. If the underlying accounting framework corresponds to an economic approach, then the book value of equity is equal to the difference between the market value of assets and the market value of liabilities, i.e., the net asset value (NAV).[39] Generally speaking, however, the market value of equity is higher than the book value of equity; we refer to this difference as franchise value (see Figure 1).[40]

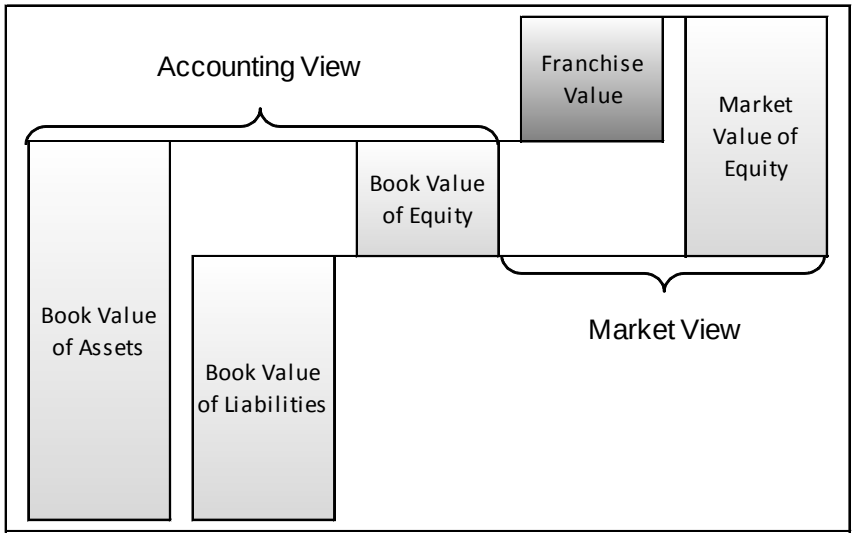

Figure 1: Franchise Value

Exley and Smith[41] show that the market value of equity, defined as the present value of all future dividends, is the sum of the book value of equity and MVA. Thus, the identity of franchise value and the present value of future EVAs holds true, regardless of the accounting standard chosen. One could argue that the application of a strict economic approach would mean that NAV exactly equals the market value of equity and that the franchise value (or MVA, respectively) would be zero. This, however, is only a theoretical issue and other aspects must still be taken into account only by a strict market view and not by traditional accounting-based measures.[42] For example, future new business usually is not part of any (economic) accounting standard, but still contributes to the market value of equity and thus to

[39] See, e.g., Hancock *et al.* (2001); Danhel and Sosik (2004).
[40] See, e.g., Sheldon and Smith (2004); Exley and Smith (2006).
[41] See Exley and Smith (2006).
[42] See, e.g., Danhel and Sosik (2004); Sheldon and Smith (2004).

franchise value.[43] Sometimes franchise value is also referred to as the value attributable to the ability to write profitable future new business.[44] We, however, denote the value of future new business as goodwill, which in our case is part of franchise value.

Accounting Bias

According to De Villiers,[45] traditional accounting-based measures of return (e.g., the return on capital) fail to assess the market-based measures of return (e.g., total shareholder return) because they are based on historical asset values, which in turn are distorted by inflation and other factors. The discrepancy between accounting-based and market-based measures of return is called "bias in accounting measures of return."[46] By definition, the EVA presents the difference between the accounting rate of return and the market rate of return that is required by the shareholders. Hence, the MVA and therefore the franchise value, turns out to be the present value of all future accounting biases.[47] Brealey *et al.*[48] suggest the use of valuation models, based on discounted cash flows, in order to reduce the accounting bias and to bring accounting-based performance measures more into line with market-based performance measures, as is done by residual income valuation models.

3. Value-Based Management using MCEV Earnings

The life insurance industry is increasingly using discounted cash flow-based performance measures such as embedded value.[49] The embedded value here is defined as the sum of net asset value (NAV) and present value of in-force business (PVIF).[50] The additional consideration of goodwill leads to the so-called appraisal value (see Figure 2).[51]

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43 See Sheldon and Smith (2004).
44 See O'Keeffe *et al.* (2005).
45 See De Villiers (1997).
46 See Exley and Smith (2006).
47 See Exley and Smith (2006).
48 See Brealey *et al.* (2011).
49 See, e.g., Klumpes (2005); Watson Wyatt (2008); KPMG (2009).
50 See King and McGaughey (2006).
51 See Frasca and LaSorella (2009).

