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**Is market value-based residual income a superior
performance measure compared to book value-based
residual income?**

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Abstract

With the increasing use of residual income-based concepts of performance measurement, significantly different formulas are proposed for calculating both the firm's operating profit as well as its cost of capital. On the one hand, there is the traditional book value-based approach (EVA), on the other hand there are market value-based approaches, in which either only the cost of capital (REVA) or both cost of capital and the firm's operating profit before interest (residual economic income, REI) are determined by using market values.

In our paper, we compare the advantages and disadvantages of these different types of residual income measurement. Our results are the following. First, we show that REVA compared to EVA might lead to underinvestment in projects with a strictly positive net present value as well as to overinvestment in projects with a strictly negative net present value even if principal and agent discount a project's income stream at the same rate. Second, we show that a proposition to base incentives on strictly positive EVA targets derived from an observed Market Value Added (MVA) equals the application of a REVA-type performance measure and, therefore, might be afflicted with the same deficiencies.

Keywords: Residual Income Measurement, Economic Value Added, Refined Economic Value Added, Economic Income, Incentives

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1 Introduction

In recent years, different concepts of residual income measurement have been widely discussed within the field of value-based management in both academic research and corporate practice. The objective has been to define a performance measure that strictly motivates an agent to implement all available investment projects with a non-negative net present value. Typical assumptions under which these types of performance measurement are discussed are the existence of unrestricted financial means at a given cost of capital and information asymmetry between the principal and the agent with regard to the net present value of the investment projects chosen by the agent.

Generally, residual income is measured by deducting a capital charge from the firm's profit. The exact way on how either profit or cost of capital is measured, is not specified at all. The only crucial assumption made in most cases is that the sum of accrued earnings measuring the firm's operating profit equals the sum of cash flows from operating and financing activities. In that case, Preinreich (1937) and Lücke (1955) have shown that the sum of discounted residual income resulting from a given investment project is equal to the project's net present value. Consequently, residual income measurement leads to an equivalent project choice compared to decision-making based on a project cash flows: the value of the discounted residual income stream equals the project's net present value.

Among the many concepts of residual income measurement that have been discussed in previous years (Bromwich/Walker, 1999), the varying use of book values versus market values in determining the firm's profit and/or the capital charge is a striking difference:

- book value-based measurement of both profit and capital charge, e.g. Stern Stewart's Economic Value Added (EVA) (see Stewart, 1991; Stewart, 1994; Stern/Shiely/Ross, 2001),
- book value-based profit measurement, market value-based measurement of capital charge, e.g. Refined Economic Value Added (REVA) (see Bacidore et al., 1997)
- market value-based profit measurement of both profit and capital charge, i.e. residual economic income (REI).

In our paper, we analyze the question whether market-based residual income – either as REVA or as REI – is superior to the commonly used book-value based approach (EVA). Our discussion is structured as follows. In section 2, we provide an overview on EVA, REVA and

REI as different types of residual income-based performance measurement. In section 3, we give a detailed analysis on the information provided by these performance measures. In section 4, we focus more closely on the incentive effects of REVA vs. EVA. We show that REVA could result in either underinvestment in projects with a positive net present value or overinvestment in projects with a negative net present value, both compared to EVA. In section 5 we discuss the possibility of using the MVA to derive EVA targets for investment centers. We prove that with an infinite horizon these targets equal the application of REVA. Section 6 concludes the paper.

2 Residual income-based performance measurement

Of all approaches to residual income-based performance measurement, Stern Stewart's Economic Value Added (EVA) has gained the most attention in economic practice. Its underlying philosophy is intuitively evident. Since investors require a return as a compensation for providing funds and bearing business risk, the firm's operating profit must exceed the cost of capital to create wealth for the shareholders. Therefore, Stern Stewart defines EVA as NOPAT less a capital charge that reflects the cost of capital:

$$(1) \quad EVA_t = NOPAT_t^{BV} - r \cdot I_{t-1}^{BV}$$

$NOPAT_t^{BV}$ is the net operating profit after adjusted taxes in period t , r is the cost of capital, usually calculated as weighted average cost of capital (WACC), and I_{t-1}^{BV} represents the firm's gross investment (assets) at the beginning of period t . Both net operating profit and the firm's gross investment are accounted for based on book values, i.e. I represents the cash outflows from a firm's investment after depreciation and impairment and NOPAT represents the changes in a firm's equity including (entity approach) the firm's interest payments.

