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THE PROBLEM OF INFORMATIVE USEFULNESS OF RESIDUAL INCOME. RI^{BV} RADAR CONCEPT

Andrzej Cwynar[1]

Abstract

RI^{BV} is one of the possible variants of residual income calculation based on unadjusted book values. The usefulness of residual income should always be evaluated separately from the point of view of its motivational function and informational function. From the first perspective, RI^{BV} is weak goal-congruent (in a decisional sense), although more goal-congruent than traditional accounting metrics. Problems implied by weak goal-congruence of RI^{BV} can be solved by utilization of a tool allowing for reduction in managerial myopia (e.g. a bonus bank). However, such tools do not resolve the problem of the low informative usefulness of RI^{BV}, that was confirmed by the empirical research presented in the article. The problem manifests itself in the fact that RI^{BV} can signal value creation (destruction) when it is not created (destroyed), it can also exhibit value created (destroyed) sums that are not true. Thus, periodic performance measurement, evaluation and a compensation system that is to be based on RI^{BV} must include not only a tool resolving problems resulting from the low motivational usefulness of the residual income version, but also a tool resolving problems resulting from the low informational usefulness of RI^{BV}. Multidimensional evaluation of RI^{BV} performance, utilizing RI^{BV} radar presented in the article, can serve as such a tool.

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Introduction: the essence, history and types of residual income

Residual income (hereafter RI) is defined as income after subtracting the cost of the entire capital invested in a firm's operating assets, including cost of equity being opportunity cost. Knowing that residual income is a form of the firm's financial outcome, though specific, it should be considered a periodic performance measure of the firm, beside its other, however secondary, functions. The roots of residual income can be traced to the fathers of classical economics – A. Smith and R. Hamilton (Mepham, 1980), although the term "residual income" was used for the first time as late as in 1950 in General Electric (Solomos, 1965, as cited in Martin, Petty & Rich, 2003). Other milestones on the residual income development path can be attributed to microeconomic work by Marshall (1890), Fisher (1906, 1930) and Hicks (1946), managerial accounting work by Solomons (1965) as well as Edwards and Bell (1961), corporate finance work by Gordon and Shapiro (1956), Modigliani and Miller (1958) as well as Sharpe (1964), and – finally – value based management work by Rappaport (1986), Stewart (1991), Copeland, Koller and Murrin (1994) as well as Madden (1999). It was the

[1] Andrzej Cwynar, PhD, Institute of Financial Research and Analyses, University of Information Technology and Management in Rzeszów, ul. Sucharskiego 2, 35-225 Rzeszów, acwynar@wsiz.rzeszow.pl.

appearance of value based management (hereafter VBM) as a new area of corporate finance research that led to the unforeseen increase of interest in the concept of residual income, promoted as the central tool of VBM systems.
The current state of knowledge on residual income suggests that it should be considered rather a class of metrics than one particular metric. In the last 50 years at least several variants of residual income were invented, however only a couple of them gained the attention of the broader public, including business practitioners. Various approaches to the same concept of residual income resulted in a situation in which one universal formula of the metric – that which assumes subtraction of capital charge (monetary cost of capital) from monetary return on capital – may consist of different contents (capital charge and return on capital can be calculated in many various ways), producing a broad range of residual income versions having different properties. These versions can be divided into two groups: RI measurement concepts referring exclusively to an accounting model of valuation and RI measurement concepts referring – at least partly – to an economic model of valuation. The first group is represented by:

1) the simplest variant of RI based solely on unadjusted book values, including standard accounting depreciation (hereafter RI^{BV}); the example of the residual income version is Marakon's economic profit (McTaggart, Kontes & Mankins, 1994),
2) RI based on adjusted book values, excluding a depreciation method that still remains accounting-based; the example of this variant is economic profit promoted by McKinsey (Copeland, Koller & Murrin, 1994),
3) economic value added (EVA®) created and labeled by Stern Stewart[2],
4) cash value added (CVA) in the form presented by Anelda (Weissenrieder, 2000), as well as HOLT Value (Madden, 1999).

The other group consists of (among other versions of RI, however less known):

1) refined economic value added (REVA) created by Bacidore, Boquist, Milbourn and Thakor (1997),
2) residual economic income (REI) presented by Bausch, Weissenberger and Blome (2003),
3) earned economic income (EEI) invented by Grinyer (1985),
4) net economic income (NEI) introduced by Drukarczyk and Schueler (2000).

Residual income utilization premises and related forms of usefulness

Normative literature on residual income suggests that it has two basic functions in a firm:

1) motivational (Stern, Stewart & Chew, 1996; Stern, 2004),
2) informational (Grant, 1996; Abate, Grant & Stewart, 2004).

The motivational function relates to the utilization of residual income as the tool of evaluation and compensation of managers and their subordinates. Because of its fundamental property – NPV compatibility – it is considered a metric that can stimulate managers to carry out an investment program maximizing NPV (and, ultimately, maximizing a firm's economic value, assumed to be, at least from a financial perspective, the primary and ultimate variable to be maximized) more successfully than other metrics. NPV compatibility of residual income

[2] EVA is registered trademark of Stern Stewart.

means that the sum of periodic values of the metric from throughout the entire economic life of the analyzed project (after discounting) equals its NPV. From the perspective of its motivational function, residual income is to be a tool ensuring managerial internalization of a firm's owners' goals (interests) expressed in the economic value maximization imperative, and thus it is expected to create the required behavioral pattern and deliver the presumed performance. It is performance management in the appropriate manner that is on the first plan when one looks at residual income from the motivational perspective. Residual income usefulness in the field can be named motivational. High motivational usefulness means that residual income is highly congruent – in a behavioral and decisional sense – with the goal defined as a firm's economic value maximization. In other words, it means that it is highly successful – utilized as the basis of evaluation and compensation – in driving managers to make decisions that lead to the realization of the goal.

From the perspective of the informational function, the issue of performance measurement in the appropriate manner, namely in the way that credibly and unambiguously provides information about the current and expected financial position of a firm, is on the first plan. The informational function relates to the fact that RI, as any other measure of a firm's periodic financial outcome, conveys an information content potentially useful for insiders (managers) as well as outsiders (participants of the firm's external environment, especially investors and other representatives of the so called "market" – brokers, analysts, etc.). Information content of RI should enable determination of the extent to which the primary financial goal of a firm, i.e. its economic value maximization, has been achieved. It should also enable formulation of opinion as to the business success in the measurement period (good or bad performance, satisfactory or disappointing performance, etc.). If one agrees that it is justified to talk about success or failure in relation to performance in just one year (or in any other single measurement period), then it is required to be able to get clear information on success or failure in the last year at the RI level. RI usefulness in the field can be named informational or informative. High informative usefulness means that residual income allows highly credible and unambiguous interpretation of a firm's performance as good (resulting in increase of the economic value) or bad (resulting in decrease of the economic value). Relevancy of informational properties of residual income relates to the fact that business decisions are (or can be) made – inside the firm (by its managers) or outside it (by investors) – on the basis of residual income levels.