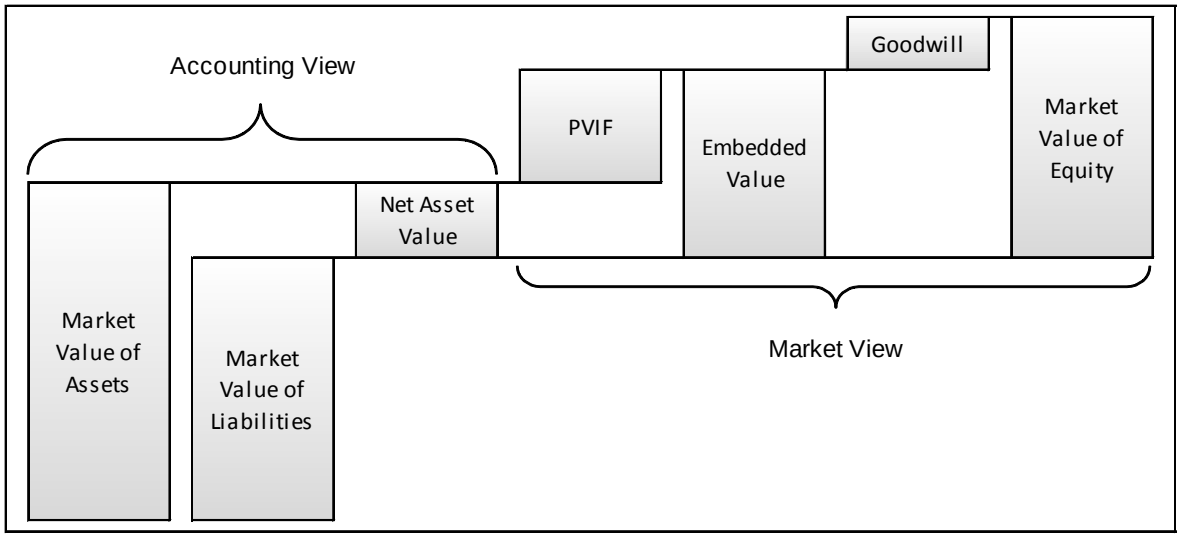

Figure 2: Embedded Value

According to Exley and Smith,[52] one of the most substantial innovations to minimize accounting bias is the embedded value reporting. The PVIF explains some of the gap between net assets and the market value of equity. This can also be seen as "additional retained profit on an EV basis" which has not been recognized in the books of the insurance company, i.e., in the calculation of the NAV.[53] However, in order to eliminate this bias entirely future new business (goodwill) has to be integrated into the valuation model.[54]

For a consistent and transparent embedded value reporting, the European Insurance CFO Forum, a discussion group formed and attended by the chief financial officers of 20 major European insurance companies, developed the concept of market-consistent embedded value (MCEV).[55] Accordingly, the MCEV consists of the free surplus (FS), the required capital (RC) and the value of in-force business (VIF), which is calculated by the present value of future profits (PVFP) deducted by the time value of financial options and guarantees (TVFOG), the frictional costs of required capital (FCRC) and the cost of residual nonhedgeable risks (CRNHR). The PVFP corresponds to projected profits, i.e., shareholder cash flows arising from the in-force business after taxation; the TVFOG captures the impact

[52] See Exley and Smith (2006).
[53] See Chung-Fern Wu and Wen-Hsin Hsu (2011).
[54] See Exley and Smith (2006).
[55] See European Insurance CFO Forum (2009a).

of financial options and guarantees on those cash flows; the FCRC reflect frictional costs for taxation and investment on the assets backing RC; the CRNHR make allowance for the impact of nonhedgeable financial and non financial risks.[56]

The MCEV of the company corresponds to the value of the business at one specific point in time. For managerial performance evaluation and decision making, however, we have to analyze the change in MCEV over time. Hence, the actual performance of the company can only be measured by a detailed movement analysis of MCEV earnings, i.e., a value added analysis. The analysis of movement in MCEV provides helpful information for management and can be a good indicator for value creation.[57] According to Frasca and LaSorella[58] the goal is to understand why embedded value changes over time.

3.1 Analysis of MCEV Earnings in Life Insurance

By means of a detailed movement analysis template provided by the European Insurance CFO Forum,[59] the analysis of MCEV earnings is based on the reconciliation of opening (t=0) and closing (t=1) values of MCEV, together with a decomposition of the change in MCEV over time, i.e., the value added. The value added enables the insurer to identify the value creation or destruction of the in-force business.[60] According to Luk,[61] however, value added cannot be considered as true value creation for the insurance company; rather, it represents the gross value creation, from which the true profits need to emerge.[62] For this purpose, we utilize the detailed movement analysis suggested by the European Insurance CFO Forum.[63]

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[56] For a detailed description of each component we refer to European Insurance CFO Forum (2009a).

[57] See, e.g., O'Keeffe *et al.* (2005); Frasca and LaSorella (2009).

[58] See Frasca and LaSorella (2009).

[59] See European Insurance CFO Forum (2009a).

[60] Note, in the case of value destruction, the value added is negative.

[61] See Luk (2004).

[62] O'Keeffe *et al.* (2005) argue that very often the analysis of movement separates between insurance earnings and investment earnings. The European Insurance CFO Forum fulfills that by explicitly differentiating between operating MCEV earnings, i.e., only taking into account operating variances, and total MCEV earnings, i.e., the additional consideration of economic variances (see European Insurance CFO Forum, 2009a).

[63] See European Insurance CFO Forum (2009a). The analysis of MCEV earnings should be net of taxation, based on a movement analysis on a line-by-line basis and be split by FS, RC and VIF (see European Insurance CFO Forum, 2009a).

Accordingly, Figure 3 illustrates the reconciliation of opening and closing values and provides a decomposition of the individual movement components. Beyond opening and closing adjustments, four movement items can be identified: (1) new business value, (2) unwinding of MCEV, (3) operating variances, and (4) economic variances.[64]

