VAIC: New Financial Performance Metric and Valuation Tool[1]

VAIC: Nueva métrica de evaluación de desempeño gerencial y herramienta de evaluación de inversiones.

VAIC: Nova métrica financeira de avaliação de desempenho gerencial e ferramenta de avaliação de investimentos

Rauf Ibragimov. [2]
Ignacio Vélez-Pareja. [3]
Joseph Tham. [4]

Abstract

This article introduces a new financial metric for managerial performance evaluation, Value Added to Invested Capital (*VAIC*), with the cost of unlevered equity as a hurdle rate to calculate the capital charge rather than the widely accepted *WACC*. *VAIC* preserves all positive features of the conventional residual operating income and EVA® and has the distinct advantage of computational simplicity and straight-forward interpretation. Associated valuation model is equivalent to the standard discounted cash flow approach; this equivalence is formally proved under certain assumptions regarding the risk of tax shields and confirms consistency of the new metric proposed. *VAIC* can serve as an aggregate financial indicator on the business performance dashboards, and might as well be considered a valid substitute for the established *EVA©* and *ReOI* metrics in evaluating managerial performance. Equivalence of the *VAIC* valuation model to the fundamental approach of valuing a business by cash flow discounting makes this metric not only a robust measure of financial performance but also a full-fledged investment valuation tool.

Keywords: Performance measurement, Economic Value Added; EVA, Residual income; Residual operating income, Valuation

JEL classification: G32; G39; M21; M41

Resumen

Este artículo introduce una nueva métrica financiera para la evaluación del desempeño gerencial, el Valor Añadido de la Inversión de Capital (VAIC), con el costo de capital no apalancado como una tasa de corte para el cálculo de los requerimientos de capital en lugar del CPPC (WACC) ampliamente aceptado. VAIC conserva todas las características positivas de la utilidad operativa residual convencional y VEA (EVA®) y tiene la ventaja de la sencillez en su cálculo y una interpretación directa y clara. El modelo de valoración asociado es equivalente al método de flujo de caja descontado estándar; esta equivalencia se demuestra formalmente bajo ciertas hipótesis sobre el riesgo de los escudos fiscales (ahorros en impuestos) y confirma la consistencia de la nueva medida propuesta. VAIC puede servir

Resumo

Este artigo introduz uma nova métrica financeira para a avaliação do desempenho gerencial, o Valor Agregado ao Investimento de Capital (VAIC), com o custo de capital não avalancado como uma taxa de corte para o cálculo dos requerimentos de capital em lugar do CMPC (WACC), amplamente aceito. VAIC conserva todas as características positivas da utilidade operativa residual convencional e VEA (EVA®) e tem a vantagem da simplicidade em seu cálculo e uma interpretação direta e clara. O modelo de valoração associada é equivalente ao método de fluxo de caixa descontado padrão; esta equivalência se demonstra formalmente sob certas hipóteses sobre o risco dos escudos fiscais (poupança em impostos) e confirma a consistência da nova medida proposta. VAIC pode

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2. Russian Presidential Academy of National Economy and Public Administration, Moscow, Russia ibrauf@gmail.com
3. Master Consultores nachovelez@gmail.com
4. Sanford School of Public Policy, Duke University and the Duke Center for International Development (DCID), Durham, North Carolina, U.S.A thamjx@duke.edu

como un indicador económico global en los cuadros de mando de desempeño empresarial, y bien podría ser considerado como un sustituto válido para el VEA (EVA©) ya establecido y ROI en la evaluación de desempeño de la gerencia. La equivalencia del modelo de valoración VAIC con el enfoque fundamental de la valoración de una empresa con flujos de caja descontados hace que este indicador no sea sólo una medida de solidez financiera, sino también una herramienta de valoración de inversiones en el más completo sentido.

Palabras clave: medición de desempeño, Valor Económico Agregado, EVA, ingreso residual, utilidad operativa residual, valoración.

servir como um indicador econômico global agregado nos *dashboards* de desempenho empresarial e também poderia ser considerado como um substituto válido para o VEA (EVA©) já estabelecido e métricas ROI na avaliação de desempenho da gerência. A equivalência do modelo de valoração VAIC, com o enfoque fundamental da valoração de uma empresa com fluxos de caixa descontados, faz que este indicador não seja somente uma medida de solidez financeira como também uma ferramenta de valoração de investimentos no sentido mais completo.

Palavras-chave: medição de desempenho, Valor Econômico Agregado, EVA, ingresso residual, utilidade operativa residual, valoração.