Assuming information asymmetry, it is possible that from the market point of view residual income can be a useful medium conveying signals that reflect a firm's earning potential expected in the future and determine decisions concerning securities for investors. Thus, if residual income is a really relevant (useful) metric for investors (because their decisions take into account the residual income level), then it should have an explanatory power meaning that a firm's economic value variation can be effectively explained by residual income variation: investors' decisions to buy, sell or hold a firm's securities, resulting in its market valuation, will depend on the levels of residual income of the firm. According to the literature, the usefulness of residual income in this special field is typically named value relevance. Value relevance should be considered a specific form of informative usefulness. High value relevance of residual income would mean that, from the investors point of view, the measure conveys important (relevant, useful) signals as to the future earning potential of a firm in the

sense that the signals drive – at least among other factors – investors' decisions reflected in the firm's market valuation. Thus, high value relevance of residual income would mean that it has high explanatory power (a high ability to explain market valuation behavior).

Research on residual income usefulness

Hitherto prevailing research on residual income usefulness was primary focused on the value relevance of the measure. It is surprising to observe that its ability to support investors to make informed decisions is not a crucial property of residual income. On the basis of normative literature on residual income one can draw the conclusion that the most important premise of RI utilization relates to its motivational function. Residual income should, first of all, motivate managers and their subordinates to make decisions consistent with a firm's ultimate financial goal which is its economic value maximization and compensate them on the basis of the decisions' results. Cwynar (2010) presents a comprehensive review of fifty empirical studies on value relevance of residual income (mostly RI based on unadjusted book values and EVA) suggesting that even though it can be considered a metric that is value relevant (at least in the versions studied so far), its explanatory power is low. However, the observation doesn't exclude possession of high motivational usefulness by residual income. Also, it doesn't have to (though it can) be interpreted as meaning that residual income reflects a firm's periodic performance on its path to maximize economic value in a faulty (not true) manner.

The issue of residual income motivational usefulness and the issue of residual income informative usefulness are interrelated. Conclusions as to its informative usefulness are normally based on the analyses of its motivational usefulness. Research in the field conducted so far has been twofold. It is represented by theoretical studies on the one hand (Reichelstein, 1997; Rogerson, 1997) and empirical tests on the other hand (Wallace, 1997; Kleiman, 1999). Cwynar (2010) presents theoretical comparative analysis of motivational usefulness including eight versions of residual income which is the broadest universe studied so far. On the basis of the research focused on motivational function of residual income one can draw the conclusion that its usefulness in the field depends on the version of the metric. The versions differ in their motivational properties and can be grouped into five categories distinguished in the literature: versions displaying no goal congruity, weak goal congruity, semi-strong goal congruity, strong goal congruity and perfect (robust) goal congruity (Mohnen, 2004; Cwynar, 2010), where goal congruity relates to their motivational usefulness (their ability to make managers make decisions that are goal congruent, i.e. translate into increase in a firm's economic value).

Unfortunately, the versions of residual income that are the most useful in the motivational sense, are the versions that are the least understandable and, what is of special importance, the least practicable at the same time (Cwynar, 2010). Residual income in its simplest form based on unadjusted book values (RI^{BV}), exhibiting weak goal congruity (low motivational usefulness), but outstandingly understandable and practicable and supported by a mechanism aimed at reduction of managerial impatience (responsible for the abovementioned weak goal congruence of RI^{BV}), e.g. in the form of a bonus bank, can be a convincing alternative for theoretically more goal congruent (more useful in a motivational sense), but less understandable and practicable at the same time, versions of RI (REI, EEI, NEI).

Informative usefulness of RI^{BV}: the essence of the problem

Utilization of a bonus bank (or other solutions to the managerial impatience problem) can give control over RI^{BV} limitations in the field of its motivational usefulness, however it doesn't solve the problem of the low informative usefulness of RI^{BV}. To illustrate the issue let's consider the example of an enterprise created just to realize an investment project requiring an initial capital outlay (equity) that equals 6,25 million of PLN to buy fixed assets. Cash flows from the investment, expected in the future, are given in table 1. The analysis will be based on the following additional assumptions:

1) cost of capital rate (discount rate) is fixed in time and equals 10% per annum,
2) economic life of the project under consideration is limited (5 years); at the end of the economic life the project will have no salvage value,
3) cash flows appear at the end of each year,
4) initial capital outlay (at the end of the year 0 which is the beginning of the year 1) is the only investment expenditure throughout the entire economic life of the project,
5) investment budget assumes that the only single difference between accrual accounting and cash accounting is the treatment of initial capital outlay (in the accrual approach it is distributed among the years of economic life of the project via depreciation); as a result, operating cash flow (OCF) is the same as EBITDA, while OCF diminished by depreciation is the same as EBIT and NOPAT (for simplicity taxation was excluded from the analysis),
6) fixed assets are depreciated in a straight-line manner in the 5-year economic life of the project.

At the assumptions set in the example, NPV of the project is positive and equals 0,57 million of PLN. Knowing that, the project should be accepted. The example intentionally assumes cash flow in the form of annuity. The supposition enables presentation of the analyzed problem in a clear manner.

Table 1: RI^{BV} stream for analyzed project (data in million of PLN except ROC)

Year	OCF	DEP^{SLD}	NOPAT	BV_{BEG}	ROC	RI^{BV}	PV RI^{BV}
1	1,80	1,25	0,55	6,25	8,80%	-0,08	-0,07
2	1,80	1,25	0,55	5,00	11,00%	0,05	0,04
3	1,80	1,25	0,55	3,75	14,67%	0,18	0,13
4	1,80	1,25	0,55	2,50	22,00%	0,30	0,20
5	1,80	1,25	0,55	1,25	44,00%	0,43	0,26
Sum							0,57

Marks:
OCF – operating cash flow,
DEP^{SLD} – straight line depreciation,
NOPAT – net operating profit after tax,
BV_{BEG} – book value at the beginning of the year,
ROC – return on capital,
RI^{BV} – residual income based on book value,
PV RI^{BV} – present value of RI^{BV}.

Source: Author

Three observations are of special importance on the basis of the data included in the table 1:

1) sum of RI^{BV} from the entire economic life of the project (after discounting) equals NPV,
2) stream of RI^{BV} is not annuity although the stream of OCF is annuity,
3) sign of RI^{BV} is not the same in each and every year of the economic life of the project as is the sign of NPV.