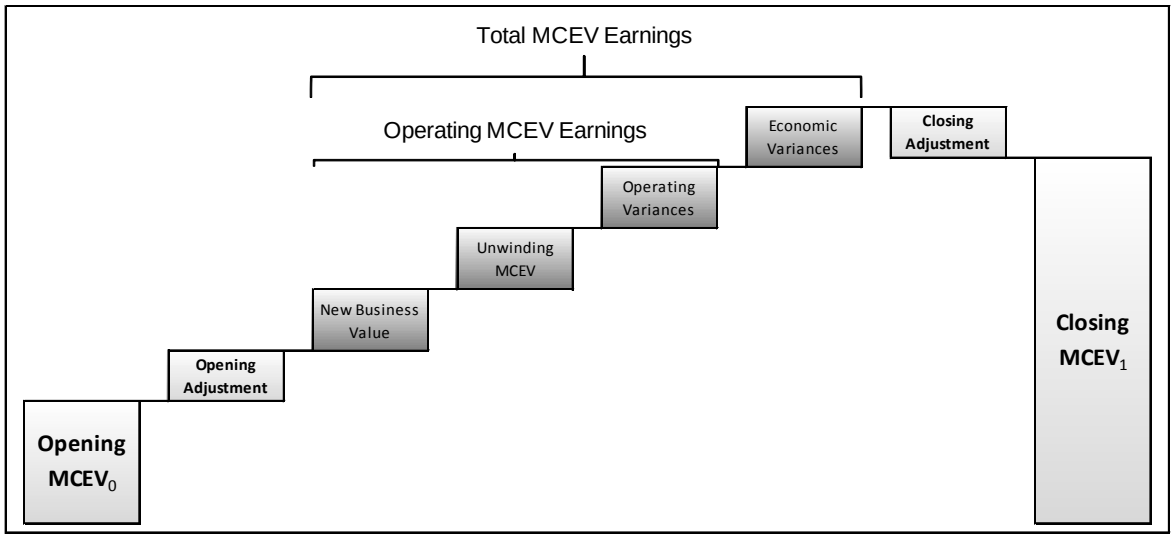

Figure 3: Analysis of MCEV Earnings

(1) New Business Value

The new business value corresponds to the value of new business written over the past accounting year and presents a key indicator for analyzing the future prospects of the company. In this context, practice varies as to whether the new business value is ideally valued using point of sale, opening or closing assumptions.[65]

(2) Unwinding MCEV

The unwinding or rollover of the in-force business corresponds to the expected contribution of existing business to MCEV earnings. It consists of three main elements:

(a) Expected existing business contribution using the reference rate (i.e., market spot rate)

(b) Expected existing business contribution in excess of the reference rate

[64] According to the European Insurance CFO Forum, movements that are not part of the MCEV earnings should be shown either as opening or as closing adjustments. This include, e.g., capital and dividend flows, variances in the foreign exchange rate, and acquired/divested business (see European Insurance CFO Forum, 2009b).

[65] See European Insurance CFO Forum (2009b).

(c) Transfer from VIF and RC to FS

Therefore, (a) equals the earnings over the year assuming that the investment result earns exactly the reference rate from the beginning of the period, (b) equals the earnings related to the investment result in excess to the reference rate from the beginning of the period (reflecting the managements expectation of the investment return on the assets held),[66] and (c) equals the release of profits in the value of in-force business as well as the release of required capital.[67]

(3) Operating Variances

The operating variances are divided into non-economic variances affected by (a) experience variances, i.e., changes resulting from the variance between the actual experience and that anticipated, and (b) assumption changes, i.e., impacts resulting from the changes in experience assumptions.[68] These different kinds of variances need to be identified, explained and disclosed in the MCEV reporting.

(4) Economic Variances

For the economic variances there is no need to separate between experience variances and assumption changes, since a natural split is not ensured. The MCEV methodology makes implicit allowance for change in economic assumptions as it is based on market consistent values.[69]

The sum of new business value, unwinding, and operating variances, i.e., (1)+(2)+(3), corresponds to the so-called operating MCEV earnings. The additional consideration of economic variances (4) leads to the so-called total MCEV earnings. Management can only

[66] See European Insurance CFO Forum (2009b).

[67] For the determination of the VIF, the European CFO Forum (2009a) makes allowance for certainty equivalent techniques, i.e., the use of a predefined reference rate as a risk-free rate for both the investment return and the discount rate. For the calculation of the expected business contribution, however, the management expectations of the investment return in excess of the reference rate on assets held is additionally taken into account (see European Insurance CFO Forum, 2009b). The methodology and assumptions used to determine the reference rate need to be disclosed (see European Insurance CFO Forum, 2009a).

[68] See European Insurance CFO Forum (2009a).

[69] See European Insurance CFO Forum (2009b).

influence the result on operating MCEV earnings; economic variances are beyond management's control. Furthermore, the unwinding of the insurance business merely equals managements' expectation of the business in the beginning of the year. Thus the true impact for value creation comes from the operating variances and value added by new business. Hence, a detailed movement analysis of MCEV earnings makes it possible to identify the true sources of value creation.

Beside a detailed movement analysis of MCEV earnings, life insurance companies very often disclose information about the percentage return on MCEV (RoEV):

$$\text{RoEV} = \frac{\text{Total MCEV Earnings}}{\text{Opening MCEV}} \tag{8}$$

Since management does not have any impact on economic variances, it is possible to argue that only the operating MCEV earnings should be used for managerial performance evaluation. Thus, alternatively, some companies disclose information about the operating return on MCEV which is defined as ratio of the operating MCEV earnings and the (unadjusted) opening MCEV.