VAIC: new financial performance metric and valuation tool

In search for a perfect financial performance measure the concept of Residual Income had been introduced as an improvement upon accounting income in measuring performance.[5] Variations of a residual income measure have been in place for many decades,[6] and historically, the debate over the selection of performance metrics used in pay-for performance compensation systems has taken place almost exclusively in the managerial accounting literature.[7] In the last two decades both academia and practitioners have taken increasing interest in the area of financial performance measurement and a number of financial consultants have developed successful value based management (VBM) practices.[8] VBM principles and metrics have become an integral part of most financial management texts[9], and among the set of popular VBM systems, a modification of the traditional Residual Operating Income (*ReOI*) measure known as *Economic value* added (*EVA*®) is among the most prominent.[10] *EVA*® is unique in that its calculation involves a number of adjustments to the conventional accounting data, and hence, significance of the difference between *EVA* and *ReOI* is dependent on the impact of adjustments made.[11] For the purpose of this paper we leave the issue of adjustments beyond the scope of discussion and view *ReOI* and *EVA*® as equivalents.[12]

We start with a short investigation into the fundamentals of the residual operating income and predicate that desired performance estimates might not be

5. Since the eighteen century, economists have recognized that in order to increase its wealth, a firm must earn more than its cost of capital. Classic references are Hamilton (1777), cited by Mepham, (1983) and Marshall (1890), cited by Biddle *et al* (1999):

6. See Lewis (1955), and Solomons (1965) for the pioneering applications of the concept. Some accounting scholars long advocated the residual income measures for evaluating business performance, see, for example, Anthony R. (1973)

7. See Ittner and Larcker (2001) for survey of the management accounting studies summarized thru the lens of the Value-Based Management Accounting Framework.

8. A review of much of the relevant literature can be found in Martin *et al.* (2009).

9. For example, see Arnold (2005, pp. 181-190), Brealey and Myers (2003, pp. 321-325), Grinblatt and Titman (2001, p. 341-343), Hawawini and Vialett (2010, Ch.15) . Ross *et al* (2009, Appendix 13A)

10. The term *Economic Value Added* was first coined by Finnegan P.T. (1989) and strongly advocated by Stern Stewart & Co. consultancy, which did much to develop and promote the metric.

11. Stewart (1991) advocates a potential set of 160 adjustments to conventional accounting statements. However, the evidence suggests that the typical corporate EVA user makes only a small number of adjustments, no more than 10-15 as reported in Martin *et al.* (2009), and even fewer than five (in most cases) according to Young and O'Byrne (2001, p.257). The explanations Young and O'Byrne give for this reduction are twofold: (a) managers are reluctant to deviate from accounting-based numbers; (b) companies have found that most of the suggested adjustments have little impact on profit and capital.

12. The issue of adjustments to accounting statements is a subject of continuing debate. Young and O'Byrne (2001, p.255) mention that "There is no accepted canon of these adjustments, because they are directed at a variety of accounting performance measurement, and incentive issues. Not only is there disagreements over the importance of each issue, but in some cases EVA proponents disagree on a correct way to address it." Anderson *et al.* (2005) report strong instability of the adjustments effect on EVA over time, and a very strong correlation between adjusted and unadjusted EVA.

readily accessible from the accounting data as usually presumed. When done consistently, calculations turn out a challenging task with a full scale valuation of a levered firm and its equity involved. This exercise requires specific skills and competences, thus undermining the original idea to empower management with a theoretically sound, meaningful and computationally simple measure of financial performance.

Above complexities triggered by the need to value future cash flows or *ReOI* streams, implicit in the *EVA* type metrics is a confusion of operating results and financing effects external to the earnings generated by the assets-in-place. As a result, underperforming assets might look acceptably efficient under *ReOI* criteria just due to the imputed tax shield effect in the conventional after tax *WACC* applied to calculate the capital charge.

Based on the argument discussed we propose a new financial measure of performance, Value Added to Invested Capital (*VAIC*) with the cost of unlevered equity as a hurdle rate to calculate the capital charge. *VAIC* effectively decomposes the total book return attributable to all providers of the capital employed into the core and financing components, preserves all positive features of the conventional residual operating income and *EVA*® and has the distinct advantage of computational simplicity and straightforward interpretation. Associated valuation model with *VAIC* as a valuation attribute is equivalent to the fundamental discounted cash flow approach; this equivalence is formally proved in Appendix A and confirms consistency of the new metric proposed.

We illustrate ideas and results presented with a numerical example and end with concluding remarks.

Residual operating income basics

Residual Operating Income is a financial metric intended to provide an estimate of how much value has been added by the firm's operations in a particular period to the beginning of the period invested capital. It incorporates information from both the income statement and the balance sheet and is calculated by deducting a charge for the capital used, both debt and equity, from the net after-tax profit from operations. The capital charge is equal to the invested capital multiplied by the return required by the share and debt holders,[13] which is the weighted average cost of all sources of funds.

A formal definition of the Residual Operating Income for the period *t* is:

$$ReOI_t \equiv NOPAT_t - WACC_t \cdot IC_{t-1} \quad (1)$$

NOPAT represents the after tax operating profit of the company, which is defined as:[14]

$$NOPAT_t \equiv EBIT_t(1-T_t) \quad (2)$$

or equivalently in terms of the period *t* Net Income (*NI*) and interest expenses (*Int*):

$$NOPAT_t \equiv NI_t + Int_t\left(1-T_t\right) \quad (3)$$

Earnings before interest and taxes (*EBIT*) is the pretax income that a company would have earned if it had no debt. It includes all type of operating income and is often equal to the line operating income on the company's income statement. T_t is the income tax rate for the period *t*, and taxes on *EBIT* represent the income taxes a company would pay if it had no debt or excess marketable securities.