The first observation means that RI^{BV} is NPV-compatible – annual residual incomes from the entire economic life of the project (after discounting) sum to NPV. Thus, calculation of RI^{BV} enables an allocation (distribution) of NPV among the years of the economic life of the project. From that point of view it is justified to consider residual income the annual (periodic) NPV. However, reliability of the aforementioned allocation is questionable. It can be explained by observation number two. RI^{BV} consistently increases year by year even though there is no economic reason for such growth (there is no reason to evaluate performance expected in one chosen year as better than expected performance in any other year). Annual cash flow (OCF), reflecting profitability of the project, and cost of capital, reflecting its risk, are the same each year. RI^{BV} growth is driven solely by evaporating net book value of fixed assets the capital was invested in, and results from the depreciation schedule assumed in the example. Replacement of the straight-line method by any other one would result in another stream of RI^{BV}. Thus, the increase in RI^{BV} observed in the example is artificial, because the economic profitability improvement along with the passage of time, suggested by the behavior of the RI^{BV} stream, is just an illusion. What's more, observation number three indicates that – despite positive NPV – RI^{BV} expected in the first year of the project's economic life is negative. In the light of the observation the following question must be asked: does it mean that performance of the firm in the first year should be evaluated negatively (while the performance in all subsequent years – positively), because RI^{BV} estimated for them are higher than zero?. Owen (2000, p. 307), who analyzes the problem from the motivational perspective, asks: on the basis of the observations, should management of the enterprise be held responsible because of negative RI^{BV} in the first year? Certainly, not. The project under consideration is economically profitable (NPV>0) and should be realized despite the sign of RI^{BV} in successive years. It is not possible to realize the project omitting the years for which expected RI^{BV} is negative (or, universally, those for which expected performance is inferior or substandard). The observations made so far lead to the conclusion according to which the informative usefulness of RI^{BV} may be low. It can signal value destruction when it is not destroyed (knowing the financial specification of the analyzed project it is hard to accept the thesis according to which it destroys value in the first year of its economic life). And inversely, RI^{BV} can signal value creation when it is not created. Even though RI^{BV} credibly signals value creation / destruction, it can indicate untrue sums (for example it is hard to agree with the assertion according to which value created e.g. in the third year of the project's economic life is higher than value created in the second year).

The problem doesn't exist in the concepts of residual income that not only are NPV-compatible (NPV-compatibility ensures merely weak goal congruence), as RI^{BV} is, but also have the property that their sign is the same – in each and every year of economic life of the project under evaluation – as the sign of NPV. To illustrate the issue table 2 includes estimations of earned economic income (EEI) – one of the residual income variants

possessing the property – for the same investment project as before[3]. EEI is positive in every year of the economic life of the project, as is NPV. In this case there is no reason to evaluate periodic performance in any chosen year negatively (as performance in the first year under the RI^{BV} regime). The project is economically profitable, which is credibly signaled by positive NPV and by annual EEI, despite the year of observation that is chosen.

Table 2: EEI stream for analyzed project (data in million PLN)

Year	OCF	1/PI	1-1/PI	EEI	PV EEI
1	1,80	0,92	0,08	0,15	0,14
2	1,80	0,92	0,08	0,15	0,12
3	1,80	0,92	0,08	0,15	0,11
4	1,80	0,92	0,08	0,15	0,10
5	1,80	0,92	0,08	0,15	0,09
Sum					0,57

Marks:
OCF – operating cash flow,
PI – profitability index = 1,0912,
EEI – earned economic income,
PV EEI – present value of EEI.
Data given in the table 2 is rounded to two digits after the coma. As the result of that sum of PV EEIs is not the same as NPV (0,57 million PLN) but it is so solely because of the rounding.

Source: Author

One should expect that the problem of the low informative usefulness of RI^{BV}, presented in theoretical dimension so far, exists in business reality. The observations made to date suggest that when standard book depreciation is used, one ought to suppose that new investment projects accepted to be realized will decrease (ceteris paribus) RI^{BV} of the entire enterprise, even though they exhibit positive NPV (and especially when the time lag between initial capital outlay and the first year for which cash flow is positive is substantial). In such a situation RI^{BV} may not be a credible tool informing about actual performance of the firm that is value maximization-oriented.

Practical implications

The problem of informative usefulness of RI^{BV} that is scrutinized in the article is significant in a practical sense because of three reasons. The first reason relates to the internal perception of RI^{BV} levels and can be expressed in the question if (if yes, then to what extent) managers and their subordinates understand the properties of the RI^{BV} formula and informative distortions resulting from them. In discussion on informative usefulness of residual income in general one should not presume a high degree understanding of its properties by persons representing a firm's internal environment, and by its managers among them. For example, the research conducted by Riceman, Cahan and Lal (2002) showed that understanding of EVA in studied Australian firms that implemented the metric was low. Keys, Azamhuzjaev and Mackey

[3] For each year EEI was calculated in the following manner: $EEI_t = OCF_t \times (1 - 1/PI)$.

(2001) write that many managers "have trouble understanding accounting net income and equities" (p. 69). Distorted and mistakenly interpreted information content of the metric can lead to wrong decisions made by managers.
Secondly, practical implications of the low informative usefulness of RI^{BV} relate also to external perception of its levels. In this case doubts as to the understanding of RI^{BV} information content are even more profound. Informative distortions of RI^{BV} may lead investors to make unjustified decisions concerning a firm's securities, resulting in its distorted market valuation.
Finally, the problem of the low informative usefulness of residual income implies dilemmas of a completely different kind and concerning yet another group of entities. Namely, the problem questions the reliability of any comparative analysis, especially in large populations of firms, many times having the form of various rankings. The enterprise that not long ago engaged in a capital intensive investment program with positive NPV may experience a temporary, yet substantial, "controlled" decrease in its RI^{BV} (sometimes below zero), which should not be evaluated negatively because of the reason for the decline in the level of the metric (acceptance of NPV-positive projects). However, in rankings based on the absolute RI^{BV} the place taken by this firm will be far from the top.
Thus, if the system of a periodic company performance measurement and evaluation based on RI^{BV} is to effectively play not only a motivational, but also informational role, then it must be equipped with a tool (mechanism) that enables it to cope with the low informative usefulness of the metric, in addition to the tool that helps to cope with its limited motivational usefulness (e.g. the bonus bank). There are two options that can be used here. The first assumes that the mechanism is introduced to the metric formula as a change in the method in which its levels are estimated. The concepts of residual income that are more useful in the motivational as well as informative sense, yet much less practicable than RI^{BV} (REI, EEI, NEI), represent the results of the first option. The other option assumes that the aforementioned mechanism is introduced outside the metric formula, as an additional tool of the entire performance measurement and evaluation system that enables reliable and unambiguous assessment of a firm's periodic performance in the context of its RI^{BV}. The first solution was presented in the literature for example by Grinyer (1985, 1987), Bausch, Weissenberger and Blome (2003) as well as Drukarczyk and Schueler (2000), and by Cwynar (2010) in the Polish literature, although primarily in relation to the motivational usefulness of residual income. On the contrary, an interesting and promising field of research, hardly covered in the literature so far, is the design of tools making the evaluation of RI^{BV} easier, more credible and unambiguous and eliminating the interpretation dilemmas implied by the low informative usefulness of the metric. The simplest form of such tools is represented by more than one-dimensional methods of RI^{BV} evaluation, sometimes named value creation matrices. In the Polish literature they are presented, for example, by Szczepankowski (2007), while in the foreign literature by Stewart (1991) as well as Hawawini and Viallet (2007). However, the research on the issue is still hardly developed.