A strong link can be established between future EVAs and the value of the firm by defining the present value of all future EVAs as Market Value Added (MVA): The sum of book value based investment I^{BV} and MVA formally equals the overall market value of the firm calculated on an estimated stream of cash flows.

To "eliminate various accounting distortions" (Stern/Shiely/Ross, 2001, p. 20) under an EVA regime, in many cases income statement and balance sheet are subject to various adjustments in deriving NOPAT and Capital, converting the underlying measurement from a firm's accounting model to the more appropriate economic model. The objectives of these adjust-

ments are e.g. to capture all sources of financing (e.g. leases) or to eliminate accounting conservatism (e.g. capitalization of R&D expenses). Although fair values are introduced in some cases both in profit measurement as well as in determining the level of investment, even after Stern Stewart's accounting adjustments a substantial part of the firm's original goodwill accounting for the difference in book value of the firm's assets and its market value is usually not included in the investment I^{BV} .

Critics of Stern Stewart's EVA argue that the book value-based EVA measurement framework does not capture the investors' opportunity costs as EVA does not take into account that investors expect a return on the market value of the firm. If investors sell the firm for its market value and invest their proceeds in assets identical in risk, they could expect to earn a return equal to the firm's WACC on the firm's overall market value and not only on the book values of the firm's investment shown in the balance sheet. Consequently, the capital charge has to reflect this opportunity cost of investors (Richter/Honold, 2000).

Mainly to overcome this shortcoming of EVA, Bacidore et al. (1997) have suggested to replace it by a measure they named REVA (Refined Economic Value Added). They define REVA as

$$(2) \quad REVA_t = NOPAT_t^{BV} - r \cdot I_{t-1}^{MV}$$

In comparison to EVA the basis for the capital charge is the market value of the firm I_{t-1}^{MV} rather than (adjusted) book values I_{t-1}^{BV} of its assets. Compared to EVA, REVA results in a higher capital charge, if the firm's market value exceeds the adjusted book values of its assets, and vice versa. Until now the REVA approach has not gained the popularity of EVA, but we have knowledge of some companies applying it successfully. In order to avoid recalculation of the market value every year they freeze the MVA for several years and alter book values according to the investments net of depreciation undertaken during this period.

Comparing REVA to EVA, REVA has a severe pitfall as any changes in market value I_{t-1}^{MV} are included into the capital charge, but not in a corresponding measure into the net operating profit $NOPAT_t^{BV}$. Only if these changes are realized in the accounting accruals, e.g. by an impairment of assets, both profit measurement and capital charge do match under an REVA regime.

This pitfall is avoided by residual economic income (REI) as a third type of residual income-based performance measurement. REI is – in contrast to EVA and REVA – entirely

based on market values. Its theoretical foundation is the concept of economic income (EI) which has been discussed in economic theory for a long time (Fisher, 1906; Hicks, 1946). The economic income of a given period t is defined as the change in equity value of the firm plus net cash flows distributed to its shareholders during this period. This definition ensures that the any changes in a firm's cash flow profile determining its overall market value are captured in a comprehensive way. Deduction a capital charge from economic income then leads to residual economic income (REI). As in the REVA approach, the capital charge reflects investor's full opportunity cost, because the capital charge is calculated on the basis of the market value of equity. Summarized, REI is defined as follows:

$$(3) \quad REI_t = NOPAT_t^{MV} - r \cdot I_{t-1}^{MV} \quad \text{with } NOPAT_t^{MV} = V_t - V_{t-1} + CF_t \text{ and } I_{t-1}^{MV} = V_{t-1}$$

with V_t representing the sum of discounted (free) cash flows CF at the end of period t .

From a theoretical ex ante perspective, REI is the best performance measure, since it captures all present and future cash flows resulting from managerial activities during a given period t (Hax, 1989). What makes REI inappropriate for incentive purpose is the subjectivity in calculation of the firm's market value in case of non-listed firms. Nevertheless, REI constitutes the benchmark for our following discussion of residual income concepts.

