# Three Residual Income Valuation methods and Discounted Cash Flow Valuation

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## ABSTRACT

In this paper we show that the Residual Income models for equity valuation always yield the same value as the Discounted Cash Flow Valuation models.

We use **three residual income measures**: Economic Profit, Economic Value Added (EVA) and Cash Value Added. We also show that economic profit and EVA are different, although Copeland, Koller and Murrin (2000, page 55) say that economic profit is a synonym of EVA.

Specifically, we first show that the present value of the **Economic Profit** discounted at the required return to equity plus the equity book value equals the value of equity. The value of equity is the present value of the Equity cash flow discounted at the required return to equity.

Then, we show that the present value of the **EVA** discounted at the WACC plus the enterprise book value (equity plus debt) equals is the enterprise market value. The enterprise market value is the present value of the Free cash flow discounted at the WACC.

Then, we show that the present value of the **Cash Value Added** discounted at the WACC plus the enterprise book value (equity plus debt) equals is the enterprise market value. The enterprise market value is the present value of the Free cash flow discounted at the WACC.

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This paper uses for valuation purposes three parameters that have been proposed for measuring a firm's "value creation" for its shareholders. The parameters[1] analyzed are:

- EVA™ (*economic value added*), which is[2] earnings before interest less the firm's book value multiplied by the average cost of capital.

- EP (*economic profit*)[3], which is the book profit less the equity's book value multiplied by the required return to equity.

- CVA (*Cash value added*), which is[4] earnings before interest plus amortization less economic depreciation less the cost of capital employed.

Many firms (Coca Cola, Bank of America, Monsanto, among others) use EVA™, EP or CVA, instead of the book profit, to assess the performance of managers or business units and as a reference parameter for executive compensation. According to CFO Magazine (October 1996), 25 companies used EVA™ in 1993 and 250 in 1996.

In Fernandez (2001), we show that to claim that EP, EVA™ or CVA measures the firm's "value creation" in each period[5] is a tremendous error. These parameters may be useful for measuring the performance of managers or business units, but it does not make any sense at all to use EP, EVA™ or CVA to measure value creation in each period. The problems with EVA™, EP or CVA start when it is wished to give these parameters a meaning (that of value creation) that they do not have: value always depends on expectations.

It is also shown that through the present value of EP, EVA™ and CVA we get the same equity value as the discounting the equity cash flow or the free cash flow. Therefore, it is possible to value firms by discounting EVA™, EP or CVA, although these parameters are not cash flows and their financial meaning is much less clear than that of cash flows.

Penman and Sougiannis (1998) admit that "dividend, cash flow and earnings approaches are equivalent when the respective payoffs are predicted to infinity", but they claim that for finite horizon analysis "accrual earnings techniques dominate free cash flow and dividend discounting approaches".

Lundholm and O'Keefe (2001a) first purpose is to probe that "any claim of the residual income model's superiority over the cash flow model is mistaken." They argue that "even in a practical implementation or large-sample study, the models should still be equivalent–for every firm in every year." And also that " the fact that the price estimates frequently differ between the two models illustrates the difficulty in consistently applying the same input assumptions to the different models." Their second

[1] EVA is a registered trademark of Stern Stewart & Co. Some consultants use the Economic Profit as a synonym of the EVA, but we shall see further on that the two parameters are different. CVA is a measure proposed by the Boston Consulting Group. See *Shareholder Value Metrics* (1996)

[2] According to Stern Stewart & Co's definition. See page 192 of their book *The Quest for Value. The EVA Management Guide*. Harper Business. 1991.

[3] Also called *residual income*. See McTaggart, Kontes and Mankins (1994, page 317), a book published by the Marakon Associates.

[4] According to Boston Consulting Group's definition. See *Shareholder Value Metrics*. 1996. Booklet 2. Page 16.

[5] For example, one can read in Stern Stewart & Co's advertising: "Forget about the EPS (earnings per share), ROE and ROI. The true measure of your company's performance is EVA." "EVA® is also the performance measure most directly linked to the creation of shareholder wealth over time."

purpose is to identify the most common inconsistencies in the implementation of the models, namely, inconsistent forecasts error (valuing the perpetuity with a wrong residual income or cash flow), incorrect discount rate error (wrong calculation of the WACC), and the missing cash flow error (wrong determination of the cash flows when the financial statements forecasts do not satisfy the clean surplus relation).

Penman (2001) says “the choice between ash accounting and accrual accounting is at the very heart of accounting research, for the difference involves issues of recognition and measurement that define an accounting system. The implication of the Lundholm and O’Keefe (2001a) position is that accrual accounting does not matter: one can be cynical about the accounting used in valuation models and so can defer to cash flow models. Or to Voodoo accounting. Something has to give in our understanding of the issue to reject Voodoo accounting or to justify accrual accounting over cash accounting.”

Lundholm and O’Keefe (2001b) is a response to Penman (2001). They reaffirm their conclusions of their previous paper (2001a).

We agree with Lundholm and O’Keefe. Of course the accounting method matters in valuation, but the accounting method has the same implications for residual income and cash flow valuation methods.

In this paper we show that the Residual Income models (EVA™, EP or CVA) for equity valuation always yield the same value as the Discounted Cash Flow Valuation models (equity cash flow or free cash flow).

Fernandez (2002, chapter 21) shows that paper shows the eight most commonly used methods for valuing companies by cash flow discounting or residual income discounting always give the same value. This result is logical, since all the methods analyse the same reality under the same hypotheses; they only differ in the cash flows or residual income measure taken as starting point for the valuation. The eight methods are:

1) free cash flow discounted at the WACC;
2) equity cash flows discounted at the required return to equity;
3) Capital cash flows discounted at the WACC before tax;
4) APV (Adjusted Present Value);
5) the business’s risk-adjusted free cash flows discounted at the required return to assets;
6) the business’s risk-adjusted equity cash flows discounted at the required return to assets;
7) economic profit discounted at the required return to equity;
8) EVA discounted at the WACC.