3.2 Analysis of MCEV Earnings in Non-Life Insurance

We now extend the MCEV valuation model presented in Diers *et al.*[70] by a detailed analysis of MCEV earnings for a non-life insurance company that is directly comparable to the concept used in life insurance. Accordingly, the MCEV at t=0 can be calculated (in accordance with life MCEV) as the sum of free surplus (FS), required capital (RC) and the value of in-force business (VIF):

$$\text{MCEV}_0 = \text{FS}_0 + \text{RC}_0 + \text{VIF}_0 = \text{NAV}_0 + \text{VIF}_0 \tag{9}$$

The sum of FS and RC corresponds to the NAV and the VIF corresponds to the present value of future profits (PVFP) deducted by the cost of residual nonhedgeable risks (CRNHR) and deducted by frictional costs of required capital (FCRC). For life insurance business, the PVFP

[70] See Diers *et al.* (2009).

additionally has to be reduced by the time value of financial options and guarantees (TVFOG). Since generally, we do not have (financial) options and guarantees within non-life insurance contracts, this component can be set equal to zero:[71]

$$\mathrm{VIF}_0 = \sum_{t=1}^{T} \left(\underbrace{\frac{\mathrm{NOPAT}_t}{(1+\mathrm{sr}_t)^t}}_{\mathrm{PVFP}} - \underbrace{\frac{\mathrm{COC}\cdot \mathrm{SCR\,II}_{t-1}}{(1+\mathrm{sr}_t)^t}}_{\mathrm{CRNHR}} - \underbrace{\frac{(\mathrm{icr}+\mathrm{tr}*(\mathrm{fr}_t-\mathrm{icr}))\cdot \mathrm{RC}_{t-1}}{(1+\mathrm{sr}_t)^t}}_{\mathrm{FCRC}} \right) \tag{10}$$

For the calculation of VIF_0, both investment returns, i.e., forward rates (fr_t) and discount rates, i.e. $(1/1+\mathrm{sr}_t)$, are derived using a risk-free yield curve at t=0 given by predefined market spot rates (sr_t). The PVFP is derived by the sum of discounted future net operating profits after tax (NOPAT_t). The CRNHR are calculated by a cost-of-capital approach similar to the risk-margin approach under Solvency II,[72] i.e., the solvency capital requirements at valuation date t-1 ($\mathrm{SCR\,II}_{t-1}$) are multiplied by the cost of capital rate (COC). The FCRC reflects investment costs (icr) and taxation (tr) on assets backing the projected required capital at valuation date t-1 (RC_{t-1}).

As described in Section 3.1, according to the European Insurance CFO Forum,[73] the change in MCEV over time, i.e., the difference between MCEV in t=1 and t=0, can be expressed by the sum of (1) opening and closing adjustments (Adj), (2) new business value (NBV_1), (3) unwinding of MCEV (U_1), (4) operating variances (OpV_1) and (5) economic variances (EcV_1). The sum of (1)-(5) corresponds to the value added ($\Delta\mathrm{MCEV}$), whereas the sum of (2)-(5) corresponds to the MCEV earnings:

$$\Delta\mathrm{MCEV} = \mathrm{MCEV}_1 - \mathrm{MCEV}_0 = \mathrm{Adj} + \underbrace{\mathrm{U}_1 + \mathrm{OpV}_1 + \mathrm{EcV}_1 + \mathrm{NBV}_1}_{\text{MCEV earnings}} \tag{11}$$

We now give a detailed mathematical description of the four major movement items that can be identified, and then present a detailed analysis of MCEV earnings in non-life insurance.

[71] See Diers *et al.* (2009).
[72] See CEIOPS (2010).
[73] See European Insurance CFO Forum (2009a).

(a) Unwinding (U_1*)*

In order to measure the true value creation of MCEV earnings, the unwinding of in-force business needs to be excluded since there is no additional value creation by the expected (existing) business contribution. For the calculation of the total unwinding effect, we separate between the unwinding effect of the present value of future profits ($\mathrm{U}_1^{\mathrm{PVFP}}$), the cost of residual nonhedgeable risks ($\mathrm{U}_1^{\mathrm{CRNHR}}$) and the frictional costs of required capital ($\mathrm{U}_1^{\mathrm{FCRC}}$). We consider the discount effect, i.e., we roll forward the corresponding value by its forward rate (fr_1) and take into account the release of CRNHR and FCRC allowance over the first accounting year. Thus, we have the following coherence:

$$\mathrm{U}_1^{\mathrm{PVFP}} = \mathrm{PVFP}_0 \cdot \mathrm{fr}_1 \tag{12}$$

$$\mathrm{U}_1^{\mathrm{CRNHR}} = \mathrm{COC} \cdot \mathrm{SCR\,II}_0 - \mathrm{CRNHR}_0 \cdot \mathrm{fr}_1 \tag{13}$$

$$\mathrm{U}_1^{\mathrm{FCRC}} = \left(\mathrm{icr} + \mathrm{tr} * (\mathrm{fr}_1 - \mathrm{icr})\right) \cdot \mathrm{RC}_0 - \mathrm{FCRC}_0 \cdot \mathrm{fr}_1 \tag{14}$$

The total unwinding effect of the in-force business (U_1) over the accounting period t=1 can be derived by summarizing the individual unwinding effects ($\mathrm{U}_1 = \mathrm{U}_1^{\mathrm{PVFP}} + \mathrm{U}_1^{\mathrm{CRNHR}} + \mathrm{U}_1^{\mathrm{FCRC}}$). Since $\mathrm{VIF}_0 = \mathrm{PVFP}_0 - \mathrm{CRNHR}_0 - \mathrm{FCRC}_0$, overall we obtain:

$$\mathrm{U}_1 = \mathrm{VIF}_0 \cdot \mathrm{fr}_1 + \mathrm{COC} \cdot \mathrm{SCR}_0 + (\mathrm{icr} + \mathrm{tr} * (\mathrm{fr}_1 - \mathrm{icr})) \cdot \mathrm{RC}_0 \tag{15}$$