Invested capital, IC_{t-1}, is defined as the sum of net fixed assets FA_t and working capital requirements, WCR_{t-1}, according to the following balance sheet relations:

$$IC_{t-1} \equiv FA_{t-1} + WCR_{t-1} \quad (4)$$

$$WCR_{t-1} \equiv CA_{t-1} - CL_{t-1} \quad (5)$$

where CA_t denotes current assets, and CL_t – non-interest bearing current liabilities. Time index *t-1* on the balance sheet or other stock items means end of the year t-1, or equivalently, beginning of the year *t*.

Standard formula for the weighted average cost of capital (*WACC*) is

$$WACC_t \equiv w_t^E k_t^E + w_t^D k_t^D (1-T_t) \quad (6)$$

with the weights equal to the relative amounts of equity E_{t-1} issued and debt D_t outstanding

$$w_t^E = \frac{E_{t-1}}{E_{t-1}+D_{t-1}}, \quad w_t^D = \frac{D_{t-1}}{E_{t-1}+D_{t-1}},$$

k_t^E is the cost of the levered equity, and k_t^D is the cost of debt.

General approach implies that not just the weights, but also the cost of equity capital k_t^E are updated period by period according to a changing capital structure and

13. The capital charge is defined as an opportunity cost of the funds if they were to be invested in another firm of a similar risk

14. *NOPAT* is a profit concept widely used in performance measurement and business valuation For further details see Koller *et al* (2010, pp. 149-154), Stewart (1991, p. 742)

to a (possibly) changing cost of debt k_t^D. If the cost of capital changes over time, one has to use different values for $WACC_t$ each year.[15] The debt outstanding D_t is assumed to be on market terms, i.e., the book value of debt is equal to its market value, and year t expected interest rate on debt is equal to the cost of debt capital for the same year.

Residual operating income is often defined in an equivalent format reflecting the "performance spread" between the rate of return earned on the firm's book invested capital

$$ROIC_t = NOPAT_t / IC_{t-1} \tag{7}$$

and the firm's overall cost of capital, i.e.

$$\mathrm{Re}OI_t \equiv \left(ROIC_t - WACC_t\right) \cdot IC_{t-1} \tag{8}$$

The dark side of *ReOI*: hidden complexities

One of the generally accepted advantages of the residual income is that it makes the cost of capital visible to operating managers. However, accessing a capital charge component of *ReOI* is highly sensitive to the cost of capital calculation and entails a number of technical complexities.

The fundamental relationship that the market value of a company is equal to the present value of its future free cash flows discounted at the *WACC* is true only if *WACC* is a market weighted average of the cost of equity and the cost of debt. Therefore, finance theory tells us to weight the debt and equity portions of the *WACC* on the basis of market values.16 The implication of this rule is twofold. First, calculations of *WACC* require valuation of a levered firm and its equity based on forecasting future cash flows or *ReOI* streams.[17] Second, valuing a levered firm and a levered equity involves circularity between the unknown values and required discount rates, making *ReOI* calculation even more complicated.

While circularity problem is primarily a technical matter which can be resolved either numerically as proposed by Vélez-Pareja and Tham (2000), Tham and Vélez-Pareja (2004), Pratt and Grabowski (2008), or analytically as done by Vélez-Pareja and Benavides (2006), Mejia-Pelaez and Vélez-Pareja (2010), the overall task of building and handling the valuation model requires specific knowledge and skills hardly attributable to executives outside the finance department of a firm. Calculation of *ReOI* performance metric intended to be accounting based and simple converts, if done consistently, into a demanding exercise difficult to comprehend and apply by the non-financial managers. Common solution of using long term target weights to calculate *WACC* even though simple comes at a cost of biased performance evaluation. Whereas it is just normal that the cost of capital evolves due to investment, operating and financing decisions thus affecting the capital charge component of *ReOI*, substituting a target figure for the capital structure leaves this effect not captured by the *ReOI* estimates.[18]

Should WACC be used to calculate the capital charge?

Apart from the technical issues mentioned, there is a conceptual question of which rate should be used to calculate the capital charge in formula (1)? The basic premise is to multiply the investment base by a prescribed rate which reflects the required return to the suppliers of capital. As the company's providers of funds, shareholders and lenders (banks, bond market, treasury market, etc.), together hold all company's assets, the rate of return that is required to compensate risks they bear[19] is the risk of assets, i.e. the cost of unlevered equity k^U. Since the company is a portfolio of stock and debt, the total expected return of the company is equal to the weighted average of expected returns of the securities in it, k_t^E and k_t^D respectively:[20]

$$k^U = w_t^E \cdot k_t^E + w_t^D \cdot k_t^D \tag{9}$$

Although the debt works to the advantage of a company, because the interest on debt can be deducted from its tax base, it has no consequences either for the risk

15. See Tham and Vélez-Pareja (2004); Pratt and Grabowski (2008).

16. This is an established rule traced both in corporate finance texts and publications on valuation and EVA. For example, see Berk *et al* (2012, Ch. 12), Koller *et al* (2010, p.802), Yong and O'Byrne (2000, pp.253-255).