## 1. Economic profit (EP) and MVA (*market value added*)

The **MVA** (*market value added*) seeks to measure a firm’s value creation, and is the difference between the market value of the firm’s equity (or market value of the new investment) and the equity’s book value (or initial investment)[6].

$Ebv_0$ is the term used for the equity’s book value and $E_0$ for its market value at t = 0 (now). Therefore:

[6] Although, as we will see in the course of the chapter, the difference between equity market value and book value corresponds to value creation when the firm is created.

**[1]** $MVA_0 = E_0 - Ebv_0$

**MVA** (*market value added*) = Equity market value (price) - Equity book value

**Economic profit (EP)** is profit after tax (PAT) less equity book value ($Ebv_{t-1}$) multiplied[7] by required return to equity (Ke).

**EP** (economic profit) = Profit after tax - Equity book value x Cost of equity

**[2]** $EP_t = PAT_t - Ke\ Ebv_{t-1}$

Note that the economic profit[8] mixes accounting parameters (profit and the equity's book value) with a market parameter (Ke, the required return to equity).

The relationship between MVA and EP is shown in Appendix 1: the present value of the EP discounted at the rate Ke is the MVA.

**[3]** $MVA_0 = MVA_0 = E_0 - Ebv_0 = PV(Ke; EP)$

As ROE = $PAT_t / Ebv_{t-1}$ we can also express the economic profit using [2], namely:

**[4]** $EP_t = (ROE - Ke)\ Ebv_{t-1}$

It is obvious that for the equity's market value to be higher than its book value (if ROE and Ke are constant)[9], ROE must be greater than Ke.

## 2. EVA™ (*economic value added*) and MVA (*market value added*)

The difference ($[E_0 + D_0] - [Ebv_0 + D_0]$) is also called MVA (*market value added*) and is identical (if the debt's market value is equal to its book value) to the difference ($E_0 - Ebv_0$).

EVA™[10] (*economic value added*) is the term used to define:

**[5]** $EVA_t = NOPAT_t - (D_{t-1} + Ebv_{t-1})WACC$

EVA is simply the NOPAT less the firm's book value ($D_{t-1} + Ebv_{t-1}$) multiplied by the average cost of capital (WACC). NOPAT (*net operating profit after taxes*) is the profit of the unlevered (debt-free) firm. Sometimes, it is also called EBIAT (earnings before interest and after tax)[11].

[7] Note that equity book value at the beginning of the period is used, that is, at the end of the previous period.
[8] The concept of economic profit is not new. Alfred Marshall was already using the term in 1890 in his book *Principles of Economics.*
[9] Some authors call this "creating value". Further on, we will explain why, as a general rule, we do not agree with this statement. The so-called "Value Creation Ratio" is also used, which is $E_0 / Ebv_0$. In the case of perpetuities growing at a constant rate g, $[E_0 / Ebv_0] = (ROE - g) / (Ke - g)$.
[10] According to Stern Stewart & Co's definition. See page 192 of their book *The Quest for Value. The EVA Management Guide.*
[11] NOPAT is also called NOPLAT (Net Operating Profit Less Adjusted Taxes). See, for example, Copeland, Koller and Murrin (2000).

Note that EVA mixes accounting parameters (profit, and equity and debt book value) with a market parameter (WACC).

The relationship between MVA and EVA is shown in Appendix 2: the present value of the EVA discounted at the WACC is the MVA.

**[6]** $\mathbf{MVA_0 = [E_0 + D_0] - [Ebv_0 + D_0] = PV(WACC;\ EVA)}$

As[12] ROA = $NOPAT_t / (D_{t-1} + Ebv_{t-1})$, we can also express EVA as follows:

**[7]** $\mathbf{EVA_t = (D_{t-1} + Ebv_{t-1})\ (ROA - WACC)}$

Thus, the EVA is simply the difference between the ROA and the WACC multiplied by the enterprise book value (debt plus equity)[13]. It is obvious that for EVA to be positive, the ROA must be greater than the WACC.[14]

**EVA** = Enterprise book value x (Return on assets – Weighted average cost of debt and equity)

Copeland, Koller and Murrin (2000, page 55) say that economic profit is a synonym of EVA. This is, obviously, not true.

## 3. CVA (*cash value added*) and MVA (*market value added*)

The Boston Consulting Group proposes *cash value added*[15] (CVA) as an alternative to the EVA. **CVA** is NOPAT plus book depreciation (DEP) less economic depreciation (ED) less cost of capital employed (initial investment multiplied by the weighted average cost of capital).

The definition of CVA is:

**[8]** $\mathbf{CVA_t = NOPAT_t + DEP_t - ED - (D_0 + Ebv_0)WACC}$

ED (economic depreciation) is the annuity that, when capitalized at the cost of capital (WACC), the assets' value will accrue at the end of their service life. The economic depreciation of certain gross fixed assets (GFA) depreciated over T years is:

**[9]** $ED = GFA\ \ WACC / [(1 + WACC)^T – 1]$

Appendix 3 shows that the present value of the CVA discounted at the WACC is the same as the present value of the EVA discounted at the WACC (MVA) in firms that have fixed assets and constant working capital requirements[16].

**[10]** $\mathbf{MVA_0 = [E_0 + D_0] - [Ebv_0 + D_0] = PV(WACC;\ CVA)}$

[12] ROA (Return on Assets) is also called ROI (*return on investments*), ROCE (*return on capital employed*), ROC (*return on capital*) and RONA (*return on net assets*). ROA = ROI = ROCE = ROC = RONA.
[13] The difference between ROA and WACC is usually called EVA spread.
[14] The creation of MVA is not a new concept. In 1924, Donaldson Brown, General Motors' CFO, said, "Managers' goal is not to maximize investment return but to achieve incremental earnings that are greater than the cost of capital employed".
[15] See *Shareholder Value Metrics*. Boston Consulting Group. 1996. Booklet 2. Page 16.
[16] This may be a reasonable hypothesis in some projects. Also, it is necessary to not adjust for inflation.