RI^{BV} radar concept

Specific properties of RI^{BV} suggest that in the evaluation of its levels one should take into account at least four criteria:

1) absolute RI^{BV} (hereafter in short SIZE = RI_t^{BV}),
2) RI^{BV} in relation to invested capital (hereafter in short INDEX = $\frac{RI_t^{BV}}{BV_{tBEG}}$),
3) change in RI^{BV} in relation to previous period (hereafter in short CHANGE = $RI_t^{BV} - RI_{t-1}^{BV}$),
4) stream of RI^{BV} expected in the future (hereafter in short POTENTIAL = $\sum_{t=1}^{t=\infty} \frac{RI_t^{BV}}{(1+r)^t}$).

Absolute residual income belongs to the group of metrics dependent largely on the scale of a firm's operation (its magnitude measured by capital invested in operating assets). In comparative analyses such metrics always favor large enterprises (on the condition that so called residual return on capital, i.e. the difference between return on capital and cost of capital, is positive; when it is negative, the largest firms are normally at the bottom of the lists resulting from comparisons based on such metrics as absolute RI^{BV}). Inclusion of the RI^{BV} index in the evaluation of performance, in addition to absolute RI^{BV}, enables expression of economic profitability in a different dimension (RI^{BV} per unit of capital), focused on the relation between inputs and outputs. The third criterion, change in RI^{BV}, is of special importance for some groups of enterprises, e.g. representing the early stages in the life cycle or under heavy restructurings. In such cases RI^{BV}, often below zero, may not reflect reliably the efforts and activities taking place in the measurement period that will result in positive RI^{BV} in the distant future. Yet, from the perspective of the impact new investments have on RI^{BV}, its evaluation must include another criterion, except SIZE, INDEX and CHANGE – POTENTIAL reflected in the stream of future positive – on average – RI^{BV}. Implementation of a large investment program exhibiting positive NPV, even though it should be considered a value creating decision, may cause (ceteris paribus) a decrease in RI^{BV} (negative CHANGE), many times below zero (negative SIZE and INDEX). Financial periodic performance of the firm implementing the program should not be judged negatively because its investment budget assumes generation of additional residual incomes in the future that more than offset current decline in RI^{BV} and lead to increase in its economic value. In the case of the companies that are listed on a stock exchange one can use an approximation of RI^{BV} streams expected by the market, named market value added (MVA), which is considered market estimation of the companies' NPV (Stewart, 1991).

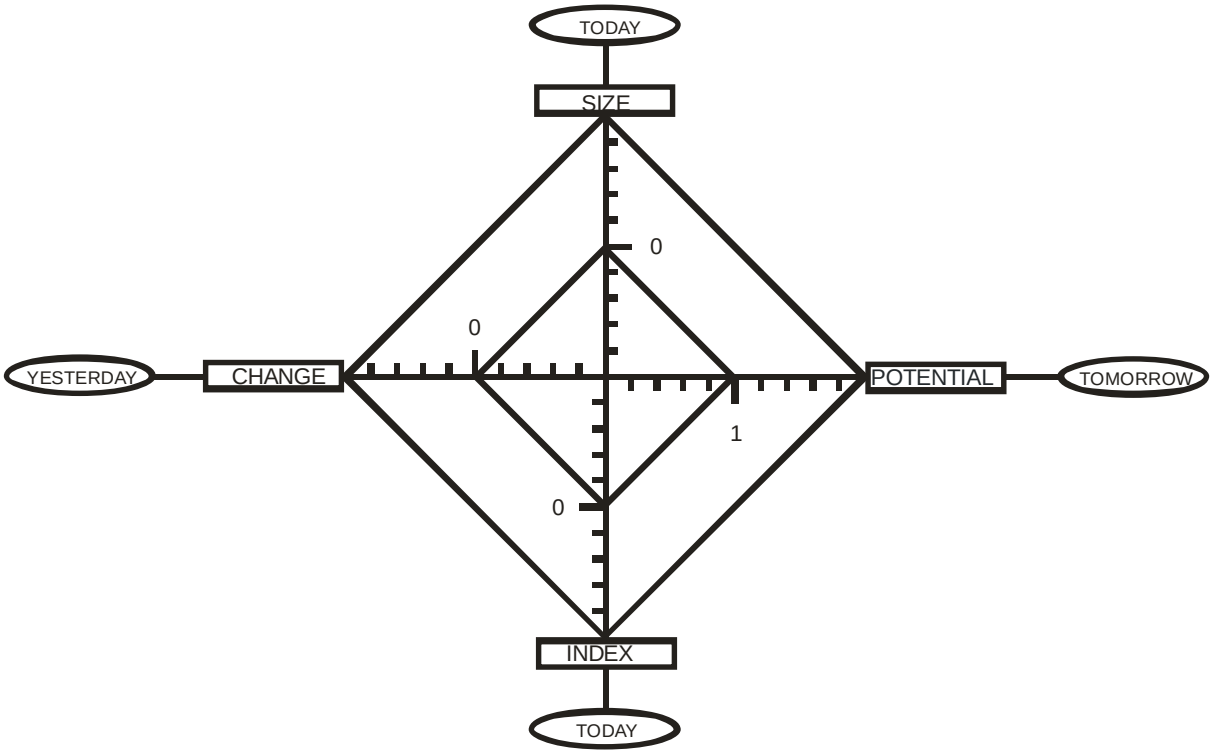
It is worth noticing that four briefly described criteria provide a look at a firm's performance in three important dimensions:

1) in the past (hereafter in the graphical presentation YESTERDAY): CHANGE,
2) in the present (hereafter in the graphical presentation TODAY): SIZE and INDEX,
3) in the future (hereafter in the graphical presentation TOMORROW): POTENTIAL.

The four abovementioned criteria (SIZE, INDEX, CHANGE and POTENTIAL) can be used to design a system allowing for credible and unambiguous final evaluation of RI^{BV} in the situation where partial scores (i.e. four distinguished criteria) send conflicting signals (e.g. negative RI^{BV} today, but positive stream of RI^{BV} expected in the future). It is convenient to equip such a system with a tool allowing for clear graphic illustration of a firm's position in the light of the four criteria used to evaluate it. Because of the multidimensional character of the tool, the most adequate seems to be a form of the radar chart (this is the genesis of the

name proposed in the article – RI^{BV} radar concept). Visualization of sucha tool is presented in exhibit 1.

Exhibit 1: Visualization of RI^{BV} radar with separate scale for SIZE



Source: Author

Construction of the tool requires determination of scales for each criterion. The problem will be discussed in more detail later in the article, however at the moment it is worth noticing that INDEX is expressed in percentage terms, while the three other criteria – in monetary units. To make the tool consistent, SIZE, CHANGE and POTENTIAL must be presented in relation to a chosen variable. POTENTIAL – reflected in the MVA – could be presented by market to book (price to book) value ratio (MV/BV) having the same information content as MVA. After the modifications the threshold values for each of the four criteria used in the RI^{BV} radar design are the following:

1) zero for SIZE, CHANGE and INDEX,
2) one for POTENTIAL.