17. The exception are traded firms in mature markets, where we can calculate weights using observed market prices for each of the firm's securities

18. Moreover, the cost of levered equity and WACC may not be constant even in the case when a firm maintains its capital structure unchanged over time. See Vélez-Pareja *et al* (2008)

19. This is an expected return equal to what investors could expect to earn elsewhere for assuming the same level of risk.

20. "The overall riskiness of the company is represented by the cost of capital, which is not the weighted average of two separate costs. The costs of equity and debt are a function of the risk of the assets, the cost of overall capital, and the respective weighting of each." (Vernimmen *et a.* 2009., p. 448)

of the company's assets-in-place, or for the expected return on the capital invested in these assets.

The standard tax adjustment (1-*T*)in the conventional *WACC* formula (6) is justified on the grounds that interest is tax deductible and expression (6) is therefore interpreted as the weighted average of the cost of the levered equity k_t^E and the after tax cost of debt $k_t^D(1-T_t)$. If the argument is that a firm paying interest at a rate k_t^D has a tax shield of $k_t^D D_{t-1} T_t$, then, in an accounting sense, the firm has incurred a net expense of $k_t^D(1-T_t)$, but this is the "book cost" of borrowing, not the economic cost of debt capital. The economic cost of debt is the creditors' opportunity cost and it depends on an expected return on alternative investments with the same risk. What creditors entitled to receive are the full (not after tax) interest payments, and they are indifferent whether a firm can deduct interest payments for tax purposes.21 Regarding the economic cost of debt capital the tax adjustment $(1-T)$ to make it an after tax cost is irrelevant.

With the elementary algebra we can see, that the conventional after tax weighted average cost of capital (6) is not the weighted average of two separate costs, k_t^E and $k_t^D(1-T_t)$, but the cost of unlevered equity adjusted for the tax effect of leverage[22]

$$WACC_t = k^U - \frac{TS_t}{V_{t-1}} \qquad (10)$$

where

$$TS_t = k_t^D D_{t-1} T_t = Int_t \cdot T_t \qquad (11)$$

is the period t interest tax shield. In the free cash flow (*FCF*) valuation framework this adjustment is a flexible and consistent method to include the value of the tax deductibility of interest into the overall value of levered firm.[23]

Although the return attributable to all suppliers of capital comes from the two sources, one is the firm's assets, and the other is a subsidy from the government to the stockholders of a levered firm, measuring financial performance with the standard *ReOI* or *EVA* has the implication of artificially lowering the minimum acceptable hurdle for the rate of return a company must earn on its operating assets while effectively compensating this reduction by the imputed tax shield effect in the conventional after tax *WACC* applied to calculate the capital charge. Consequently, underperforming assets might look acceptably efficient under *ReOI* criteria just due to the tax savings on interest – a pure financing factor external to the earnings generated by the operating assets. An intuitive and theory compliant way to avoid confusion of returns from operations and side effects of financing in *ReOI* estimates is to assess the capital charge as a product of the invested capital and the required return on assets k^U, the true threshold for operations as noted earlier, and add the tax deduction on interest explicitly as a separate item. This approach effectively decomposes the total book return attributable to all providers of the capital employed into the core *NOPAT* and financing *TS* components, providing additional information for managerial judgment regarding the firm's financial performance.

It is also worth noting that implicit in the *WACC* formula (6) is the assumption that the interest rate firm pays on its debt coincides with the market cost of debt capital. However this assumption might not hold, and applying standard *ReOI* expression (1) or (8) can lead to aberrations in financial performance measurement due to divergence in actual and implicit interest tax shields. These aberrations could be significant if the firm has issued long term public debt. Consistent modification of *ReOI* to incorporate explicit assessment of the tax effects of leverage will help eliminate this measurement error.

Value added to invested capital (VAIC). New measure of financial performance

Based on the argument discussed in the previous section and following ideas put forward by Vélez-Pareja and Tham (2004) we propose *VAIC* (Value Added to Invested Capital) – new transparent and computationally simple member to the family of residual income measures of performance:

$$\begin{aligned} VAIC_t &\equiv NOPAT_t - k^U \cdot IC_{t-1} + TS_t = \\ &= \left(ROIN_t - k^U\right) \cdot IC_{t-1} + TS_t \end{aligned} \qquad (12)$$

From the definition it is clear, that the metric is free of the circularity problem and all other complications

21. Strictly speaking, creditors are indifferent to the interest tax deduction by the firm as long as the firm is solvent

22. Note that the formula (10) is strictly correct only when the systematic risk of the cash flow from tax deductibility of interest equals the cost of unlevered equity. See Taggart (1991), Tham and Vélez-Pareja (2004) for further details.