## 4. First valuation. Investment without value creation

A firm funded entirely by equity is created to undertake a project that requires an initial investment of 12 billion pesetas (10 billion in fixed assets and 2 billion in working capital requirements).

The fixed assets are depreciated uniformly over the 5 years that the project lasts. The corporate income tax rate is 34% and the book profit is 837.976 million (constant over the 5 years).

Consequently, the project's (firm's) *free cash flows* (FCF) are -12 billion in year zero, 2.837976 billion in years 1 to 4, and 4.837976 billion in year 5. Therefore, this project's (firm's) IRR is 10%.

The risk-free rate is 6%, the market premium is 4%, and the project's beta is 1.0. Therefore, the required return to equity is 10%.

As the required return to equity is the project's IRR, the shares' price at t=0 must be equal to their book value and there will be no value creation: the shares' value ($E_0$ = 12 billion) is equal to their baseline book value ($Ebv_0$ = 12 billion).

Table 1 gives the firm's accounting statements, valuation, and economic profit, EVA and MVA. Lines 1 to 7 show the balance sheet and lines 8 to 14 the income statement. Line 17 contains the equity cash flow (in this case, equal to the FCF, as there is no debt).

**Table 1. EVA, EP and MVA of a company without debt. ($ million)**
**IRR of investment = Required return to equity (Ke) = 10%**

| | ***Balance Sheet*** | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 1 | WCR (Working Capital Requirements) | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 0 |
| 2 | Gross Fixed Assets | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| 3 | - cumulative depreciation | 0 | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 |
| 4 | **NET ASSETS** | **12,000** | **10,000** | **8,000** | **6,000** | **4,000** | **0** |
| 5 | Debt | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | Equity (book value) | 12,000 | 10,000 | 8,000 | 6,000 | 4,000 | 0 |
| 7 | **NET WORTH & LIABILITIES** | **12,000** | **10,000** | **8,000** | **6,000** | **4,000** | **0** |
| | ***Income Statement*** | | | | | | |
| 8 | Sales | | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| 9 | Cost of sales | | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| 10 | General & administrative expenses | | 2,730 | 2,730 | 2,730 | 2,730 | 2,730 |
| 11 | Depreciation | | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| 12 | Interest | | 0 | 0 | 0 | 0 | 0 |
| 13 | Taxes | | 432 | 432 | 432 | 432 | 432 |
| 14 | **PAT** | | **838** | **838** | **838** | **838** | **838** |
| 15 | + Depreciation | | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| 16 | - Δ WCR | | 0 | 0 | 0 | 0 | 2,000 |
| 17 | **ECF = Dividends = FCF** | | **2,838** | **2,838** | **2,838** | **2,838** | **4,838** |
| 18 | **ROE = ROA** | | 6.98% | 8.38% | 10.47% | 13.97% | 20.95% |
| 19 | **ROGI** | | 6.98% | 6.98% | 6.98% | 6.98% | 6.98% |
| 20 | **Ke = WACC** | **10.00%** | **10.00%** | **10.00%** | **10.00%** | **10.00%** | **10.00%** |
| 21 | **E = PV(Ke; ECF)** | **12,000** | **10,362** | **8,560** | **6,578** | **4,398** | **0** |
| 22 | **MVA = E - Ebv** | **0.00** | **362.03** | **560.26** | **578.31** | **398.16** | **0.00** |
| | | | | | | | |
| 23 | **EP = EVA** | | **-362.0** | **-162.0** | **38.0** | **238.0** | **438.0** |
| 24 | MVA = PV(Ke; EP) = PV (WACC; EVA) | **0.0** | **362.0** | **560.3** | **578.3** | **398.2** | **0.0** |

Line 18 shows the ROE (in this case, equal to the ROA as there is no debt) and enables us to question its meaning: the ROE increases from 6.98% to 20.95%, which makes no economic or financial sense. The ROGI[17] (line 19) is 6.98% and does not make any economic or financial sense either.

[17] ROGI (*return on gross investment*) is NOPAT divided by the initial investment.

The required return to equity (Ke) is equal to the WACC (line 20) and is 10%.

The equity's baseline value (line 21) is 12 billion, which is equal to the book value. Consequently, the baseline value creation (line 22) is nil. However, there "seems" to exist value creation at the end of successive years because the equity's market value is greater than its book value. This is obviously a mistake because the return on the investment is equal to the required return to equity. This "apparent" value creation in years 1 to 4 is because we are comparing a market value (present value of future cash flows) with a book value. The difference between market value and book value makes sense in year zero (because then the book value is a flow, which is the initial investment), but not in the following years.

As there is no debt, EP (line 23) is identical to EVA and WACC is the same as Ke. The present value of the EP discounted at Ke (line 24) is identical to the present value of the EVA discounted at the WACC and both agree with MVA = E - Ebv (line 22).

Table 2 gives the ***cash value added*** of the firm in Table 1.

**Table 2. Cash value added of a company without debt.**
**IRR of the investment = Required return to equity = 10%**

| *Cash value added* | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **NOPAT** | 838 | 838 | 838 | 838 | 838 |
| + Depreciation | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| - Economic depreciation | 1,638 | 1,638 | 1,638 | 1,638 | 1,638 |
| - Cost of capital employed | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| **CVA** | 0 | 0 | 0 | 0 | 0 |

Economic depreciation (ED) is the annuity that, when capitalized at the cost of capital (WACC), the fixed assets' value will accrue at the end of their service life. In our example, 1.638 billion per year capitalized at 10% provide, at the end of year 5, the 10 billion that was the initial investment in year zero.

The cost of capital employed is the initial investment (12 billion) multiplied by the weighted cost of capital (in this case, 10% = WACC).