(b) Operating and Economic Variances (OpV_1 *and* EcV_1*)*

In order to separate the effect of operating and economic variances from each other, we calculate the MCEV for the accounting period t=1 with operating/economic assumptions at t=1 denoted by expectations operator $\mathrm{E}_1^{\mathrm{op}}[.]$ or $\mathrm{E}_1^{\mathrm{ec}}[.]$, respectively, and with expected assumptions in t=0 denoted by expectations operator $\mathrm{E}_0[.]$. This difference corresponds to the impact resulting from assumption changes. We also compare the NOPAT_1 (for the accounting period t=1) based on assumptions in t=0 with that based on assumptions at t=1. This difference corresponds to the impact of experience variances:

$$\mathrm{OpV}_1 = \mathrm{E}_1^{\mathrm{op}}[\mathrm{MCEV}_1] - \mathrm{E}_0[\mathrm{MCEV}_1] + \left(\mathrm{E}_1^{\mathrm{op}}[\mathrm{NOPAT}_1] - \mathrm{E}_0[\mathrm{NOPAT}_1]\right) \tag{16}$$

$$\mathrm{EcV}_1 = \mathrm{E}_1^{\mathrm{ec}}[\mathrm{MCEV}_1] - \mathrm{E}_0[\mathrm{MCEV}_1] + (\mathrm{E}_1^{\mathrm{ec}}[\mathrm{NOPAT}_1] - \mathrm{E}_0[\mathrm{NOPAT}_1]) \quad (17)$$

(c) New Business Value (NBV_1*)*

In order to separate the impact of new business value, we first calculate the MCEV at t=1 with actual new business value realizations over the accounting period t=1 and with operating/economic assumptions at t=1 denoted by expectations operator $\mathrm{E}_1^{\mathrm{all}}[.]$. We then calculate the MCEV at $\mathrm{t} = 1$ with expected assumptions at t=0. In a second step, the difference between the NOPAT with assumptions in t=1 and t=0 also has to be taken into account (experience variances). Additionally, to separate the new business value from the economic and operating variances, those variances also have to be deducted. We thus obtain:

$$\mathrm{NBV} = \mathrm{E}_1^{\mathrm{all}}[\mathrm{MCEV}_1] - \mathrm{E}_0[\mathrm{MCEV}_1] + \left(\mathrm{E}_1^{\mathrm{all}}[\mathrm{NOPAT}_1] - \mathrm{E}_0[\mathrm{NOPAT}_1]\right) - \mathrm{OpV}_1 - \mathrm{EcV}_1 \quad (18)$$

MCEV versus Residual Income Valuation

In its broadest sense, the concept of MCEV is the same as the concept of residual income valuation. Thus, we utilize the expression of O'Hanlon and Peasnell[74] for "excess money return" which describes the observed excess of the periodic change in entity value over that required by the owners and formulate the net value created (NVC) in terms of MCEV for the accounting period t=1 by:[75]

$$\mathrm{NVC}_1 = (\mathrm{MCEV}_1 - \mathrm{MCEV}_0 + \mathrm{C}_1) - (\mathrm{k} \cdot \mathrm{MCEV}_0) = (\mathrm{MCEV}_1 - \mathrm{MCEV}_0 + \mathrm{C}_1) - (\mathrm{U}_1) \quad (19)$$

where C_1 corresponds to all the cash flows paid out to shareholders, e.g., dividends. The first term on the right hand side of equation 19 corresponds to the MCEV earnings and the second term presents the total unwinding effect of the expected (existing) business contribution in the beginning of the year (see equation 15).

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[74] See O'Hanlon and Peasnell (1998).

[75] We adopt the expression "net value created" from Schüler and Krotter (2008). The latter part of NVC_1 corresponds to a situation where expectations in the beginning of the year are met, i.e., the net value creation is emerged from the gross value creation by deducting the so-called time effect (see Schüler and Krotter, 2008). The time effect based on the (non-life) MCEV valuation model described in Diers et al. (2009) exactly corresponds to the unwinding U_1. For MCEV calculations in life insurance, however, the time effect would be measured differently; financial options and guarantees imply the use of risk-neutral or deflator valuation techniques (see European Insurance CFO Forum, 2009a) and therefore the expected payoff should be evaluated using stochastic valuation techniques as described in Sheldon and Smith (2004).

4. Theoretical and Numerical Comparison of EVA/RAROC and MCEV Earnings

Diers *et al.*[76] transfer the concept of MCEV valuation from life to non-life insurance business in order to find a consistent approach at the insurance group level. In Section 3, we adopt their approach and extend the valuation model by a detailed analysis of MCEV earnings (see Section 3.2). Based on this performance evaluation model, we now are able make a theoretical and numerical comparison between EVA/RAROC and MCEV earnings for a non-life insurance company.

4.1 Theoretical Comparison

Based on the EVA valuation model, the value of the company is defined as the sum of net asset value (NAV) and the market value added (MVA). MCEV is defined as NAV plus value of in-force business (VIF). Thus, comparing the EVA valuation model with MCEV requires comparison of MVA with VIF. Table 1 presents a quantitative comparison between the calculations of MVA according to Danhel and Sosik[77] and of VIF according to Diers *et al.*[78] for a non-life insurance company.