23. In the general case, *TS* is not necessarily the interest expenses times the corporate tax rate. It could also include the tax deductibility from other financial items, such as losses carried forward, exchange losses, deductibility of dividends and inflation adjustments to the equity book value in financial statements. The advantage of the generalized formulation (10) is that it allows accounting for the tax and cash flow effects of these real-life complexities on the overall cost of capital of the levered firm. See Vélez-Pareja and Tham (2010).

triggered by the need to perform valuation of a levered firm and its equity when calculating *ReOI* or *EVA*. The cost of unlevered equity k^U is relatively stable parameter invariant to the changes in capital structure, and can be estimated following standard procedures either from the market data for the firm in question if reliable or from the market data for comparable firms traded in mature markets.[24] Data for all other inputs is assessable from the financial statements.

Following conventional accounting relations, we can reformulate *VAIC* expression (12) in terms of the net income and interest expenses:

$$\begin{aligned} VAIC_t &= NOPAT_t - k^U \cdot IC_{t-1} + Int_t \cdot T_t = \\ &= NI_t + Int_t\left(1-T_t\right) + Int_t \cdot T_t - k^U \cdot IC_{t-1} = \\ &= NI_t + Int_t - k^U \cdot IC_{t-1} \end{aligned} \tag{13}$$

The main advantage of *VAIC* formulation (13) is that it requires minimum effort to collect input data. Regarding internal information, net income and interest expenses from the Income Statement and total assets less non-interest bearing current liabilities from the Balance Sheet is all that is needed to calculate the metric. The drawback of the *VAIC* formulation (12) is the need to explicitly estimate the interest tax shields TS_t, which may not be straightforward since the actual tax shield realizations depend not only on the interest expenses and corporate tax rate, but are a function of *EBIT* and other sources of tax deductibility available to the firm.

Subtracting (1) from (12) and remembering (10) we can see, that *VAIC* and *ReOI* (*EVA*) are not identical. They differ by the amount of tax shield in the measurement period adjusted for the relative difference in the market and book values of the firm's operating assets.

$$EVA_t = VAIC_t - TS_t\left(1 - \frac{IC_{t-1}}{V_{t-1}}\right) \tag{14}$$

With the equation (14) it is fully possible to convert *VAIC* quantities into *EVA* quantities and vice versa, however one can clearly see that the valuation of a levered firm is a required component for the *ReOI* and *EVA* calculations. The need to perform a valuation exercise takes the assessment of the conventional residual income metrics to the finance department of the firm, far away from ongoing operations. On the contrary, *VAIC* properties mentioned above make it an efficient device to implement the original idea of measuring performance down to the workshop floor with a robust metric based on the reliable accounting data and the opportunity cost of capital invested in the income generating assets.

Overall, *VAIC* is a financial measure focused on evaluating managerial performance over certain periods of time. It contrasts the book return to all capital providers with the expected return on assets and fully accounts for the firm's overall capital cost. *VAIC* preserves all positive features of the conventional residual operating income and *EVA*® and has the distinct advantage of computational simplicity and straightforward interpretation. It is a flow measure and can, in theory, be calculated for any level, including divisions, departments, product lines or geographic business segments.

VAIC valuation model

From a finance perspective, the *VAIC* concept is equivalent to the fundamental premise that value is equal to the present value of the expected free cash flows. As formally proved in the Appendix A and illustrated by the numerical example in the next section

$$\text{Firm value} = \begin{array}{c}\text{Present}\\ \text{value of}\\ \text{future free}\\ \text{cash flows}\end{array} = \begin{array}{c}\text{Invested}\\ \text{capital}\end{array} + \begin{array}{c}\text{Present}\\ \text{value of}\\ \text{future VAIC}\\ \text{stream}\end{array}$$

Thus, a firm value is equal to the capital that has been invested in a company plus the present value of all future *VAIC*. This view of the firm value provides a transparent and relatively simple tool for business appraisal and investment valuation Simplicity of the *VAIC* valuation model comes from the fact, that the valuation attribute *VAIC* is the number obtained directly from the prospective financial statements, and that the discount rate for *VAIC*, the cost of unlevered equity k^U, is independent of the capital structure, the cost of levered equity and the cost of debt capital.

In this context the firm's *MVA* or, equivalently, *NPV* of an investment opportunity is equal to the present value of expected future VAIC discounted at the cost of unlevered equity k^U, exactly as it is equal to the present value of future *EVA* discounted at *WACC*. Stating in more formal terms

$$MVA = \text{Firm value} - \text{Invested capital} = \text{Present value of future } VAIC \text{ stream}$$

As an important reminder we have to note, that the assumption underlying all developments in this paper is that the risk of the interest tax shields is equal to the risk of unlevered equity k^U. Although in theory this

24. One established approach is to unlever the equity beta obtained from regressing market data and then applying the capital assets pricing model (CAPM) to calculate the cost of unlevered equity, see Damodaran (2010). As an alternative, one can calculate the cost of unlevered equity directly from the observable cost of levered equity of comparable firm by applying appropriate model, relating the cost of levered equity to the cost of unlevered equity and the cost of debt, see Tham and Vélez-Pareja (2004).

assumption is not strictly correct for all financial policies of a firm, it is a reasonable approximation for the real life applications. Any possible loss of precision, which in most cases may have immaterial effect on the periodic performance metric figures and present values, is far compensated by the advantage of simplicity and inherent transparency of all calculations.