This firm's CVA (whose IRR is equal to the required return to equity) is zero in every year. The present value of the CVA is also equal to the MVA, which is zero.

One "apparent" advantage of the CVA over the EVA is that, while the EVA was negative for the first two years and positive for the following years, the CVA is zero for all the years, which, in this firm, makes more sense.

## 5. Usefulness of EVA, EP and CVA

As the present value of the EVA[18] corresponds to the MVA, it is common for the EVA to be interpreted incorrectly, saying that the EVA is each period's MVA[19].

It is sufficient to see the example of Table 1 to see this error: this firm's EVA (line 23) is negative during the first two years and positive during the following years, which makes no economic or financial sense. It makes no sense to say that this firm does worse in year 1 (EVA = -362) than in year 5 (EVA =

[18] A similar argument can be made for EP and CVA.

[19] However, one can read in Stern Stewart & Co's brochure: "EVA is the only measure that gives the right answer. All the others -including operating income, earnings growth, ROE and ROA- may be erroneous". In 2001, the message has been toned down and now says: "Economic Value Added is the financial performance measure that comes closer than any other to capturing the true economic profit of an enterprise." In a communiqué issued in February 1998 by Monsanto's management to its employees, one can read: "The larger the EVA, the more wealth we have created for our shareholders".

438). In this example, in which earnings and Ke are constant in every year, EVA grows (from negative to positive) because the shares' book value decreases as the fixed assets are depreciated.

In a 1997 circular, Stern Stewart & Co. says: "what matters is the growth of EVA... it is always good to increase the EVA." In our example, the EVA increases each year, but this does not mean that the company is doing better.

The Boston Consulting Group does recognize the limitations of these parameters. One can read in its advertising that "a major failure of EVA and CVA is that they ignore the cash flows produced by the business".

We have seen that, although the present value of EVA, EP and CVA corresponds to MVA, it makes no sense to give EVA, EP or CVA the meaning of value creation in each period.

Many companies consider that EVA, EP or CVA are better indicators of a manager's performance than earnings because they "refine" earnings with the quantity and risk of the capital required to obtain them[20]. For example, in AT&T's 1992 annual report, the CFO says that "our executives' remuneration in 1993 will be linked to the attainment of EVA goals". Likewise, Coca Cola's president, Roberto Goizueta, referred to EVA to say that "it is the way to control the company. It's a mystery to me why everyone doesn't use it"[21].

A policy of maximizing the EVA each year may be negative for the company. Let us imagine that the CEO of the company in Table 1 is assessed and remunerated on the basis of the EVA. One obvious way of improving the EVA during the first four years is to depreciate less during the first years. Let us assume that it depreciates 1,000 during the first four years and 6,000 in year 5. Thus, the first 4 year's EVA would improve (it would be 298, 398, 498 and 598 million) and fifth year's EVA would be worse, -2.602 billion. With these depreciations, the shares' value would be 11.767 billion, instead of 12 billion if constant-rate depreciation were to be used.

It is obvious[22] that a period's EVA increases: 1) with increased NOPAT; 2) with reduced cost of capital; and 3) with reduced assets employed. But there are ways of increasing NOPAT, such as depreciating less, that decrease the company's cash flow and value. There are also many ways of reducing the cost of capital (for example, if interest rates fall) that have nothing to do with executive performance. There are also ways of decreasing assets employed (for example, deferring investment in new projects) that decrease or defer the cash flow and decrease the company's value.

On the other hand, it may happen that a particular year's EVA and economic profit have been very positive and even better than expected, but that the company's or business unit's value has decreased because the business's prospects have deteriorated due to poor management. To get partly round this problem, many consulting firms recommend (for those executives whose compensation is tied to the EVA or economic profit) to not pay the entire bonus immediately but to hold it as a provision that will be paid if the coming years' goals are also met.

Stern Stewart & Co proposes a series of adjustments to the NOPAT and the book value (see Appendix 4) with the intention of "giving more economic meaning" to EVA and the book value[23]. However, these

[20] Many companies use different costs of capital for different activities within the company, logically applying a higher cost to activities with a higher risk. The RORAC (*return on risk adjusted capital*) seeks to do just this: determine each business unit's return while taking into account its risk.
[21] "The Real Key to Creating Wealth", *Fortune*, 20 September 1993.
[22] See formula [5].
[23] One can read in a Stern Stewart & Co brochure: "EVA also undoes accounting fictions and provides a much more accurate measure of operating income."

adjustments[24] do not solve the EVA's problems, but rather tend to worsen them. In addition, when any of these adjustments is made, the EVA's present value is no longer the same as the MVA, unless another adjustment is made to the book value that is equal to the present value of the adjustments to the income statement.

## 6. Second valuation. Investment with value creation

Here, we come back to the firm of Table 1, but this time partly financed with 4 billions of debt at 8%[25]. The firm's FCF are -12 billion in year zero, 2.837976 billion in years 1 to 4 and 4.837976 billion in year 5. Therefore, this firm's IRR is 10%.

Table 3 shows the firm's accounting statements, valuation, and economic profit, EVA and MVA.