3 Information content of REI, REVA, and EVA

In this section, we discuss the information content of the three concepts of residual income measurement outlined in the previous section. In other words, we formalize in how far a firm's economic periodic performance is reflected by these performance measures.

As indicated in section 2, the benchmark solution is REI, as it is based on economic income and therefore captures all present and future cash flows induced by managerial decisions. Starting with the analysis of the firm's economic income, it can be exhaustively decomposed into three effects: time effect, investment effect, and information effect (Laux, 1999, pp. 166-173; Neus, 1998, pp. 341-346). These effects can be illustrated, if the cash flows CF_t of any period t that is included into the measurement of economic income at a given time is split into three components:

$$(4) \quad CF_t = CF_t^P + CF_t^{inv} + \Delta CF_t^P$$

CF_t^P represents the cash flows that have been planned for t in $t-1$. CF_t^{inv} represents the cash flows that result from new investment projects that have been undergone during the period,

and $\Delta CF_t^p = CF_t^p - CF_t^R$ is difference between the planned cash flows CF_t^p and the realized cash flows CF_t^R

$$(5) \quad EI_t = I_t^{MV} - I_{t-1}^{MV} = V_t + CF_t - V_{t-1} = \sum_{\tau=t+1}^T CF_{\tau} q^{-(\tau-t)} + CF_t - \sum_{\tau=t}^T CF_{\tau} q^{-(\tau-(t-1))}$$

Equation (4) together with (5) can be restated as

$$(6) \quad EI_t = \underbrace{\sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-t)} + CF_t^p - \sum_{\tau=t}^T CF_{\tau}^p q^{-(\tau-(t-1))}}_{\text{time effect}} + \underbrace{\sum_{\tau=t+1}^T CF_{\tau}^{inv} q^{-(\tau-t)} + CF_t^{inv}}_{\text{investment effect}} + \underbrace{\sum_{\tau=t+1}^T \Delta CF_{\tau}^p q^{-(\tau-t)} + \Delta CF_t^p}_{\text{information effect}}$$

Note that any change in a firm's market value can be attributed to one of the three effects which are have to be explored in further detail.

(1) The *time effect* explains the component of economic income, that simply results from the time elapsed from the beginning to the end of the period. The following example may illustrate this point: A firm has a WACC of 10% and consists of one asset only from which a one time cash flow of 100 is expected in period 3. At the beginning of the period the present value of the firm is 75.13, at the end it is 82.64. Consequently, the economic income is 7.51 in this period. It equals exactly the interest gained on the firm's market value at the beginning of the period, if expectations of future cash flows and interest rates remain unchanged as assumed in our example.

Proposition: $V_t^p + CF_t^p - V_{t-1}^p = r \cdot V_{t-1}^p$

Proof: The equation's left hand side can easily be restated so that the following holds

$$\begin{aligned} & \sum_{\tau=t+1}^T CF_{\tau} q^{-(\tau-t)} + CF_t^p - \sum_{\tau=t}^T CF_{\tau}^p q^{-(\tau-(t-1))} \\ &= \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-t)} + CF_t^p - \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-(t-1))} - CF_t^p q^{-1} \end{aligned}$$

$$\begin{aligned}
&= \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-t)} + CF_t^p - \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-(t-1))} - CF_t^p q^{-1} \\
&= \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-t)} + CF_t^p - q^{-1} \sum_{\tau=t+1}^T CF_{\tau}^p q^{-(\tau-t)} - CF_t^p q^{-1} \\
&= V_t^p + CF_t^p - q^{-1} (V_t^p + CF_t^p) \\
&= (1 - q^{-1}) (V_t^p + CF_t^p) \\
&= r \cdot q^{-1} (V_t^p + CF_t^p) \\
&= r \cdot V_{t-1}^p \\
&\text{q.e.d.}
\end{aligned}$$

The concept of time value of money gives an explanation for the time effect. Since people normally prefer earlier cash flows to later ones, the situation at the end of the period is an improvement compared to the beginning of this period. This improvement is identical to the interest that investors would have gained, if they had sold the firm for its market value at the beginning of the period and had invested the proceeds at the capital market (provided that the discount rate equals the rate of return on the capital market). As the time effect therefore simply results from the market valuation process, it is not stipulated by the firm's economic activities during that period.

