

# EVA and NPV: some comparative remarks<sup>\*</sup>

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Received: March 2006 – Accepted: April 2007

**Abstract.** The paper mainly proposes a comparison between two valuation criteria of a firm - the Net Present Value (NPV) and the Economic Value Added (EVA) - from a mathematical point of view. In particular, the project whose NPV coincides with EVA valuation is individuated. Moreover, it is shown that every period discounted EVA is but a period quota of NPV which Peccati proposed in his decomposition of NPV in 1987. Finally, we prove that generally EVA method and the so-called Value - Driver model do not give the same results and provide sufficient conditions for their equivalence.

**Keywords.** Financial Valuation, Economic Value Added, Net Present Value, Value-Driver model.

**M.S.C. classification.** 91B28, 91B38, 91B99.

**J.E.L. classification.** C60, G30, L10.

## 1 Introduction

In the Nineties, a new index, the Economic Value Added (EVA), was proposed in order to *measure* the value of a firm. EVA is defined as the difference between the operating profits and the cost of the capital used to obtain them. The valuation method based on EVA became very successful both from a theoretical and an operative point of view. The “Bible book” about EVA is<sup>1</sup> “*The Quest for value*”, [27], by G. B. Stewart.

The EVA method emphasizes the capacity of a company to produce earnings in the future better than other current methods. EVA seems to be more than a simple mathematical derivation: it is considered a cornerstone of the management strategy by a very large part of business agents.

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<sup>\*</sup> Supported by M.I.U.R.

<sup>1</sup> It is a book with few formulas, whereas, in our opinion, a good formalization could be useful. Sometimes, it is difficult to distinguish statements from axioms and the Author (maybe to provide managers with simple examples and convenient manipulations) uses numerical *ad hoc* examples to state universal truths that hold only in particular cases.

As Stewart says<sup>2</sup> (without proving), the EVA valuation is equivalent to the one based on the Net Present Value (NPV) of a particular financial project. An important distinction between the two concepts is that the NPV approach is based on market values whereas the EVA principle refers to accounting figures. Furthermore, EVA seems to provide more immediateness and incisiveness than NPV.

About EVA and, in particular, about the equivalence between EVA and NPV, a huge literature<sup>3</sup> exists, including studies which challenge Stewart's claims (see, among others, [1], [5], [12], [17], [26], [29], [30]). Many theoretical problems come out as, for instance, Adserà and Viñolas well emphasize in [2]: methods which are often assumed to be equivalent require relevant adjustments to produce consistent results.

Along these lines, our contribution consists in a rigorous comparison between NPV and EVA methods first and EVA and Value - Driver model then.<sup>4</sup> More specifically, our analysis provides two main results:

- we find the exact ‘project’ whose NPV allows to state the desired equivalence between EVA and DCF/NPV methods. EVA valuation of a firm coincides with the sum of the economic book value and the NPV (valued at WACC) of a financial project whose cash flows are the difference between net operating profits after taxes and net new capital invested for growth at every successive time, that is the free cash flows (FCF)<sup>5</sup> of the company. Then, we show that EVA's of different periods are just the period quotas of such NPV according to a decomposition of NPV proposed by Peccati in 1987 in order to attribute to every period a specific “portion” of NPV;<sup>6</sup>
- we show that, differently from what stated in [27], usually EVA model and *Value - Driver Model* (as presented in [27]) do not coincide and provide sufficient conditions for their equivalence.

In the next section, we illustrate the concepts of NPV and EVA. In section 3 EVA is read in terms of NPV and its decomposition and in section 4 the *Value - Driver Model* is examined. The last section is devoted to discussion and conclusions.

<sup>2</sup> See [27], p. 175 and the following.

<sup>3</sup> Besides a wide theoretical debate about the validity of EVA as value indicator (see, among many others, [11]), improvements and specifications concerning the correct quantities to be considered (for instance about accounting data) have been proposed (see, for example, [28]); the model has been introduced in different fields like as bank and actuarial disciplines (see, among others [8]) and many empirical studies have been presented (see, among others, [18]).

<sup>4</sup> We do not propose adjusted or revisited formulas or models, but we are interested in analysing the original proposal and the possible contradictions in [27].

<sup>5</sup> See, for instance, [27], p. 121, 307-308. In particular, FCF indicates the difference between revenues and operating costs, taxes, net investments and change in working capital. It gives a measure of the (yearly) change in the overall investment level and is a source for new investments.

<sup>6</sup> See [14], [24], [25].