**Table 3. EVA, EP and MVA ($ million)**
**Company with constant debt level ($4,000 million) . IRR of investment = 10%.**

| | ***Balance Sheet*** | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 1 | WCR (Working Capital Requirements) | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 0 |
| 2 | Gross Fixed Assets | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| 3 | - cumulative depreciation | 0 | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 |
| 4 | **NET ASSETS** | **12,000** | **10,000** | **8,000** | **6,000** | **4,000** | **0** |
| 5 | Debt | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 0 |
| 6 | Equity (book value) | 8,000 | 6,000 | 4,000 | 2,000 | 0 | 0 |
| 7 | **NET WORTH & LIABILITIES** | **12,000** | **10,000** | **8,000** | **6,000** | **4,000** | **0** |
| | ***Income Statement*** | | | | | | |
| 8 | Sales | | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
| 9 | Cost of sales | | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| 10 | General & administrative expenses | | 2,730 | 2,730 | 2,730 | 2,730 | 2,730 |
| 11 | Depreciation | | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| 12 | Interest | | 320 | 320 | 320 | 320 | 320 |
| 13 | Taxes | | 323 | 323 | 323 | 323 | 323 |
| 14 | **PAT** | | **627** | **627** | **627** | **627** | **627** |
| 15 | + Depreciation | | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| 16 | + Δ Debt | | 0 | 0 | 0 | 0 | -4,000 |
| 17 | - Δ WCR | | 0 | 0 | 0 | 0 | 2,000 |
| 18 | - Investment in fixed assets | | 0 | 0 | 0 | 0 | 0 |
| 19 | **ECF = Dividends** | | **2,627** | **2,627** | **2,627** | **2,627** | **627** |
| 20 | **FCF** | | **2,838** | **2,838** | **2,838** | **2,838** | **4,838** |
| 21 | **ROE** | | 7.83% | 10.45% | 15.67% | 31.34% | N.A. |
| 22 | **ROA** | | 6.98% | 8.38% | 10.47% | 13.97% | 20.95% |
| 23 | **ROGI** | | 6.98% | 6.98% | 6.98% | 6.98% | 6.98% |
| 24 | **Ke** | | **10.62%** | **10.78%** | **11.08%** | **11.88%** | **20.12%** |
| 25 | **E = PV(Ke; ECF)** | **8,516** | **6,793** | **4,898** | **2,814** | **522** | **0** |
| 26 | **WACC** | | **8.91%** | **8.74%** | **8.47%** | **8.00%** | **6.99%** |
| 27 | **E = PV(WACC;FCF) - D** | **8,516** | **6,793** | **4,898** | **2,814** | **522** | **0** |
| 28 | **MVA = E - Ebv** | **516** | **793** | **898** | **814** | **522** | **0** |
| 29 | **EP = PAT - Ke x Ebv** | | **-223** | **-20** | **184** | **389** | **627** |
| 30 | **MVA = PV(Ke; EP)** | **516** | **793** | **898** | **814** | **522** | **0** |
| 31 | **EVA** | | **-232** | **-36** | **160** | **358** | **558** |
| 32 | **MVA = PV(WACC; EVA)** | **516** | **793** | **898** | **814** | **522** | **0** |
| 33 | EP - EVA | | 9 | 16 | 23 | 32 | 68 |

Line 21 shows the ROE (in this case, greater than the ROA, as there is debt with a cost after tax less than the ROA). Again, the ROE is economically and financially meaningless: it increases from 7.83% to 31.34%, and is infinite in the fifth year. The ROGI (line 23) is meaningless too: it is 6.98%. The project's

[24] Weaver (2001) reports that from a menu of up to 164 adjustments, the average EVA user makes 19 adjustments with a range between 7 and 34 adjustments.
[25] Consequently, the beta associated with this debt cost is 0.5.

internal rate of return (which ROA and ROGI try to give) is 10%. The internal rate of return on the investment in equity (which the ROE tries to give) is 13.879%. In this case, the debt ratio increases over time and, therefore, Ke (required return to equity) grows from 10.62% to 20.12% (line 24). As the debt ratio increases, the WACC decreases from 8.91% to 6.99% (line 26).

The shares' baseline value (lines 25 and 27) is 8.516 billion, which is 516 million more than the book value. Consequently, the baseline value creation (line 28) is 516 million.

As there is debt, the EP (line 29) is greater than the EVA (line 31). The EP's present value discounted at Ke (line 30) is identical to the EVA's present value discounted at the WACC (line 32) and both agree with MVA = E - Ebv (line 28). This does not mean that EP or EVA indicates "value creation" in each period: the value (516 million) "is created" at the beginning when an investment with an expected return (10%) greater than the cost of capital employed (WACC) is begun.

Looking at the course followed by the EVA, it is meaningless to say that this firm is doing worse in year 1 (EVA = -232) than in year 5 (EVA = 558). Looking at the economic profit, it is also meaningless to say that this firm is doing worse in year 1 (EP = -223) than in year 5 (EP = 627).

Table 4 shows the cash value added of the firm in Table 3.

In this case, the CVA is not constant in all years because the WACC decreases each year as the leverage is increased. This firm's CVA (IRR > WACC) is positive every year and growing. The CVA's present value discounted at the WACC is equal to the MVA, which is 516 million. This does not mean that the CVA indicates "value creation" in each period: the value (516 million) "is created" at the beginning when an investment with an expected return (10%) greater than the cost of capital employed (WACC) is begun.

Looking at the course followed by the CVA, it is meaningless to say that this firm is doing worse in year 1 (CVA = 57) than in year 5 (CVA = 287).

**Table 4. Cash value added**
**Firm with constant debt (4 billion) . IRR of the investment = 10%.**

| ***Cash value added*** | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| **NOPAT** | | 838 | 838 | 838 | 838 | 838 |
| + Depreciation | | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| - Economic depreciation | | 1,712 | 1,712 | 1,712 | 1,712 | 1,712 |
| - Cost of capital employed | | 1,070 | 1,049 | 1,017 | 961 | 839 |
| **CVA** | | 57 | 77 | 110 | 166 | 287 |
| **PV(WACC; CVA)** | **516** | | | | | |

The return for the shareholder who bought the shares in year zero for 8.516 billion (at "market value") will be 10.62% in year 1 (equal to Ke): 2.627 billion (dividends) less 1.723 billion (fall in the share price from 8.516 to 6.793 billion) divided by 8.516 billion (purchase of the shares in year zero). The TSR in year 2 will be 10.78% (Ke): 2.627 billion (dividends) less 1.895 billion (fall in the share price from 6.793 to 4.898 billion) divided by 6.793 billion (shares' value in year 1). Note that the value creation due to the investment (investment of 8 billion in shares that are worth 8.516 billion) is done in year zero.