Numerical example

In this section with the data from the Appendix B we illustrate numerically the basic points discussed in the article. We accept 35% income tax rate, and take as an input data 15% for the cost of unlevered equity and 10% for the cost of debt

First, two sequences of *ReOI* figures are calculated in the Table 1, one using *WACC* with book value weights ($WACC_{BW}$), and the other using *WACC* with long term target weights ($WACC_{TW}$) corresponding to the target capital structure of $(D/E)_{TW}$=1

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
NOPAT		23,6	34,7	44,7	49,2	48,6	51,9
IC	134,0	196,7	269,2	309,1	327,6	343,1	359,7
D	44,0	96,0	150,0	165,0	170,0	175,0	180,0
w^D	0,33	0,49	0,56	0,53	0,52	0,51	0,50
w^E	0,67	0,51	0,44	0,47	0,48	0,49	0,50
D/E	0,49	0,95	1,26	1,15	1,08	1,04	1,00
k^E		17,4%	19,8%	21,3%	20,7%	20,4%	20,2%
$WACC_{BW}$		13,9%	13,3%	13,0%	13,1%	13,2%	13,2%
$ReOI_{BW}$		5,0	8,6	9,5	8,6	5,4	6,6
$(D/E)_{TW}$	1,0	1,0	1,0	1,0	1,0	1,0	1,0
w^D	0,5	0,5	0,5	0,5	0,5	0,5	0,5
k^E		20,0%	20,0%	20,0%	20,0%	20,0%	20,0%
$WACC_{TW}$		13,3%	13,3%	13,3%	13,3%	13,3%	13,3%
$ReOI_{TW}$		5,8	8,7	9,0	8,3	5,2	6,5

Table 1. *ReOI* with the book and target weights in *WACC*

Next, we turn to the most complicated exercise, which is calculating *ReOI* with the *WACC* periodically adjusted in accordance with the changes in the capital structure. Consistent approach implies that the weights in *WACC* formula (6) are estimated as the market values of equity *E* and debt *D* relative to the overall market value of the firm. This procedure generates circularity, because the value of the firm and its equity depend on the present value of future *ReOI* discounted at *WACC*. The problem is solved numerically in the spreadsheet with activated iterations feature as detailed by Tham and Vélez-Pareja (2004), and it is equivalent to solving a system of simultaneous equations for *D/E* , k^E, *WACC*, *ReOI*, *MVA*, *V* and *E*. Table 2 presents the final results of calculations. Note (Tham and Vélez-Pareja, 2004; Koller *et al*, 2010, Appendix D) that the correct expression to calculate the cost of levered equity under assumption that the risk of interest tax shields equals the risk of unlevered equity k^U is $k_t^E = k^U + \left(D_{t-1}/E_{t-1}\right)\left(k^U - k_t^D\right)$. Market Value Added (*MVA*) is calculated as the present value of future *ReOI* discounted at *WACC* (Stewart, 1991).

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
NOPAT		23,6	34,7	44,7	49,2	48,6	51,9
IC	134,0	196,7	269,2	309,1	327,6	343,1	359,7
D	44,0	96,0	150,0	165,0	170,0	175,0	180,0
E=V-D	139,1	152,2	169,8	192,8	205,0	217,2	229,6
D/E	0,32	0,63	0,88	0,86	0,83	0,81	0,78
kE		16,6%	18,2%	19,4%	19,3%	19,1%	19,0%
WACC		14,2%	13,6%	13,4%	13,4%	13,4%	13,4%
ReOI		4,6	7,9	8,7	7,8	4,7	5,8
MVA	49,1	51,5	50,7	48,7	47,4	49,1	49,9
V= IC + MVA	183,1	248,2	319,8	357,8	375,0	392,2	409,6

Table 2. Consistent *ReOI* calculation with the market value weights in *WACC*

Comparing in the Table 3 the periodic values from simplified EVA calculations in the Table 1 and consistent values from the Table 2 we see, that the measurement error could be significant. In this particular example it falls in the range of 3,4% to 26,6%, and this error is solely due to the simplifying conventions to calculate *WACC*.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
EVA		4,6	7,9	8,7	7,8	4,7	5,8
ReOIBW		5,0	8,6	9,5	8,6	5,4	6,6
Relative difference		9,0%	8,9%	9,5%	10,0%	16,2%	13,2%
ReOITW		5,8	8,7	9,0	8,3	5,2	6,5
Relative difference		26,6%	9,9%	3,4%	5,4%	11,5%	11,1%

Table 3. The difference between the consistent and approximate EVA estimates

Although consistent approach eliminates instrumental errors in the performance measurement, it is too complicated both technically and conceptually to serve as a tool for everyday use by the nonfinancial managers. *VAIC* is a reliable substitute, possessing the advantage of simplicity and ease of use. It is consistent, and as can be seen in the Table 4, discounting *VAIC* at the cost of unlevered equity produces *MVA* values equal to the *MVA* obtained by discounted *ReOI* at a periodically adjusted *WACC* as presented in the Table 2.