In graphic presentation, the values that are below threshold levels are located inside the smaller rhomb (see exhibit 1). Performance of a particular firm is illustrated by colored rhomb. The further the colored rhomb goes beyond the threshold rhomb, the better position of the firm in the light of its RI^{BV}.

To allow comparisons in space, one can include average performance (for each criterion – SIZE, INDEX, CHANGE and POTENTIAL) of a chosen universe of firms in the design of

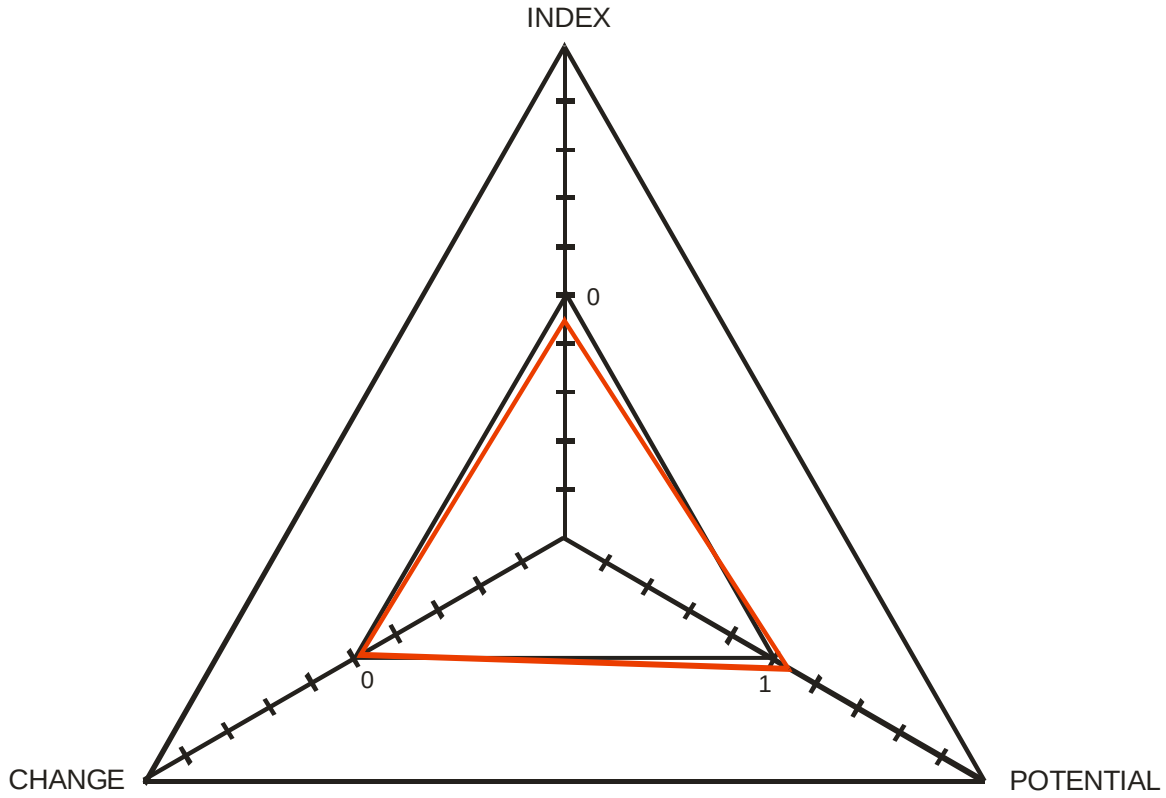
RI^{BV} radar (comparisons in time are included via CHANGE). The user of the tool can choose among the following benchmarks:

1) entire market,
2) sector,
3) selected firms (e.g. close competitors).

In the design of RI^{BV} radar one can consider many ways SIZE can be presented, for example:

1) in relation to the sum of all positive (negative) RI^{BV} in the studied universe of firms,
2) by using a scale divided into partitions based on percentiles, e.g. quartiles, set separately for the range of positive RI^{BV} in the studied population of firms and for the range of negative RI^{BV} in the studied population of firms,
3) without a separate scale for SIZE (in such a case, in graphic presentation the radar becomes a rectangle instead of a rhomb), by using different colors for different classes of firm size (e.g. WIG20, mWIG40, sWIG80 for Warsaw Stock Exchange).

Exhibit 2: Visualization of RI^{BV} radar without a separate scale for SIZE



Source: Author

In the analysis presented in the empirical part of the article the last solution (different colors for different classes of firm size) was utilized. Two other solutions were rejected because of results obtained in the research. It occurred that residual income calculated for CEZ was 85,91% of the total sum of positive RI^{BV} calculated for all firms having $RI^{BV}>0$. As a result,

residual incomes of the other companies, expressed in relation to total sum of positive RI^{BV}, were bigger than 1% in just two cases. The situation did not change substantially after removing CEZ from the studied population (total RI^{BV} still remained dependent primarily on performance of two companies – TPSA and KGHM). For the same reason division of the studied population into percentiles led to a situation in which companies from the first percentile were not substantially different from companies representing the last percentile in their share in total RI^{BV} (positive or negative) of all studied firms. Thus, in graphic presentation of RI^{BV} radar for a couple of chosen companies (analyzed later in the article) the convention based on different colors reserved for different classes of firm size was used:

1) green for companies representing WIG20,
2) blue for companies representing mWIG40,
3) yellow for companies representing sWIG80.

WIG20, mWIG40 and sWIG80 indices include only selected firms. Thus, research that includes the entire population of companies listed on a particular stock exchange must presume their division into classes according to their size (magnitude) measured by invested capital, sales or market capitalization.

For the three remaining criteria (INDEX, CHANGE and POTENTIAL) the design of RI^{BV} radar, in the form used to illustrate the position of the four firms analyzed in the later part of the article, presumes scales divided into partitions presented in table 3 (for each criterion 5 partitions below and 5 partitions above the threshold value set for the criterion). For firms exhibiting outstandingly positive or negative performance (substantially above or below average) the scales can be modified. In the graphic presentation of RI^{BV} radar for the four chosen companies the average results (median) for the entire population of the studied companies were marked by a red line.