The return of a founder shareholder who invested 8 billion in shares in year zero and sells them in year 1 will be 17.75%: he will receive the dividends corresponding to year 1 (2.627 million) and will then sell the shares at the expected price of 6.793 billion.

## 7. Conclusions

In the light of the foregoing sections, the following conclusions can be drawn.

· The information required to value a firm using the EP, EVA and CVA is exactly the same as that required for valuing by cash flow discounting.

· The present value of the EP, EVA and CVA is equal to the MVA. Valuing the firm using the EP, EVA and CVA gives the same result as valuing by cash flow discounting.

· Maximizing the present value of the EP, EVA or CVA is equivalent to maximizing the value of the firm's shares.

· Maximizing a particular year's EP, EVA or CVA is meaningless: it may be the opposite to maximizing the value of the firm's shares.

· The claim that the EP, EVA or CVA measures the firm's "value creation" in each period is a tremendous error: it makes no sense to give the EP, EVA or CVA the meaning of value creation in each period.

· The EVA, EP and CVA do not measure value creation during each period. It is not possible to quantify value creation during a period on the basis of accounting data. Value always depends on expectations.

· It may happen that the EVA and the economic profit in one year have been positive, and even higher than expected, but that the value of the firm or business unit has fallen because the business's expectations have deteriorated due to poor management.

· The problems with EVA, EP or CVA start when it is wished to give these parameters a meaning they do not have: value and shareholder value creation **always** depends on **expectations**.

## Appendix 1
## The EP (economic profit) discounted at the rate Ke is the MVA (Equity market value – Equity book value)

The value of equity is the present value of the equity's expected cash flows (ECF) discounted at the required return to equity (Ke):

**[11]** $E_0$ = PV(Ke; ECF)

The equity cash flow (ECF) is equal to the distributable dividends[26]. PAT is the profit after tax or net income of the company and DIV are the dividends paid to the shareholders. The part of the earnings that is not distributed will increase the equity's book value (Ebv). Consequently[27]:

[12] $ECF_t = DIV_t = PAT_t - \Delta Ebv_t = PAT_t - (Ebv_t - Ebv_{t-1})$

Replacing [12] in [11] gives:

$$[13]\quad E_0 = \frac{PAT_1 - Ebv_1 + Ebv_0}{1+Ke} + \frac{PAT_2 - Ebv_2 + Ebv_1}{(1+Ke)^2} + \frac{PAT_3 - Ebv_3 + Ebv_2}{(1+Ke)^3} + ...$$

Taking into account the identity $Ebv_0$ / (1+Ke) = $Ebv_0$ – Ke $Ebv_0$ /(1+Ke), equation [13] becomes:

$$[14]\quad E_0 = \frac{PAT_1}{1+Ke} + \frac{PAT_2}{(1+Ke)^2} + \frac{PAT_3}{(1+Ke)^3} + ... + Ebv_0 - \frac{KeEbv_0}{1+Ke} - \frac{KeEbv_1}{(1+Ke)^2} - \frac{KeEbv_2}{(1+Ke)^3} - ...$$

$$[15]\quad E_0 = Ebv_0 + \frac{PAT_1 - Ke\,Ebv_0}{1+Ke} + \frac{PAT_2 - Ke\,Ebv_1}{(1+Ke)^2} + \frac{PAT_3 - KeEbv_2}{(1+Ke)^3} + ...$$

**[16] $E_0 - Ebv_0 = PV(Ke; PAT_t - Ke\,Ebv_{t-1})$**

The difference ($E_0$ - $Ebv_0$) is called MVA (*market value added*). The economic profit (EP) is the numerator of equation [16]:

| [2] $EP_t = PAT_t - Ke\,Ebv_{t-1}$ |
|---|

Consequently, equation [16] can be expressed as:

| [3] $MVA_0$ = **$E_0 - Ebv_0 = PV(Ke; EP_t)$** |
|---|

ROE is the return on equity of the company. As $PAT_t$ = ROE $Ebv_{t-1}$ , the economic profit can also be expressed as:

[26] In actual fact, we are referring to expectations: formula [11] indicates that the shares' value is the NPV of the expected value of the equity cash flows. We not introduce the operator "expected value" in the formula in order to not complicate the expressions further. The expected value of the equity cash flow is, by definition, identical to the expected distributable dividend.

[27] We are assuming that $DIV_t = PAT_t - \Delta Ebv_t$ . If this equality should not be met in a firm, for example, because it allocates a quantity Π directly to reserves, then the earnings should be adjusted as follows:

[4] $EP_t = (ROE - Ke)\ Ebv_{t-1}$

The relationship between profit and NOPAT (Net operating profit after tax) is the following:

[17] $PAT_t = NOPAT_t - D_{t-1}\ Kd(1-T)$

D is the financial debt of the company and Kd is the cost of debt.

Therefore, the economic profit can also be expressed as:

[18] $EP_t = NOPAT_t - D_{t-1}\ Kd(1-T) - Ke\ Ebv_{t-1}$

The WACC calculated using the equity and debt book values is:

[19] $$WACC_{bv} = \frac{D_{t-1}\ Kd(1\text{-}T) + Ebv_{t-1}\ Ke}{D_{t-1} + Ebv_{t-1}}$$

Consequently:

[20] $D_{t-1}\ Kd(1-T) + Ke\ Ebv_{t-1} = WACC_{bv}\ (D_{t-1} + Ebv_{t-1})$

The relationship between NOPAT and ROA is[28]:

[21] $NOPAT_t = ROA\ (D_{t-1} + Ebv_{t-1})$

Replacing [20] and [21] in [18] gives:

[22] $EP_t = (D_{t-1} + Ebv_{t-1})\ (ROA - WACC_{bv})$

Consequently, another way of expressing the MVA is:

[23] $MVA_0 = E_0 - Ebv_0 = PV[Ke; (D_{t-1} + Ebv_{t-1})\ (ROA - WACC_{bv})]$

It is important to take into account that[29]

[24] $(D_{t-1} + Ebv_{t-1}) = NFA_{t-1} + WCR_{t-1}$

The relationships obtained are valid even if Ke is not constant over time.
Equation [16] becomes:

[25] $$E_0 - Ebv_0 = \sum_{t=1}^{\infty} \frac{PAT_t - Ke_t\ Ebv_{t-1}}{\prod_{i=1}^{t} (1+Ke_i)}$$

---------------------------------------------------------------------------------------------------------------------

$PAT_t = PATbv_t - \Pi$, where $PATbv_t$ is the profit shown by accounting methods.