Market Value Added	**Value of in-force business**
$\mathrm{MVA} = \sum_{t=1}^{T'} \frac{\mathrm{EVA}_t}{(1+\mathrm{COC})^t} + \mathrm{TV}$	$\mathrm{VIF}_0 = \mathrm{PVFP}_0 - \mathrm{CRNHR}_0 - \mathrm{FCRC}_0$
$= \sum_{t=1}^{T'} \frac{\mathrm{NOPAT}_t - \mathrm{COC} \cdot \mathrm{NAV}_{t-1}}{(1+\mathrm{COC})^t} + \mathrm{TV}$	$= \sum_{t=1}^{T} \left(\frac{\mathrm{NOPAT}_t}{(1+\mathrm{sr}_t)^t} \right) - \mathrm{CRNHR}_0 - \mathrm{FCRC}_0$
$= \sum_{t=1}^{T'} \left(\frac{\mathrm{NOPAT}_t}{(1+\mathrm{COC})^t} - \frac{\mathrm{COC} \cdot \mathrm{NAV}_{t-1}}{(1+\mathrm{COC})^t} \right) + \mathrm{TV}$	$= \sum_{t=1}^{T} \left(\frac{\mathrm{NOPAT}_t}{(1+\mathrm{sr}_t)^t} - \frac{\mathrm{COC} \cdot \mathrm{SCR\ II}_{t-1}}{(1+\mathrm{sr}_t)^t} \right) - \mathrm{FCRC}_0$

Table 1: Quantitative Comparison of MVA and VIF

For the calculation of MVA, we consider a projection process of discounted future cash flows, i.e., the present value of all future EVAs. For practical applications, the present value of all future EVAs is divided into the sum of the projection of a forecast period and a terminal value

[76] See Diers *et al.* (2009).
[77] See Danhel and Sosik (2004).
[78] See Diers *et al.* (2009).

(TV) as perpetuity. The determination of an appropriate time horizon for the EVA valuation process must be a trade-off between the allowance of long-term character of insurance business on the one side and a careful consideration of the ability to set correct assumptions for the future on the other side. On average, a projection horizon T′ of 15-20 years is used before the TV is added as perpetuity.[79] Taking into consideration the premise of going concern, future cash flows are divided into run-off of existing business and future new business. For the determination of the cost of capital, the cost of capital rate is applied to the NAV at time t-1. Finally, the discount rate equals the cost of capital rate.[80]

For the calculation of VIF, however, we have a projection process of discounted future cash flows until the state of complete settlement of the existing insurance business has been reached. In contrast to MVA, VIF does not consider future new business (i.e., goodwill). The projection horizon T therefore emerges from the expectations over the time horizon for the settlement process of existing business. For the determination of the cost of capital, the cost of capital rate is applied to the solvency capital requirement according to Solvency II[81] (SCR II) at time t-1. As a discount rate, a risk-free rate, derived from a risk-free yield curve at t=0 consisting of spot rates (sr_t) for each relevant time to maturity, is used. Finally, in contrast to MVA, the FCRC are taken into account additionally, which reflect extra costs (taxation and investment on RC) due to regulatory restrictions.

Table 2 presents a qualitative comparison between the principles of calculation of MVA and VIF. A first important difference emerges from the consideration of future new business. While MVA takes into account goodwill (i.e., value of future new business), VIF does not. In addition, while the MVA concept uses a risk-adjusted discount rate (COC) in order to incorporate risk, the VIF makes allowance for risk by the consideration of frictional costs of

[79] See Danhel and Sosik (2004).

[80] The choice of the cost of capital rate is essential for the determination of MVA, as well as for VIF. For the calculation of an appropriate cost of capital rate for insurance companies we refer to Zanjani (2002), Cummins and Phillips (2005), and Froot (2007).

[81] See CEIOPS (2010).

required capital (FCRC) and cost of residual nonhedgable risks (CRNHR) and uses a risk-free discount rate.[82]

Criteria	Market Value Added	Value of in-force business
Future new business	Yes	No
Time horizon	Reasonable time horizon T for cash flow modeling and additional consideration of a terminal value	Complete settlement of the insurance business in year T'
Discount rate	Cost of capital rate	Risk-free rate
Frictional costs	No	Yes

Table 2: Qualitative Comparison of MVA and VIF

In conclusion, the two concepts are not too different.[83] Through the consideration of future cash flows (and thus the incorporation of franchise value), EVA valuation and MCEV both reduce the accounting bias and thus bring accounting-based performance measures more in line with market-based performance measures. Both EVA and MCEV valuation can be traced back to the residual income valuation theory. The similarity of the underlying valuation concepts makes it possible to give a detailed comparison between the performance measures EVA/RAROC on one side and the MCEV earnings on the other side, and helps us to emphasize existing coherences.

EVA/RAROC versus MCEV Earnings

EVA measures the value added through the accounting profit of one economic period in excess of the capital charge based on the NAV, i.e., the cost of capital. The economic counterpart of EVA, the net value created (NVC), is defined as the value added, expressed in terms of change in MCEV over time, in excess of the unwinding effect of existing business contribution (see equation 19). This can also be expressed as:[84]

$$\mathrm{NVC}_1 = \mathrm{NAV}_1 - \mathrm{NAV}_0 + \mathrm{C}_1 - \mathrm{U}_1 + (\mathrm{VIF}_1 - \mathrm{VIF}_0) \qquad (20)$$

[82] Due to the new principles for the calculation of MCEV, the concept of a risk discount rate that was used in previous embedded value approaches was replaced by valuing assets and liabilities in line with market prices (see De Mey, 2009).

[83] The difference between the EVA valuation model and the MCEV is very similar to the difference between the traditional embedded value concept and the MCEV as described in O'Keeffe *et al.* (2005). Accordingly the results of both traditional and market-consistent methods should be comparable. However, the use of MCEV in life and non-life gives the management at group level a consistent technique for measuring value creation.