Table 3: Scales for CHANGE, INDEX and POTENTIAL used in graphic presentation of RI^{BV} radar for four chosen companies

Criterion	Scale
CHANGE	From -75,00% to -60,00% From -59,99% to -45,00% From -44,99% to -30,00% From -29,99% to -15,00% From -14,99% to -0,01% From 0,00% to 14,99% From 15,00% to 29,99% From 30,00% to 44,99% From 45,00% to 59,99% From 60,00% to 74,99%
INDEX	From -75,00% to -60,00% From -59,99% to -45,00% From -44,99% to -30,00% From -29,99% to -15,00% From -14,99% to -0,01% From 0,00% to 14,99%

	From 15,00% to 29,99% From 30,00% to 44,99% From 45,00% to 59,99% From 60,00% to 74,99%
POTENTIAL	From 0,00 to 0,19 From 0,20 to 0,39 From 0,40 to 0,59 From 0,60 to 0,79 From 0,80 to 0,99 From 1,00 to 1,49 From 1,50 to 1,99 From 2,00 to 2,49 From 2,50 to 2,99 From 3,00 to 3,50

Source: Author

Utilization of RI^{BV} radar to evaluate performance of companies listed on WSE in 2009: empirical research

To verify the thesis according to which the informative usefulness of RI^{BV} is low as well as to illustrate the concept of RI^{BV} radar as a tool that allows for coping with the problems implied by the low informative usefulness of RI^{BV}, the RI^{BV} performance of companies listed on the Main Market of the Warsaw Stock Exchange (hereafter WSE) in 2009 was studied. In the research four variables, monitored by RI^{BV} radar, were estimated: absolute RI^{BV}, RI^{BV} index, change in RI^{BV} in relation to its level in 2008 and RI^{BV} potential reflected in MVA. The variables were expressed as ratios, except SIZE that was not plotted on a separate axis but reflected by color instead. RI^{BV} potential was presented as a ratio by using the market to book indicator (MV/BV). Change in RI^{BV} was presented as a percent of invested capital. To make at least preliminary comparisons in space, each of the three variables estimated for every company was adjusted by its average level calculated on the basis of results for the entire population (267 companies treated as the market in the research). Residual income (RI^{BV}) was calculated in its simplest form as the monetary difference between net income (income after subtracting depreciation, interest and tax) and cost of equity. Calculation of RI^{BV} required estimation of equity cost which was based on the capital asset pricing model utilizing the following assumptions:

1) risk free rate = expected return on two years' government bonds (5,80% for 2009 and 5,72% for 2008) corresponding (in the sense of duration) with the time frame used in estimation of beta coefficients,
2) estimation of beta coefficients was based on weekly data for two preceding years (betas for 2009 were based on data from 2007 and 2008 while betas for 2008 – on data from 2006 and 2007); the way of calculation allowed for inclusion of bull as well as bear markets on the WSE; additionally, in beta coefficients estimation Blume adjustment was utilized to increase the prognostic properties of betas,
3) market risk premium was assumed to equal 7%; the supposition was based on observations of credit default swap and bond default swap levels.

The research assumed also comparison of estimated RI^{BV} with total stock returns (TSR).
To sum up, the variables utilized in the research were estimated in the following manner:

$$SIZE = RI^{BV}_{2009} = NI_{2009} - BV_{2009BEG} \times COE_{2009}, \quad (1)$$

$$INDEX = \frac{RI^{BV}_{2009}}{BV_{2009BEG}}, \quad (2)$$

$$CHANGE = RI^{BV}_{2009} - RI^{BV}_{2008}, \quad (3)$$

$$CHANGE(ratio) = \frac{CHANGE}{BV_{2009BEG}}, \quad (4)$$

$$POTENTIAL = MVA_{2009END} = MV_{2009END} - BV_{2009END}, \quad (5)$$

$$POTENTIAL(ratio) = \frac{MV_{2009END}}{BV_{2009END}}, \quad (6)$$

where RI^{BV} = residual income based on unadjusted book values,
NI = net income,
BV_{BEG} = book value (equity) at the beginning of the year,
BV_{END} = book value (equity) at the end of the year,
COE = cost of equity,
MV = market value,
MVA = market value added.

Calculations were based on data delivered by Notoria (accounting data) and Bloomberg (market data). The final universe of companies that was studied (267 objects) was formed on the basis of companies listed on the Main Market of the WSE at the end of 2009 (379 entities). Then some exclusions were made from the population:

1) removal of companies that were the subject of initial public offering in the period under research (2008 – 2009) and, as the result of that, were not quoted during an entire year (13 companies in 2009 and 33 in 2008),
2) removal of banks, insurance firms and national investment funds – for standard reasons concerning differences in the structure and contents of financial reports (29 companies),
3) removal of companies having negative equity at the end of at least one year from three years' period of time including 2007, 2008 and 2009 (9 companies),
4) removal of companies for which some required data (accounting or market) was unavailable (28 companies).

As the result of the exclusions, the ultimate number of companies scrutinized in the research equaled 267. Table 4 illustrates main descriptive statistics for the studied variables estimated in the universe of the 267 companies included in the analysis.

Table 4: Variables estimated in the research: descriptive statistics

	SIZE (thousand of PLN)	INDEX	CHANGE (thousand of PLN)	CHANGE (as % of equity)	POTENTIAL (as MVA in thousand of PLN)	POTENTIAL (as MV/BV)	TSR
Average	90131,16	-8,71%	13038,06	3,47%	-150830,53	1,71	61,30%
Median	-4473,96	-7,08%	-555,08	-0,59%	18206,00	1,28	46,62%
Standard deviation	1721162,00	20,74%	324712,12	41,06%	6539921,53	1,51	75,92%
Maximum	27955636,71	42,69%	3391298,36	496,81%	10796043,00	13,14	339,06%
Minimun	-1116641,00	-110,93%	-1594835,72	-97,29%	-105369375,00	0,29	-55,84%

Source: Author

Total RI^{BV} of the 267 companies covered by the research was 24 065 020,63 thousand of PLN[4]. However, only one firm – CEZ – is responsible for 85,91% of the total sum of positive RI^{BV} in the studied population. After removing CEZ, total RI^{BV} turned into a negative number (-3 890 616,08 thousand of PLN). For 70 companies (26%) RI^{BV} was positive while for 197 (74%) it was below zero. Because of CEZ average RI^{BV} equaled 90 131,16 thousand of PLN, although its median was negative (-4 473,96 thousand of PLN). The number of companies from the WIG20 (the biggest ones) in the top 10 of the SIZE ranking was relatively high (6 firms). However, in the top 10 of the INDEX ranking there was virtually no company representing the WIG20. Yet, two firms from the top 10 of the SIZE ranking – MOSTALWAR and ZYWIEC – were situated also in the top 10 of INDEX ranking. Their outstandingly high residual returns on capital (42,69% for MOSTALWAR and 38,63% for ZYWIEC) must have resulted in exceptionally high RI^{BV}, despite medium amounts of capital. Average and median RI^{BV} indices were not substantially different.