[28] ROA *(return on assets*) is also called ROI *(return on investments*), ROCE *(return on capital employed*), *ROC (return on capital*) and RONA *(return on net assets*). ROA = ROI = ROCE = ROC = RONA. ROA = ROE if D = 0.

[29] NFA are net fixed assets. WCR are working capital requirements. The sum NFA+WCR is often called NAE (*net assets employed*).

## Appendix 2
## Obtainment of the formulas for EVA and MVA from the FCF and WACC

In this Appendix, we perform a process that is fully analogous to that of Appendix 1, but using formula [26], which postulates that the value of the debt plus the market value of the equity (also called the company's market value) is the present value of the expected FCF (free cash flows) discounted at the WACC. [30]

[26] $E_0 + D_0 = PV(WACC; FCF)$

The relationship between the FCF and profit (PAT) is[31]:

[27] $FCF_t = PAT_t - \Delta Ebv_t + D_{t-1} Kd (1-T) - \Delta D_t$

We know that $PAT_t = NOPAT_t - D_{t-1} Kd(1-T)$. So

[28] $FCF_t = NOPAT_t - (\Delta Ebv_t + \Delta D_t)$

Replacing [28] in [26]:

[29] $$E_0 + D_0 = \frac{NOPAT_1 - (\Delta Ebv_1 + \Delta D_1)}{1+WACC} + \frac{NOPAT_2 - (\Delta Ebv_2 + \Delta D_2)}{(1+WACC)^2} + .... =$$

$$= \frac{NOPAT_1}{1+WACC} + \frac{NOPAT_2}{(1+WACC)^2} + ....- \frac{(Ebv_1 + D_1) - (Ebv_0 + D_0)}{1+WACC} - \frac{(Ebv_2 + D_2) - (Ebv_1 + D_1)}{(1+WACC)^2} - ... =$$

$$= \frac{NOPAT_1}{1+WACC} + \frac{NOPAT_2}{(1+WACC)^2} + ....+(Ebv_0 + D_0) - \frac{WACC(Ebv_0 + D_0)}{1+WACC} - \frac{WACC(Ebv_1 + D_1)}{(1+WACC)^2} + ...$$

because $\frac{D_0 + Ebv_0}{1+WACC} = D_0 + Ebv_0 - \frac{(D_0 + Ebv_0)WACC}{1+WACC}$

Consequently:

[30] $[E_0 + D_0] - [Ebv_0 + D_0] = PV[WACC; NOPAT_t - (Ebv_{t-1} + D_{t-1}) WACC]$

Stern Stewart & Co. calls EVA the numerator of expression [30]

[5] $EVA_t = NOPAT_t - (D_{t-1} + Ebv_{t-1})WACC$

Consequently, the relationship between MVA and EVA is given by equation [6].

[6] $MVA_0 = [E_0 + D_0] - [Ebv_0 + D_0] = PV[WACC; EVA_t]$

[30] In actual fact, we are referring to expectations: formula [11] indicates that the shares' value is the NPV of the expected value of the equity cash flows. We not introduce the operator "expected value" in the formula in order to not complicate the expressions further.

We know that $NOPAT_t = ROA\ (D_{t-1} + Ebv_{t-1})$. So:

$$[7]\ EVA_t = (D_{t-1} + Ebv_{t-1})\ (ROA - WACC)$$

Replacing [7] in [6] gives:

$$[31]\ MVA_0 = [E_0 + D_0] - [Ebv_0 + D_0] = PV[WACC;\ (D_{t-1} + Ebv_{t-1})\ (ROA - WACC)]$$

Comparing [7] with [22] gives:

$$EP_t - EVA_t = (D_{t-1}+Ebv_{t-1})(ROA-WACC_{bv}) - (D_{t-1}+Ebv_{t-1})(ROA-WACC) =$$

$$= (D_{t-1}+Ebv_{t-1})\ (WACC-WACC_{bv}) =$$

$$= (D_{t-1} + Evc_{t-1}) \left[ \frac{D_{t-1} Kd(1-T) + E_{t-1}\ Ke}{D_{t-1} + E_{t-1}} - \frac{D_{t-1}\ Kd(1\text{-}\ T) + Evc_{t-1}\ Ke}{D_{t-1} + Evc_{t-1}} \right] =$$

$$= \frac{D_{t-1}\left[Kd(1-T)(Evc_{t-1} - E_{t-1}) + Ke(E_{t-1} - Evc_{t-1})\right]}{D_{t-1} + E_{t-1}} = \frac{D_{t-1}(E_{t-1} - Evc_{t-1})\left[Ke - Kd(1-T)\right]}{D_{t-1} + E_{t-1}}$$

$$[32]\quad EP_t - EVA_t = \frac{D_{t-1}(E_{t-1} - Ebv_{t-1})\left[Ke - Kd(1-T)\right]}{D_{t-1} + E_{t-1}} = (D_{t-1}+Ebv_{t-1})\ (WACC-WACC_{bv})$$