The simplicity of *VAIC* metric proposed is evident when one compares Table 2 and Table 4 for the number of items to be included in the calculations, not to mention the circularity issue and complications arising from it.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Net income		20,7	28,5	34,9	38,5	37,5	40,6
Interest expenses		4,4	9,6	15,0	16,5	17,0	17,5
IC	134,0	196,7	269,2	309,1	327,6	343,1	359,7
k^U		15,0%	15,0%	15,0%	15,0%	15,0%	15,0%
VAIC		5,0	8,6	9,5	8,6	5,4	6,6
MVA	49,1	51,5	50,7	48,7	47,4	49,1	49,9
V=IC + MVA	183,1	248,2	319,8	357,8	375,0	392,2	409,6

Table 4. *VAIC*, *MVA* and the value of levered firm

Finally in the Table 5 the value of a levered firm is calculated via iterative backward discounting procedure (A.3) for the free cash flows starting with the terminal value. Expression (10) and (11) are respectively applied to calculate *WACC* and the interest tax shields (*TS*).

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
FCF		-39,1	-37,8	4,8	30,7	33,1	35,4
TS		1,5	3,4	5,3	5,8	6,0	6,1
WACC		14,2%	13,6%	13,4%	13,4%	13,4%	13,4%
V	183,1	248,2	319,8	357,8	375,0	392,2	409,6

Table 5. FCF valuation

As can be seen, both the *WACC* estimates and the values *V* obtained match the corresponding figures in the Table 2 and Table 4. This illustration confirms the equivalence of the *VAIC* valuation model to the fundamental approach of valuing a business by cash flow discounting formally proved in the Appendix A.

VAIC is not only a robust measure of financial performance but also a full-fledged investment valuation tool.

Concluding remarks

This paper presents a new financial metric for managerial performance evaluation, Value Added to Invested Capital (*VAIC*). It is a residual income type measure which contrasts the total book return to all capital providers of a firm with the expected return on capital employed. Associated valuation model with *VAIC* as a valuation attribute is equivalent to the standard discounted cash flow approach, and this equivalence confirms consistency of the new metric proposed.

VAIC is a flow measure and can be considered a valid replacement for the established *EVA*™, *ReOI* and EP metrics in evaluating managerial performance over certain periods of time. The main advantage of *VAIC* is computational simplicity. It departs from the two clearly defined items from the Income Statement: Net Income and Interest expenses and calculates the capital charge using the cost of unlevered equity. Equivalence of the *VAIC* valuation model to the fundamental approach of valuing a business by cash flow discounting makes this metric not only a robust measure of financial performance but also a full-fledged investment valuation tool.

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Appendix A. Equivalence of VAIC and FCF valuation

First we show that the yearly dynamics of the two valuation models are *equivalent* for an arbitrary year t in the forecast period. Since the models and the discounting procedure are applied in the same way for any year, then the equivalence must hold for any and *all* years. By this argument the equivalence is proved.

The free cash flow valuation model

The *FCF* model suggests that the levered *firm value*, V_t is equal to the present value of all future free cash flows generated by the company discounted at a periodically adjusted weighted average cost of capital

$$V_t = \sum_{k=1}^{L} FCF_{t+k} \prod_{j=1}^{k} \left(1+WACC_{t+j}\right)^{-1} \quad \text{(A.1a)}$$

or

$$V_t = \sum \frac{FCF_{t+k}}{\prod_{j=1}^{k}\left(1+WACC_{t+j}\right)} \quad \text{(A1.b)}$$

L denotes the expected end of life of the company.

Since the value at each date *t* includes the value of all subsequent cash flows, it is even simpler to compute V_t by working backward from period $t+1$, discounting that period free cash flow FCF_{t+1} and the value V_{t+1} of free cash flows in year $t+2$ and beyond

$$V_t = \frac{FCF_{t+1}+V_{t+1}}{1+WACC_{t+1}} \quad \text{(A.3)}$$

Equation (A.3) represents yearly value dynamics according to the *FCF* model:

Following the definition of free cash flow[25]

$$FCF_t \equiv NOPAT_t + DP_t - CapEx_t - \left(WCR_t - WCR_{t-1}\right) \quad \text{(A.4)}$$

This definition can be reformulated as

$$FCF_t = NOPAT_t + DP_t - \left(FA_t - FA_{t-1} + DP_t\right) - \left(WCR_t - WCR_{t-1}\right)$$

and after cancelling out depreciation and taking into account (4) it simplifies to

$$FCF_t = NOPAT_t - \left(IC_t - IC_{t-1}\right) \quad \text{(A.5)}$$

Yearly value dynamics in the VAIC valuation model:

According to the *VAIC* model, the value of the levered firm at time *t*, V_t is:

$$V_t = IC_t + \sum_{s=t+1}^{L} \frac{VAIC_s}{\left(1+k^U\right)^{s-t}} \quad \text{(A.6)}$$

Taking the term $\frac{VAIC_{t+1}}{1+k^U}$ outside the summation we can rewrite (A.6) as

$$V_t = IC_t + \sum_{s=t+1}^{L} \frac{VAIC_s}{\left(1+k^U\right)^{s-t}} = IC_t + \frac{VAIC_{t+1}}{1+k^U} + \frac{1}{1+k^U} \sum_{s=t+2}^{L} \frac{VAIC_s}{\left(1+k^U\right)^{s-t-1}} \quad \text{(A.7)}$$