CHANGE was analyzed in two ways – in monetary units and in percentage terms (in relation to equity at the beginning of 2009). It would also be justified to scale change in RI^{BV} by using revenues (sales) or, alternatively, to express the change as a growth rate. The second solution was rejected in the research because of the fact that some companies had negative RI^{BV} close to zero in 2008 and positive RI^{BV} in 2009. As the result of that, growth rates of RI^{BV} calculated for them were unnaturally low (an extremely low denominator in growth rate formula)[5]. When change in RI^{BV} was divided by equity, the effect of the extremely low denominator was not so strong. In 2009 121 companies (45%) improved their RI^{BV} in relation to 2008, while 146 (55%) experienced decline in the level of the metric. Average and median, calculated for CHANGE (in monetary units as well as in percent), were substantially different, especially for CHANGE expressed in monetary units, which was affected – as in the case of SIZE – by the result of just one firm (CEZ).

POTENTIAL was also analyzed in two ways – in monetary units (MVA) and in a relative manner (as MV/BV ratio). There were three companies having extremely low book values – for various reasons – at the top of the MV/BV ratio ranking (TRAVELPL and BEST – because of the character of their operation, SWARZEDZ – because of losses in the past). The situation is completely different in the MVA ranking. There were three large companies

[4] Residual income is additive (see Siudak, p. 87).

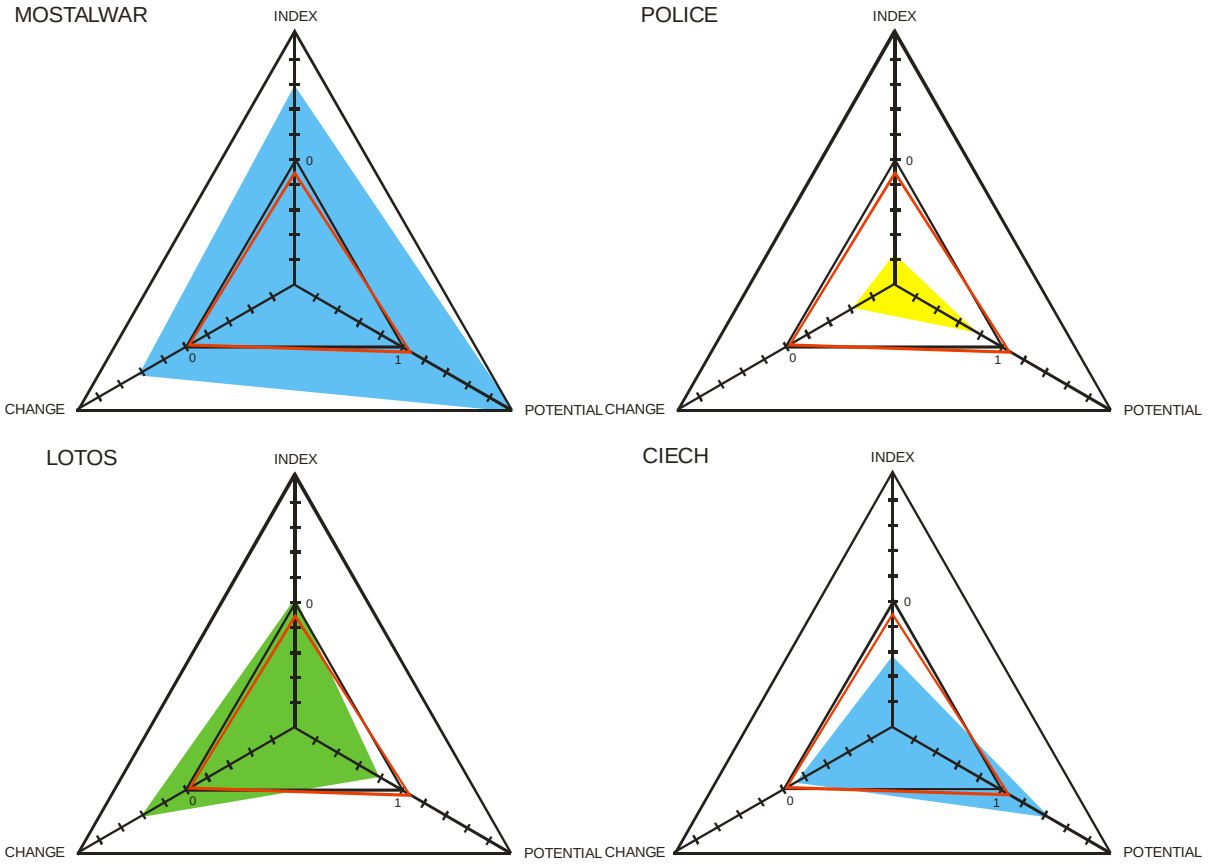
[5] For example growth rate of RI^{BV} for ENERGOPLD was estimated to be 2 343,32% (RI^{BV} in 2009 = 8 811,38 thousand of PLN, RI^{BV} in 2008 = -392,78 thousand of PLN).

representing the WIG20 at the top of it – KGHM, TPSA and PGNIG. The observations made on the basis of MV/BV and MVA rankings suggest that because of the size distortions that were noticed it would be recommended to express MVA in relation to sales in the future research. At the end of 2009 172 (64%) companies had positive MVA and 95 companies (36%) – negative MVA.

A relatively small number of companies (44, i.e. 16% of the entire population) exhibited negative stock returns (measured as TSR) in 2009. 220 companies delivered their shareholders TSR>0 (3 companies exhibited TSR = 0). Average TSR was high and equaled 61,30% (median was lower, namely 46,62%).

Only 37 companies (14% of the entire population) showed results that can be interpreted as unambiguously positive from the point of view of RI^{BV} (positive RI^{BV}, increase in RI^{BV} in relation to its level in previous year, positive stream of RI^{BV} expected in the future, reflected in positive MVA). MOSTALWAR deserves special attention in the group. It was classified high in all rankings constructed on the basis of the obtained results: as number one in the INDEX ranking, as number seven in the SIZE ranking, as number seventeen in the CHANGE (%) ranking and as number twenty fifth in the POTENTIAL (MV/BV) ranking. Exhibit 3 illustrates RI^{BV} radar plotted for this company.

Exhibits 3 – 6: RI^{BV} radars plotted for MOSTALWAR, POLICE, LOTOS and CIECH



Source: Author

On the other hand, 54 companies (20% of the entire population) demonstrated unambiguously negative performance from the point of view of RI^{BV} (negative RI^{BV}, decrease in RI^{BV} in relation to its level in previous year, negative stream of RI^{BV} expected in the future, reflected in negative MVA). Exhibit 4 illustrates RI^{BV} radar plotted for POLICE – a company representing the group (classified as number 265 in the SIZE ranking, as number 259 in the INDEX ranking, as number 260 in the CHANGE (%) ranking and as number 229 in the POTENTIAL (MV/BV) ranking. To sum up, unambiguous evaluation of RI^{BV} performance in 2009 was possible for only 1/3 of all companies included in the research. The other companies were classified in one of the six following classes in which performance was not definite:

1) $RI^{BV}>0$, $\Delta RI^{BV}<0$, MVA<0,
2) $RI^{BV}<0$, $\Delta RI^{BV}>0$, MVA<0,
3) $RI^{BV}>0$, $\Delta RI^{BV}<0$, MVA>0,
4) $RI^{BV}<0$, $\Delta RI^{BV}>0$, MVA>0,
5) $RI^{BV}>0$, $\Delta RI^{BV}>0$, MVA<0,
6) $RI^{BV}<0$, $\Delta RI^{BV}<0$, MVA>0.