(2) To define the *investment effect*, we assume that all management decisions have consequences on present and future cash flows. Typically, investment decisions result in an immediate cash outflow and additional cash inflows in the same and/or future periods. Economic income increases or decreases by the net effect of these cash flows – the net present value. Therefore, we define the component of economic income that is causally related to a firm's managerial decision making as the investment effect. It may be interpreted as an indicator for the quality of the decisions undertaken by the management within a certain period of time.

(3) In addition to pure time elapse and management decisions, changes of expectations on cash flows. This is called the *information effect*, because it represents the component of economic income that can be attributed to new or revised information about the firm's prospects. On closer inspection the information effect comprises two aspects: First, economic income results from the difference between expected cash flows for the current period and those actually realized. Secondly, it reflects the change of the firm's market value within the period as a con-

sequence of a revised projection of future cash flows at period end due to additional information.

The extent to which these effects are incorporated in the approaches to residual income measurement discussed in the previous section depends on their reliance on the market value of the firm instead of book values of its assets.

Since REI is entirely based on the firm's market value, the time effect is neutralized in the REI approach by deducting the capital charge calculated on a market value-basis so that the remaining *residual* economic income (i.e. REI) is confined to investment effect and information effect ($r \cdot V_{t-1}^p = r \cdot I_{t-1}^{MV}$).

Eliminating the time effect may be interpreted as setting a hurdle that reflects the opportunity costs of investors: in the absence of any other effects, REI is zero if and only if this hurdle is met and thus the investors' opportunity costs have been realized. If managers undertake new investment projects they increase or decrease the REI by the NPV of these new investment projects, because REI as an entirely market value-based measure does reflect any change in expectations of future cash flows immediately and fully.

With respect to eliminating the time effect component from periodic income REVA takes investor's opportunity costs into account to the same extent as REI does, because in the REVA approach the capital charge is calculated on the basis of the firm's market value as well. But due to its hybrid character (NOPAT based on book values, capital charge based on market value) REVA differs from REI when it comes to a change in expectations about future cash flows of the firm either due to new investment projects or because of new or revised information. In both cases the change in the firm's market value results in a higher or lower capital charge from the following period on. In addition to the impact on the capital charge, REVA is affected by new investment projects insofar, as they have an impact on the current period's *NOPAT*.

The impact on *NOPAT* consists of additional net cash flows less depreciation induced by the new investment projects. The same holds for new information: the impact on the *NOPAT* is confined to the impact this information has on cash flows of the current period. Thus, information that influences future cash flows has impact on current *NOPAT* only with regards to impairments. Both investment effect and information effect are therefore incorporated in REVA in a very rudimentary way due to the book value basis in calculating *NOPAT*. This re-

sults in a mismatch of the three effects in REVA: While the time effect is eliminated completely (as an expression of investor's opportunity costs), the other effects are included in periodic income only partially.

Since *NOPAT* is not only a component of REVA but of EVA as well, the argument concerning the impact new information and additional investments have on *NOPAT* holds for EVA in exact the same manner: information effect and investment effect influence *NOPAT* only insofar, as the *NOPAT* (cash flows net of depreciation) of the current period changes. But EVA differs from REVA in calculating the capital charge by using book values as a calculation basis instead of market values, which means that capital charge in EVA is an incomplete compensation of the time effect of economic income. Thus, EVA does not incorporate the entire opportunity costs investor's face when investing in a firm.

4 Incentive effects of residual income-based performance measurement

In section 3, REI has been characterized as the performance measure that captures the consequences of a firm's periodic economic performance regarding managerial project implementation in a comprehensive way.

Unfortunately, residual income measurement does not provide a clear signal on managerial decision-making. More specifically, a positive (negative) residual economic income does not indicate whether projects with positive (negative) net present value have been implemented, as the investment effect e.g. of a project with positive net present value might be wholly or at least partially set of (or reinforced) by a modification of expectations on the cash flow profile of projects implemented in earlier periods. As the signals of both investment effect and information effect can be observed only in a combined way, REI is clearly not suited for management incentive purposes under asymmetric information with regards to managerial project implementation.