As $Ebv_{t-1}\ ROE = ROA\ (D_{t-1} + Ebv_{t-1}) - D_{t-1}\ Kd\ (1\text{-}T)$, we can also express [5] as:

$$[5']\ EVA_t = Ebv_{t-1}\ ROE + D_{t-1}\ Kd\ (1\text{-}T) - (D_{t-1} + Ebv_{t-1})\ WACC$$

The relationships obtained are valid even if the WACC is not constant over time. [30] becomes:

$$\textbf{[33]}\quad D_0 + E_0 - (D_0 + Ebv_0) = \sum_{t=1}^{\infty} \frac{NOPAT_t - WACC_t\ (D_{t\text{-}1} + Ebv_{t\text{-}1})}{\prod_{i=1}^{t} (1 + WACC_i)}$$

---------------------------------------------------------------------------------------------------------------------

[31] We are assuming that $DIV_t = PAT_t - \Delta Ebv_t$ (clean surplus relation). If this equality should not be met in a firm, for example, because it allocates a quantity $\Pi$ directly to reserves, then the earnings should be adjusted as follows: $PAT_t = PATbv_t - \Pi$, where $PATbv_t$ is the profit shown by accounting methods.

## Appendix 3
## The CVA (*cash value added*) discounted at the WACC is the MVA

We wish to verify that:

[10] $MVA_0 = [E_0 + D_0] – [Ebv_0 + D_0] = PV[WACC; CVA_t]$

The definition of CVA is:

[8] $CVA_t = NOPAT_t + DEP_t - ED - (D_0 + Ebv_0)WACC$

where $DEP_t$ is the book depreciation and ED is the economic depreciation.

The economic depreciation (ED) is the annuity that, when capitalized at the cost of capital (WACC), the fixed assets' (GFA) value will accrue at the end of their service life. It will be immediately seen that the economic depreciation of certain gross fixed assets (GFA) depreciated over T years is:

[9] $ED = GFA\ WACC / [(1 + WACC)^T – 1]$

The equality [10] for a firm with certain fixed assets (FA) that are depreciated over T years is:

[34] $$[E_0 + D_0] - [D_0 + Ebv_0] = \sum_{t=1}^{T} \frac{NOPAT_t + DEP_t - [D_0 + Ebv_0]WACC - ED}{(1+WACC)^t}$$

Taking into account that:

[35] $$\sum_{t=1}^{T} \frac{[D_0 + Ebv_0]WACC\text{-}ED}{(1+WACC)^t} = [D_0 + Ebv_0] - \frac{[D_0 + Ebv_0]\text{-}GFA}{(1+WACC)^T} = [D_0 + Ebv_0] - \frac{WCR_0}{(1+WACC)^T}$$

Replacing [35] in [34] gives:

[36] $$[E_0 + D_0] = \sum_{t=1}^{T} \frac{NOPAT_t + DEP_t}{(1+WACC)^t} + \frac{WCR_0}{(1+WACC)^T}$$

thus verifying and confirming its validity: [36] is valid for firms (projects) with constant gross fixed assets and constant WCR. These hypotheses can be valid for investment projects without inflation, without fixed assets purchases during the project's life, with constant income statement (after discounting inflation).

The relationships obtained are valid even if WACC is not constant over time. [10] becomes:

[37] $$D_0 + E_0 - (D_0 + Ebv_0) = \sum_{t=1}^{T} \frac{NOPAT_t + DEP_t - WACC_t\ (D_0 + Ebv_0) - ED}{\prod_{i=1}^{t} (1 + WACC_i)}$$

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## APPENDIX 4
## Adjustments suggested by Stern Stewart & Co. for calculating the EVA

Stern Stewart & Co. proposes (see page 112 of its book *The Quest for Value*) the following operations and adjustments for converting from book value to what it calls "economic book value". They recommend performing similar adjustments in the book NOPAT.

| **Operations for calculating the "economic book value"** | **Operations for calculating the "economic NOPAT "** |
|---|---|
| Equity book value | Earnings available for common stock |
| + debt book value | + interest (1 - tax rate) |
| + preferred stock | + preferred dividends |
| + minority interest (equity) | + minority interest (earnings) |
| **BOOK VALUE** | **NOPAT** |
| **ADJUSTMENTS** | **ADJUSTMENTS** |
| + deferred taxes | + increase in deferred taxes |
| + LIFO reserve | + increase in LIFO reserve |
| + cumulative depreciation of goodwill | + depreciation of goodwill |
| + uncapitalized goodwill | |
| + allowance for bad debts | + increase in allowance for bad debts |
| + allowance for stock obsolescence | + increase in allowance for stock obsolescence |
| + accrued R&D expenses | + R&D expenses |
| - cumulative depreciation of R&D | - depreciation of R&D |
| + capitalization of non-cancelable contracts | + implicit interest on non-cancelable contracts |
| + accrued losses from sale of assets | + losses from sale of assets |

## APPENDIX 5.
## Dictionary

CVA = Cash value added
D = Value of debt
DIV = Dividends paid to the shareholders
E = Value of equity
Ebv = Book value of equity
ECF = Equity cash flow
ED = Economic depreciation
EP = Economic Profit
EVA = Economic value added
FCF = Free cash flow
g = Growth rate of the constant growth case
I = interest paid
Ke = Cost of levered equity (required return to levered equity)
Kd = Required return to debt = cost of debt
MVA = Market value added
N = Book value of the debt
NOPAT = Net Operating Profit After Tax = profit after tax of the unlevered company
PAT= Profit after tax = Net income
PBT = Profit before tax
$P_M$ = Market premium = E ($R_M$ - $R_F$)
PV = Present value
$R_F$ = Risk-free rate
ROA = Return on assets = NOPAT / (D + Ebv)
ROE = Return on equity = PAT / Ebv
T = Corporate tax rate
VTS = Value of the tax shield
Vu = Value of shares in the unlevered company
WACC = weighted average cost of capital
$WACC_{bv}$= weighted average cost of capital using book values to calculate the weights
WCR = Working capital requirements = net current assets

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