Classes 5 and 6 deserve special attention. Companies representing the fifth class exhibit positive RI^{BV} accompanied by an increase in its level in relation to the previous year, but also negative MVA that should be interpreted as a signal informing that the market expects negative RI^{BV} – on average – in the future. Companies representing the sixth class exhibit negative RI^{BV} accompanied by a decrease in its level in relation to the previous year, but also positive MVA suggesting that the market positively assesses the firm's future prospects concerning its expected RI^{BV}. Among 267 companies covered by the study only seven represent the fifth class. Exhibit 5 illustrates RI^{BV} radar plotted for one of them – LOTOS. The sixth class was much more numerous – 66 companies were classified here. Exhibit 6 illustrates RI^{BV} radar plotted for CIECH representing this class.

As was mentioned in the theoretical part of the article, RI^{BV} radar can be a part of a RI^{BV}-based performance measurement and evaluation system, aimed at resolving problems implied by the low informative usefulness of RI^{BV} and allowing for reliable and unambiguous assessment of a firm's position in its path to maximize economic value. The simplest form of such a system is to give a number of points for exceeding threshold values established for criteria distinguished earlier: zero for RI^{BV} (SIZE), ΔRI^{BV} (CHANGE) and MVA (POTENTIAL), as well as a median for each of the three criteria. Assuming that for reaching or exceeding each threshold the firm is given 0,5 of a point, the companies could be classified in one of 7 possible groups of different ratings (final scores) based on their multidimensional RI^{BV} performance. Table 5 shows the classes as well as number and share of companies included in them on the basis of results obtained in the research presented in the article. The number of firms that not only demonstrated positive RI^{BV}, positive ΔRI^{BV} and positive MVA, but also RI^{BV}, ΔRI^{BV} and MVA bigger than the market median, was 34. On the other hand, the number of firms that not only demonstrated negative RI^{BV}, negative ΔRI^{BV} and negative MVA, but also RI^{BV}, ΔRI^{BV} and MVA smaller than the market median, equaled 45.

Table 4: Number and share of companies representing 7 classes of different final scores calculated on the basis of multidimensional RI^{BV} performance analysis

Final score	Number of companies	Share of companies
3.0	34	12,73%
2.5	21	7,87%
2.0	50	18,73%
1.5	41	15,36%
1.0	54	20,22%
0.5	22	8,24%
0.0	45	16,85%

Source: Author

The observations made so far allow for some general conclusions. Firstly, although the number of companies that showed positive RI^{BV} in 2009 was smaller than in 2008 (70 and 86, respectively), aggregated RI^{BV} in 2009 was higher than in previous year (in both cases – with and without CEZ, the company having the greatest impact on total RI^{BV} in the studied population), which can be interpreted as a bigger concentration of value creation in 2009 in comparison with 2008 (a smaller number of companies creates more value). Secondly, the share of companies with positive MVA at the end of 2009 is much bigger than the share of companies exhibiting positive RI^{BV} in 2009 (64,4% and 26,2%, respectively). It means that at the end of 2009 investors' expectations concerning future residual incomes of companies covered by the research were – on average – optimistic, despite disappointing results in the light of RI^{BV} in 2009. Thirdly, of the four rankings analyzed in the article (SIZE, CHANGE, INDEX and POTENTIAL) INDEX ranking is the most correlated with the final comparison made on the basis of the companies' final scores. Knowing that, the criterion (INDEX) can be thought of as a more suitable measure of real financial success than the other criteria. Finally fourthly, the companies that were classified as having the highest final score based on multidimensional RI^{BV} analysis (3.0) were not among those that showed the highest shareholder returns (TSR) in 2009. However, the companies classified as having the lowest final mark (namely 0.0) were among those that delivered their shareholders the lowest stock returns.

Discussion and conclusions

RI^{BV}-based performance of 267 companies covered by the research presented in the article confirms the thesis according to which informative usefulness of the version of residual income is low. For the majority of the studied companies (2/3) the performance can't be evaluated unambiguously. Many of them exhibited negative RI^{BV}, however they were able to improve its level in comparison with the level in the previous year, and finally were rewarded by the market in the form of positive MVA. There are also many companies having negative RI^{BV} and negative ΔRI^{BV} but valued above their book values by the market.

On the other hand, there is also a group of companies, though relatively small, having positive RI^{BV} and positive ΔRI^{BV}, yet valued by the market below their book values. These observations, among many others, suggest that not only RI^{BV}, but also RI^{BV} in conjunction with its change in relation to the level of the metric in the previous period, may not be a

sufficient basis for formulating opinions as to the efficacy of a firm in realization of its ultimate financial goal defined as economic value maximization.

A multidimensional RI^{BV}-based performance measurement and evaluation system, equipped with a tool allowing for clear graphic presentation of a firm's position in the light of the performance (as RI^{BV} radar presented in the article) and enabling various types of analysis (comparisons in time, comparisons in space, retrospective analysis, prospective analysis, absolute results analysis, relative results analysis, etc.) offers a solution – at least partial – to the problem of the low informative usefulness of RI^{BV}. Under the evaluation based on such a system many firms exhibiting RI^{BV} below zero and, what's more, negative change in its level, would not be judged negatively.

The solutions to the low informative usefulness of RI^{BV}, suggested in the article, are simplified and should be considered preliminary propositions aimed at indication of possible avenues for future research on the issue and, on the basis of the research results, promising ways the RI^{BV}-based performance measurement and evaluation system could be designed. These aforementioned simplifications, an opening for polemic discussions, concern several things. Firstly, the tool presented in the article provides a look at a firm's periodic performance from three perspectives: yesterday, today and tomorrow, where tomorrow means performance expected by the market in the future (and reflected in the firm's MVA). Credibility of the market valuation as a mirror of a firm's results forecasted in the future is questionable and is well documented in the literature. Thus, it would be recommended to utilize different ways of presentation of a firm's performance in the prospective configuration. Secondly, the variables that were expressed in monetary units (RI^{BV}, ΔRI^{BV}, MVA) were scaled by using book value (equity). As a result, in some cases sharp distortions occurred (e.g. in the POTENTIAL ranking). It would be recommended to use sales instead of book value in such scaling in future research. Thirdly, the tool proposed in the article allows for comparisons in space and the benchmark used is market median. However, the benchmark can be easily changed for example into sector median or close competitors median and, what's more, the design of tools such as the recommended RI^{BV} radar can also include other benchmarks, e.g. market expectations as to the annual RI^{BV} level at the beginning of the measurement year or internal budget goals. Finally, fourthly, efficacy of the suggested tool must be put through rigorous scientific testing that requires preparation of an adequate research model.

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