Note that the value of the levered firm at time $t+1$ is

$$V_{t+1} = IC_{t+1} + \sum_{s=t+2}^{L} \frac{VAIC_s}{\left(1+k^U\right)^{s-t-1}}$$

After substituting

$$\sum_{s=t+2}^{L} \frac{VAIC_s}{\left(1+k^U\right)^{s-t-1}} = V_{t+1} - IC_{t+1}$$

into expression (A.7) it simplifies to

$$V_t = IC_t + \frac{VAIC_{t+1}}{1+k^U} + \frac{1}{1+k^U}\left(V_{t+1} - IC_{t+1}\right)$$

Finally, reducing to a common denominator we obtain the relation of the levered firm values for the two subsequent time periods according to the VAIC model

$$V_t = IC_t + \frac{VAIC_{t+1} + V_{t+1} - IC_{t+1}}{1+k^U} \quad \text{(A.8)}$$

Proof of equivalence

According to (12) and (11)

$$VAIC_{t+1} = NOPAT_{t+1} - k^U IC_t + k^D_{t+1} D_t T_{t+1} \quad \text{(A.9)}$$

Multiplying both sides of (A.8) with $(1+k^U)$ obtain

$$V_t + V_t k^U = IC_t + IC_t k^U + VAIC_{t+1} + V_{t+1} - IC_{t+1} \quad \text{(A.10)}$$

Substituting (A.9) into (A.10) gives

$$V_t + V_t k^U = IC_t + IC_t k^U + NOPAT_{t+1} - k^U IC_t + k^D_{t+1} D_t T_{t+1} + V_{t+1} - IC_{t+1} \quad \text{(A.11)}$$

25. This is common definition found in literature, see Koller *et al* (2010, pp. 154-156); Berk *et al* (2012, pp. 254-259)

After making rearrangements and taking into account (A.5) equation (A.11) reduces to

$$V_t + V_t k^U - k^D_{t+1} D_t T_{t+1} = FCF_{t+1} + V_{t+1} \quad \text{(A.12)}$$

Remembering (10) the expression (A.12) finally transforms into (A.3) – the yearly levered value dynamics in the FCF valuation model

$$V_t = \frac{FCF_{t+1} + V_{t+1}}{1 + WACC_{t+1}}$$

Appendix B. Financial Data for XYZ llc

These are stylized forecasted financial statements of a hypothetical XYZ llc company used as the basis for numerical example.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Sales		1445,4	1969,3	2363,1	2599,2	2793,3	2865,2
Cost of goods sold		1156,3	1575,4	1890,5	2079,4	2234,6	2292,2
Gross profit		289,1	393,9	472,6	519,8	558,7	573,0
SG&A		217,4	296,2	355,5	391,0	420,2	431,0
Depreciation		35,4	44,2	48,4	53,1	63,7	62,1
EBIT		36,2	53,4	68,7	75,7	74,8	79,9
Interest expenses		4,4	9,6	15,0	16,5	17,0	17,5
Earnings before tax		31,8	43,8	53,7	59,2	57,8	62,4
Income tax		11,1	15,3	18,8	20,7	20,2	21,8
Net income		20,7	28,5	34,9	38,5	37,5	40,6

Table B1. XYZ llc Pro Forma Income Statement

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Net Fixed Assets	117,0	180,0	250,8	292,4	304,3	310,6	328,5
Inventory	29,0	43,0	54,0	65,0	71,0	75,0	78,0
Receivables	14,0	22,0	27,0	32,0	36,0	37,0	39,0
Other Current Assets	20,0	19,7	22,4	21,7	27,3	37,5	37,2
Total Assets	180,0	264,7	354,2	411,1	438,6	460,1	482,7
Accounts payable	35,0	52,0	65,0	78,0	85,0	90,0	94,0
Other Current Liabilities	11,0	16,0	20,0	24,0	26,0	27,0	29,0
Long Term Debt	44,0	96,0	150,0	165,0	170,0	175,0	180,0
Shareholders' Equity	90,0	100,7	119,2	144,1	157,6	168,1	179,7
Total Liabilities and Equity	180,0	264,7	354,2	411,1	438,6	460,1	482,7

Table B2. XYZ llc Pro Forma Balance Sheet

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
NOPAT		23,6	34,7	44,7	49,2	48,6	51,9
- Net Capex		63,0	70,8	41,6	11,9	6,3	17,9
- ΔWCR		-0,3	1,7	-1,7	6,6	9,2	-1,3
FCF		-39,1	-37,8	4,8	30,7	33,1	35,4

Table B3. XYZ llc Forecasted Free Cash Flow

Free cash flows in the Table B3 are derived from the data in Tables B1 and B2, following definitions in Appendix A.

$$Net\ Capex_t = Capex_t - DP_t$$

and

$$\Delta WCR_t = WCR_t - WCR_{t-1}$$

The Year 6 ending value of XYZ llc (Terminal Value) is estimated to be equal 409,6.