This shortcoming is even reinforced if the manager whose economic performance is to be measured may even influence the expectations on future cash flows either by giving discretionary signals to the capital markets or by being directly asked to provide estimations on the firm's cash flow profile.

For this reason, in corporate practice management compensation schemes rely usually on book value-based residual income, such as Stern Stewart's EVA. It can easily be shown (see Reichelstein, 1997, that basically EVA leads to a first best level of investment if unrestricted

financial means are available, i.e. every project with non-negative NPV is to be implemented, if principal and agent use the same discount rate r to evaluate future streams of income, and if there is no other source of disutility, e.g. some cost of effort, which the agent is subject to.

Proposition: If the agent can be provided with unrestricted financial means at a rate r , if principal and agent use the same discount rate r to evaluate future streams of income, and if there is no other source of disutility, e.g. some cost of effort, which the agent is subject to, then an EVA-based linear incentive scheme leads to the first-best level of investment.

Proof: If the principal sets the level of investment I^* in $t = 0$ we have

$$\max \sum_{t=1}^T CF_t q^{-t} - I$$

with $q = (1 + r)$ and

with $CF_t = x_t(I)$ and

with $x_t(I) > 0$, $x'_t(I)$ and $x''_t(I) < 0$

$$\Rightarrow \sum_{t=1}^T x'_t(I^*) q^{-t} = 1$$

If the agent sets the level of investment I^* in $t = 0$ based on EVA with

$$EVA_t = x_t(I) - ab_t \cdot I - r \left(1 - \sum_{\tau=1}^{t-1} ab_{\tau} \right) I$$

with ab being the depreciation rate and with $\sum_t ab_t = 1$

we have

$$\max \sum_{t=1}^T EVA_t q^{-t} = \max \sum_{t=1}^T \left(x_t(I) - ab_t \cdot I - r \left(1 - \sum_{\tau=1}^{t-1} ab_{\tau} \right) I \right) q^{-t}$$

$$\Rightarrow \sum_{t=1}^T \left(x'_t(I^{EVA}) - ab_t - r \left(1 - \sum_{\tau=1}^{t-1} ab_{\tau} \right) \right) q^{-t} \stackrel{!}{=} 0$$

$$\Leftrightarrow \sum_{t=1}^T x'_t(I^{EVA}) q^{-t} = \sum_{t=1}^T \left(ab_t + r \left(1 - \sum_{\tau=1}^{t-1} ab_{\tau} \right) \right) q^{-t}$$

As Preinreich (1937) and Lücke (1955) have shown that

$$\sum_{t=1}^T \left(ab_t + r \left(1 - \sum_{\tau=1}^{t-1} ab_{\tau} \right) \right) q^{-t} = 1 \text{ if } \sum_{t=1}^T ab_t = 1$$

this can be restated as

$$\sum_{t=1}^T x_t '(I^{EVA}) q^{-t} = 1 = \sum_{t=1}^T x_t '(I^*) q^{-t}$$

q.e.d.

Even though EVA leads to the first-best investment level, several authors (Baciodore et al., 1997, Richter/Honold, 2000) criticize that the book value-based capital charge deducted from *NOPAT* under an EVA regime does not reflect the investors' opportunity costs which have to be calculated on a market value basis. The reasoning behind this argument is the following: Investors could sell the firm at any point of time and invest their proceeds in the capital market. In this case they could expect a return on the market value of the firm and not on the book values only as the EVA approach assumes implicitly when calculating the capital charge on the book value of the firm's assets. Therefore, EVA does not reflect the full opportunity costs investors face when investing their funds in the firm.

In addition to this argument to be found in economic literature, mainly practitioners argue that EVA does lack comparability in case of identical businesses with different book values of their respective investments. For example, a firm consists of two divisions identical with respect to future cash flows: one owns a new plant and machinery while the other has an old plant and machinery. Due to differences in the assets book value the EVA of these divisions varies significantly. This would cause problems in measuring and judging the performance of these two divisions and their management for comparison purpose. Another example would be a difference between divisions with respect to the internal vs. external growth strategies in the past. As a consequence of external growth in the past acquired goodwill is part of the capital in these division while other divisions – although yielding the same future cash flows – have a small asset base. Thus, the EVAs of the division without acquired goodwill exceeds the EVA of other divisions due to a lower capital charge.