[84] See, e.g., O'Hanlon and Peasnell (1998).

The difference between VIF_1 and VIF_0 denotes unrecorded franchise value during the accounting period t=1. Hence, we have the following relationship between the EVA and MCEV earnings:

$$\mathrm{NVC}_1 = \mathrm{EVA}_1 + (\mathrm{VIF}_1 - \mathrm{VIF}_0) - (\mathrm{U}_1 - \mathrm{COC} \cdot \mathrm{NAV}_{t-1}) \quad (21)$$

Thus, the NVC can be split into (a) the residual income as excess money return on the book value component of EVA (EVA_1) and (b) the excess money return on unrecorded franchise value: $(\mathrm{VIF}_1 - \mathrm{VIF}_0) - (\mathrm{U}_1 - \mathrm{COC} \cdot \mathrm{NAV}_{t-1})$. Hence, equation 21 presents a direct link between the residual income of one accounting period (EVA) and the residual income of all the future accounting periods.

As stated above, RAROC is defined as the ratio of the NOPAT and risk-adjusted capital. The corresponding return on embedded value (ROEV) is then the ratio of the MCEV earnings (over the accounting period t=1) divided by the opening MCEV (in t=0) (see equation 8). Thus, in the case of using NAV for the calculation of risk-adjusted capital, EVA can be transformed into RAROC using the following equation (see equation 7):

$$\mathrm{RAROC} - \mathrm{RoEV} = \frac{\mathrm{NOPAT}_1}{\mathrm{NAV}_0} - \frac{\text{MCEV earnings}}{\mathrm{MCEV}_0} = \frac{\mathrm{EVA}_1}{\mathrm{NAV}_0} + \mathrm{COC} - \frac{\mathrm{NVC}_1 + \mathrm{U}_1}{\mathrm{MCEV}_0} \quad (22)$$

We thus conclude that the different concepts of EVA/RAROC on one side and MCEV earnings on the other can be unified within a single consistent framework, i.e., the residual income valuation theory.

4.2 Numerical Comparison

In order to give a numerical comparison between EVA/RAROC and MCEV earnings, we now apply both methods to a fictitious German non-life insurer. All the following numbers and figures are based on numbers used by the Working Group on internal models of the German Actuarial Society.[85] For simplicity and illustration purposes, we only consider one line of business: motor third-party liability insurance. All MCEV calculations are based on the

[85] See DAV-Arbeitsgruppe Interne Modelle (2008).

valuation model described in Diers *et al.*[86]; all assumptions and parameters are used.[87] The cost of capital rate is therefore set equal to 6% as suggested by the European Union solvency regulations (Solvency II).[88] The statutory balance sheet according to German local GAAP at valuation date December 31, 2008 of the considered (fictitious) non-life insurance company is shown in Figure 3.[89]

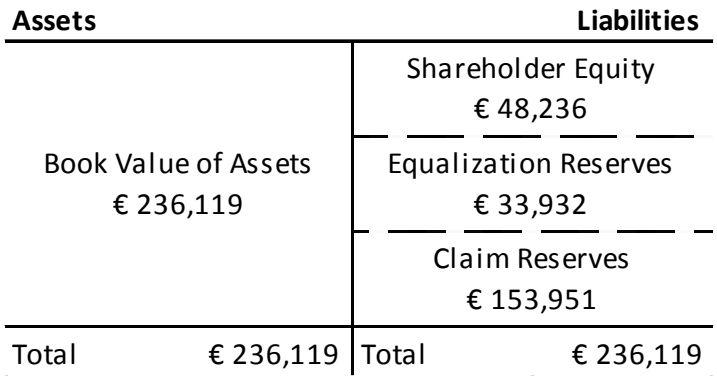

Figure 3: Statutory Balance Sheet as of December 31, 2008

We now assume that the actual development (actual experience) of the insurance company over the accounting year 2009 shows deviations – with regard to economic and non-economic (operating) factors – from the expectations at the beginning of the year. This leads to economic and operating variances, both based on experience variances and assumption changes. Table 3 sets out the anticipated input factors and the actual development over the 2009 accounting year. In addition, we assume that 3% of the initial number of insurance contracts were written as new business during the 2009 accounting year. Overall, the actual performance leads to a statutory balance sheet as well as a profit and loss account (P&L statement) as presented in Figure 4.

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86 See Diers *et al.* (2009).

87 For illustration purposes Diers *et al.* (2009) use two different scenarios for their MCEV calculations: one scenario neglecting renewal business (i.e., cancelation rate of 100%) and another scenario making a reasonable assumption with regard to renewals (using a cancelation rate of 13%). The present analysis is based on the second scenario.

88 See CEIOPS (2010).

89 According to German local GAAP the reserves are split up between the claim reserves and equalization reserves. Hereby the equalization reserves correspond to a special kind of reserves to compensate fluctuations in loss ratios over time. For more details on the different kind of reserves we refer to Diers *et al.* (2009).