The REVA approach of residual income seems to provide an elegant solution for both aspects mentioned: Calculating the capital charge on a market value-basis captures investor's opportunity costs correctly and it uncouples the capital charge from the age of a division's assets and from the extent to which acquired goodwill is part of the division's assets.

As a consequence of using REVA as a measure for periodic performance and as a basis for management compensation, managers are prompted to judge new projects by the effect these projects have on REVA. It will be illustrated below, that using REVA as a performance measure instead of EVA does not lead to a first best level of investment: REVA could induce managers to approve value destructing investment projects on the one hand, and it could prevent them from investing in value creating projects on the other hand. Consequently, REVA lacks superiority in comparison to EVA when it comes to motivating managers to implement all available investment projects with positive net present value only.

The dysfunctional effects of a REVA regime can easily be seen if the condition for the optimal investment level I^{REVA} is derived which is

$$\begin{aligned}
 (7) \quad & \max \sum_{t=1}^T REVA_t q^{-t} = \max \sum_{t=1}^T \left(x_t(I) - ab_t \cdot I - r \sum_{\tau=t}^T x_\tau(I) q^{-(\tau-(t-1))} \right) q^{-t} \\
 & \Rightarrow \sum_{t=1}^T \left(x_t'(I^{REVA}) - ab_t - r \sum_{\tau=t}^T x_\tau'(I^{REVA}) q^{-(\tau-(t-1))} \right) q^{-t} \stackrel{!}{=} 0 \Leftrightarrow \\
 & = \sum_{t=1}^T \left(x_t'(I^{REVA}) \right) q^{-t} = \sum_{t=1}^T \left(ab + r \sum_{\tau=t}^T x_\tau'(I^{REVA}) q^{-(\tau-(t-1))} \right) q^{-t}
 \end{aligned}$$

with

$$\begin{aligned}
 (8) \quad & \sum_{t=1}^T \left(ab_t + r \sum_{\tau=t}^T x_\tau'(I^{REVA}) q^{-(\tau-(t-1))} \right) q^{-t} \neq \sum_{t=1}^T \left(ab_t + r \left(1 - \sum_{\tau=1}^{t-1} ab_\tau \right) \right) q^{-t} \Leftrightarrow \\
 & \sum_{t=1}^T \left(r \sum_{\tau=t}^T x_\tau'(I^{REVA}) q^{-(\tau-(t-1))} \right) q^{-t} \neq \sum_{t=1}^T \left(r \left(1 - \sum_{\tau=1}^{t-1} ab_\tau \right) \right) q^{-t}
 \end{aligned}$$

Condition (8) shows that the optimal level of investment under REVA / EVA differs depending on the capital charge that is calculated. There may be projects with a negative net present value in which the reduced capital charge offsets the lower cash flow profile so that the sum of discounted REVA is positive whereas the project's net present value is negative. On the other hand, projects with a positive net present value may be allocated an overrated capital charge under a REVA regime which offsets the high cash flow profile so that the sum of discounted REVA is negative.

These effects will be illustrated by the following examples.

The example shows two investment projects (A, see Exhibit 1, and B, see Exhibit 2) with a necessary cash outlay of 236.25 in period 0 for each project.

	0	1	2	3	4	5
Investment	-236,25					
Book Value	236,25	189,00	141,75	94,50	47,25	0,00
OCF		16,74	16,74	16,74	167,44	167,44
Depreciation		-47,25	-47,25	-47,25	-47,25	-47,25
NOPAT		-30,51	-30,51	-30,51	120,19	120,19
Capital Charge (BV)		23,63	18,90	14,18	9,45	4,73
EVA	0,00	-54,13	-49,41	-44,68	110,74	115,47
Discounted EVA (MVA)	23,72	80,22	137,65	196,10	104,97	0,00
Economic Income	23,72	26,00	26,92	27,94	29,06	15,22
Economic Capital Charge	0,00	26,00	26,92	27,94	29,06	15,22
REI	23,72	0,00	0,00	0,00	0,00	0,00
REVA		-56,50	-57,43	-58,45	91,13	104,97
Discounted REVA	-15,32	39,65	101,05	169,60	95,43	0,00

Exhibit 1 (Project A)

While project A has a slightly positive MVA, i.e. net present value of 23.75, B has a negative MVA, i.e. net present value of -7.77. Obviously, from a shareholder's point of view, managers should approve project A and reject project B.