Input Factor	Anticipated	Actual
Loss Ratio	70.80%	70.50%
Acquisition Costs	13.00%	12.50%
Risk-Free Yield Curve (Spot Rate)	3.92%	3.42%

Table 3: Variance of Parameters during Accounting Year 2009

Assets		Liabilities	
Book Value of Assets € 217,829		Shareholder Equity € 33,563	
		Equalization Reserves € 33,279	
		Claim Reserves € 150,987	
Total	€ 217,829	Total	€ 217,829

P&L Account	
Premium Income	€ 121,530
Claims Payment	€ 87,936
Release of Claim Reserves	-€ 2,964
Release of Equalizaton Reserves	-€ 653
Costs	€ 23,043
Investment Income	€ 6,243
Earnings before Interest and Taxes	€ 20,412
Taxes	€ 6,532
NOPAT	€ 13,880

Figure 4: Statutory Balance Sheet and Profit & Loss Account as of December 31, 2009

Table 4 presents the associated analysis of MCEV earnings. The opening MCEV is € 129,438 and the closing MCEV is € 109,477. Dividends paid out to the shareholders amount to € 28,708 (= 14,828 + 13,880).[90] Thus, the total MCEV earnings equal € 8,747. These consist of the new business value (€ 391), the unwinding of the existing insurance business (€ 5,441), operating variances (€ 3,336), and economic variances (-€ 421). More details on the separate presentation between the value of in-force business (VIF), required capital (RC) and free surplus (FS) are available upon request.

	PVFP	FCRC	CRNHR	RC	FS	MCEV
Opening MCEV	91,190	-2,193	-8,760	34,373	14,828	129,438
Opening Adjustments					-14,828	-14,828
New Business Value	435	-22	-22	1,118	-1,118	391
Unwinding MCEV	3,575	392	1,474	-4,735	4,735	5,441
Operating Variances	3,872	-124	-412	235	-235	3,336
Operating MCEV Earnings	7,882	246	1,040	-3,383	3,383	9,168
Economic Variances	-430	-37	46	0	0	-421
Total MCEV Earnings	7,452	209	1,086	-3,383	3,383	8,747
Closing Adjustments	-13,880					-13,880
Closing MCEV	84,762	-1,983	-7,674	30,989	3,383	109,477

Table 4: Analysis of MCEV Earnings

[90] Based on Diers *et al.* (2009), for the reason of simplification, we assume that free surplus (FS) of the accounting year 2008 in the beginning of the accounting year 2009 (Opening Adjustment) and the annual net income (NOPAT) of the 2009 accounting year at the end of the 2009 accounting year (Closing Adjustment) are paid as dividends to the shareholders.

For the unwinding of the existing business, two impacts can be identified: (1) we have discount effects since now there is one year less of discounting; and (2) we have a release within the FCRC and the CRNHR for risk allowance.[91] The negative impact of change in interest rates and thus the negative impact of the actual development of financial markets, i.e., economic variances, are compensated by a positive impact of experience change in the loss ratio and acquisition costs, i.e., operating variances. Nevertheless, since we have a natural split between operating and experience variances within the movement analysis, the different effects can be identified and explained.

EVA/RAROC versus MCEV Earnings

Having calculated the MCEV earnings for the accounting year 2009, we can measure the performance of the insurance company for the 2009 reporting period by calculating the NVC. Hereby the NVC is equal to € 3,306 ($= 8{,}747 - 5{,}441$). The EVA for the accounting year 2009 is equal to € 10,928 ($= 13{,}880 - 0.06 \cdot 49{,}201$). The difference between EVA and NVC in the amount of € 7,622 exactly corresponds to the excess money return on unrecorded franchise value, see equation 21 ($= (75{,}105 - 80{,}237) - (5{,}441 - 0.06 \cdot 49{,}201)$).

The RoEV is equal to 6.76% ($= 8{,}747/129{,}438$). The RAROC is equal to 28.21% ($= 13{,}880/49{,}201$). The difference between RAROC and RoEV in the amount of 21.45% corresponds exactly to the difference between the return on EVA and the return on NVC, see equation 22 ($= 10{,}928/49{,}201 + 0.06 - (3{,}306 + 5{,}441)/129{,}438$).[92]

Overall we find that the numerical comparison between EVA/RAROC and MCEV earnings leads to the same results as the theoretical comparison within Section (4.1) and thus provides a direct link between the different concepts.

[91] We refer to Diers *et al.* (2009) for more details.

[92] For the reason of comparability, we assume that the risk-adjusted capital within RAROC exactly corresponds to the NAV.

5. Conclusion

The aim of this paper is to compare the different performance metrics used for value-based management in life and non-life insurance business in order to identify a consistent basis for performance measurement at the insurance group level. For this purpose, we perform a detailed comparison between the EVA and RAROC concept used in non-life insurance, and the analysis of MCEV earnings used in life insurance.

For a theoretical comparison we oppose EVA and MCEV. We find that, except for some minor details, i.e., (1) consideration of goodwill, (2) consideration of frictional cost, and (3) the use of different discount rates, both concepts are very similar and can be traced back to the residual income valuation theory. Furthermore, we show a direct link between EVA/RAROC and MCEV earnings by explaining the difference in terms of unrecorded franchise value. For a numerical comparison, based on the fictitious German non-life insurer described in Diers *et al.*,[93] we use the movement analysis template provided by the European Insurance CFO Forum[94] to explain the analysis of MCEV earnings and illustrated the unrecorded franchise value.

The concept of MCEV earnings is thus directly comparable to the concept of EVA/RAROC and can be used consistently at the insurance group level. Although non-life insurance contracts usually expire after one year, they are renewed on a rolling basis and thus lead to long-term business operations. Hence at the insurance group level, in line with Exley and Smith[95] and Brealey *et al.*,[96] we suggest the use of discounted cash flow based performance measures such as MVA or MCEV in order to reduce accounting bias and to bring accounting-based measures of return more into line with market-based measures of return.

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93 See Diers *et al.* (2009).
94 See European Insurance CFO Forum (2009a).
95 See Exley and Smith (2006).
96 See Brealey *et al.* (2011).

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