	0	1	2	3	4	5
Investment	-236,25					
Book Value	236,25	189,00	141,75	94,50	47,25	0,00
OCF		117,21	117,21	16,74	16,74	1,67
Depreciation		-47,25	-47,25	-47,25	-47,25	-47,25
NOPAT		69,96	69,96	-30,51	-30,51	-45,58
Capital Charge (BV)		23,63	18,90	14,18	9,45	4,73
EVA	0,00	46,33	51,06	-44,68	-39,96	-50,30
Discounted EVA (MVA)	-7,77	-54,89	-111,43	-77,89	-45,73	0,00
Economic Income	-7,77	22,85	13,41	3,03	1,66	0,15
Economic Capital Charge	0,00	22,85	13,41	3,03	1,66	0,15
REI	-7,77	0,00	0,00	0,00	0,00	0,00
REVA		47,11	56,55	-33,54	-32,17	-45,73
Discounted REVA	14,00	-31,71	-91,43	-67,03	-41,57	0,00

Exhibit 2 (Project B)

If REVA is used for management compensation, exactly the opposite would happen: Due to a discounted REVA of -15.32 regarding A and of 14,00 regarding B managers would reject the value-creating project A and undertake project B resulting in a shareholder wealth destruction totalling $7.77 + 23.72 = 31.47$. This means that a REVA-based compensation scheme does not ensure that managers implement all value creating investment projects and reject investments.

5 EVA targets: Reconciling EVA with REVA

In its basic interpretation, performance measurement under an EVA regime decouples the budgeting process from compensation when the incentive system pays managers to generate

an indefinite but positive EVA. However, EVA-based incentive programs of most companies pay managers not only to generate a positive EVA but also for improvements in EVA.

In the first case, an incentive payment is earned only if a period's observed EVA is positive. This might prevent manager-agents to implement projects with an overall positive net present value if the first periods' EVA are negative, e.g. because of high investments inducing a high capital charge and low income, and if the agent discounts the stream of EVAs with a higher discount rate than the principal, i.e. if the agent takes a myopic perspective compared to the principal

It has been formally shown (Baldenius/Fuhrmann/Reichelstein, 1999), that

$$(9) \quad \sum_{t=1}^{T+1} \Delta EVA_t q^{-t} = r q^{-1} \sum_{t=1}^{T+1} EVA_t q^{-t}$$

Therefore, the sum of discounted changes in EVA (ΔEVA) is proportionate with the strictly positive factor $r q^{-1}$ to the sum of discounted EVA representing a project's net present value. This alleviates the problem of the myopic agents but does not lead to a first best-level of investment.

For companies that implement such kind of compensation scheme, it is necessary to define expected EVA improvements in terms of EVA targets. It has turned out that a proper setting of those expected EVA improvements is vital for a successful implementation of EVA-based compensation plans particularly in multi-business enterprises. The division performance in creating value contributions (on one side) and the incentive which is finally rewarded according to the achievements (on the other side) have to be linked depending on the particular conditions of the respective line of business. Especially because of differing current EVA levels and/or industry features, an appropriate assessment of performance is also always a matter of comparing several outcomes in consideration of the underlying business characteristics. As a case in point, it is obvious that the lower the current EVA level of a particular business unit is, the higher are potential EVA improvements, *ceteris paribus*. In other words, divisional management could enhance their prospects for improvements just by reducing the current EVA as compensation reference for EVA improvements (known as "big-bath-accounting"). Furthermore, a company-wide definition of EVA targets in a multi-industry enterprise has to be aware of possibly varying market growth opportunities in different industries, since they determine EVA growth prospects fundamentally.

In the application of the described compensation approach, the issue for any company is how to determine a fair EVA improvement rate used as compensation base in a given context. Privately owned companies given, one approach is to conduct benchmarking studies to identify the potential of improvements by comparing its results on a series of measures with those of peers. In contrast, the way performance standards are established in publicly traded companies is influenced by the fact that stock prices are driven by expectations.

The equity value of a given stock can be seen as the present value of all future cash flows to equity as they are expected by the market. Conceptually, the relation between equity value and cash flows to equity exists also in the EVA approach.

It can be shown that the present value of all future EVAs equals the MVA that provides a present value measure of wealth created for investors and represents the difference between the market value of a firm and its book value.

Consequently, shareholders expected EVA improvements are impounded in the company's share price. Which level of EVAs and, thus, which magnitude of improvement would be necessary to ultimately justify the current market value of a firm?

Let us assume that MVA can be computed as

$$(10) \quad MVA_t = \sum_{\tau=t+1}^T EVA_{\tau} q^{-(\tau-t)} > 0$$

In a perpetuity model MVA represents the market expectations of a constant stream of future EVAs* with

$$(11) \quad MVA_t = \frac{EVA^*}{r}$$

Exhibit 3 provides an example in which the conjunction between MVA and EVA* is shown, assuming a stock-listed division. The example shows in the first column, that there is a constant stream of EVAs required ($EVA^* = 100$) to pursue today's implicit expectations of the stock market. Since the current EVA is assumed to be 0, the necessary EVA improvement is 100 in order to materialize the given expectations. A market value oriented compensation plan would target a corresponding EVA improvement. Now suppose the division management could re-deploy the 1000 in capital and an expected future growth potential of the investment would cause the market value to go to 3000.

	Today	Immediately after Investment
Book Value of Equity	1000	1000
Market Value of Equity	2000	3000
MVA	1000	2000
Current EVA	0	0
EVA* (WACC 10%)	100	200

Exhibit 3: EVA/MVA Perpetuity Model

In Exhibit 3, the second column shows the impact on MVA and EVA*. If EVA* were used as a basis for compensation purposes, the investment would not be taken because it would rise the EVA target to 200. In fact, the contrary effect would exist that the more valuable the business idea, the higher the market value would rise and the higher the EVA targets would become. In other words, managers would avoid systematically an engagement in highly valued projects. Thus, if EVA* is used as target profit in investment centers, it could result in a replication of REVA with all its unfortunate consequences.

It can be shown in general that an EVA-oriented compensation which is focused on share price-based expectations is equivalent to a REVA-oriented compensation plan, verified below.

Proposition: Deriving EVA targets from a firm's observed market value is equivalent to a REVA performance measurement regime.

Proof: Deriving EVA targets implies according to conditions (10) and (11)

$$\begin{aligned}
 & \overset{!}{EVA_t} = EVA^* \\
 \Leftrightarrow & NOPAT_t - r \cdot I_{t-1}^{BV} = r \cdot MVA_{t-1} \\
 \Leftrightarrow & NOPAT_t - r \cdot I_{t-1}^{BV} - r \cdot MVA_{t-1} = 0 \\
 \Leftrightarrow & NOPAT_t - r \cdot (I_{t-1}^{BV} + MVA_{t-1}) = 0 \\
 \Leftrightarrow & NOPAT_t - r \cdot I_{t-1}^{MV} = 0 \\
 \Leftrightarrow & \overset{!}{REVA_t} = 0
 \end{aligned}$$

q.e.d.

This implies that the dysfunctional effects shown in section 4 with regards to REVA can be extended also to a regime of strictly positive EVA-targets.

6 Conclusion

In our paper we compare different types of book value-based vs. market value-based residual income measurement (EA, REVA, REI). We provide a detailed analysis on the information provided by these performance measure. With regards to the incentive effects, we focus more closely on comparison of REVA vs. EVA. We show that REVA could result in either under-investment in projects with a positive net present value or over-investment in projects with a negative net present value, both compared to EVA. Finally, we discuss the possibility of using the MVA to derive EVA targets for investment centers. We prove that with an infinite horizon these targets equal the application of REVA.

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