## 2 NPV and EVA: basic concepts and differences

As it is well known, NPV is simply the sum of present values of the cash flows of a financial project. Let  $CF_0, CF_1, \dots, CF_n$  be the cash flows of a project to be paid or received in  $s = 0, 1, \dots, n$ , and let  $i$  be the opportunity cost of equity. The NPV is defined as:

$$NPV(i) = \sum_{s=0}^n \frac{CF_s}{(1+i)^s}. \quad (1)$$

Also in the case of EVA the basic idea is very simple. EVA is defined as the period (yearly) operating profit net of the cost of all the capital needed to produce those earnings.

In the case of one period (for instance, one year), if  $C$  is the economic book value of the capital committed to business at the beginning of the period, we can define the rate of return of total capital as:

$$r = \frac{NP}{C}$$

where  $NP$  represents the net operating profit after taxes (Nopat).

By definition, it is:

$$EVA = (r - WACC)C$$

where WACC is the weighted average cost of capital at  $t = 0$ .

If EVA is discounted at WACC, it coincides with the NPV of a financial project in which  $C$  is paid in  $t = 0$  and  $C(1+r)$  is received in  $t = 1$ :

$$\begin{aligned} \text{discounted } EVA &= \frac{(r - WACC)C}{1 + WACC} = \\ &= -C + \frac{C(1+r)}{1 + WACC} = NPV(Wacc). \end{aligned}$$

In the case of several periods, if  $EVA_s$  is a period EVA, that is  $EVA_s = (r_s - WACC)C_{s-1}$  where  $C_{s-1}$  is the sum of  $C_0$  and all the next investments up to  $s - 1$  included and  $r_s$  is the period rate of return, the market value of a firm is defined as the sum of its economic book value  $C_0$  at  $t = 0$  and its Market Value Added (MVA), that is the sum of the present values (valued at WACC) of all future EVA's:

$$V = C_0 + \sum_{s=1}^{+\infty} \frac{EVA_s}{(1 + WACC)^s}. \quad (2)$$

EVA and NPV take two opposite routes. EVA considers accounting period data and sums them up. The NPV works on non accounting data (often on market data) and provides a global valuation of the project.

Yet, it is possible to decompose the NPV of a financial project in period's quotas and introduce accounting data in NPV. We will discuss such aspects in the next section.

### 3 EVA and NPV: similarities

At the end of the Eighties, Peccati proposed a model for the decomposition of the NPV of a financial project.<sup>7</sup> Such a model turns out to be very flexible and applicable in many different contexts. The idea is to spread the NPV of a financial project on  $n$  periods, attributing to every period a quota of NPV.

Since Peccati decomposition is not a standard approach and its diffusion is not very large, it is necessary to present it rigorously.

Consider again the project whose NPV is given by (1). In order to decompose NPV in period quotas, at every time  $s$  a cash balance value (*outstanding capital*) is attributed to the project. There is freedom in the choice of outstanding capitals: for instance, the outstanding capital at time  $s$  may be an accounting value or the value for which the investor might sell the project at time  $s$ . Its choice depends on the nature of the project and on the economic-financial context: we may think of the outstanding capital as a sort of "transfer value" between a period and the successive one, the value of the project at the beginning of  $(s + 1)$ -th period.

Let  $oc_0, oc_1, \dots, oc_n$  be the sequence of the outstanding capitals. It is always  $oc_0 = -CF_0$  (the value of the project at the beginning is, obviously, its price) and  $oc_n = 0$  (when all is over, the value of the project is null). Let us define *period internal rate of return* of the  $s$ -th period, the rate:

$$IRR_s = \frac{CF_s + oc_s - oc_{s-1}}{oc_{s-1}}$$

that is the rate which provides at time  $s$  the future value  $CF_s + oc_s$  (the real cash flow  $CF_s$  plus the virtual residual value of the project  $oc_s$ ) if you "invest"  $oc_{s-1}$  at time<sup>8</sup>  $s - 1$ .

It is quite natural to define the period quota  $q_s$  of NPV as:

$$q_s = \frac{oc_{s-1}(IRR_s - i)}{(1 + i)^s}$$

which states that the quota of NPV of the  $s$ -th period is the difference between the present values of the earned interest (at the rate  $IRR_s$ ) and of the *lost* interests (at the rate  $i$ ), that is the period amount the investor gives up when he decides to undergo the financial project. It is easy to verify that:

$$\sum_{s=1}^n q_s = NPV(i) .$$

Note that the above result holds *for any choice* of the outstanding capitals (with  $oc_0 = -CF_0$ ).

<sup>7</sup> See [14], [24], [25].

<sup>8</sup> In fact, it is:

$$oc_{s-1}(1 + IRR_s) = CF_s + oc_s .$$

The result<sup>9</sup> holds also in the more general case of an infinite number of cash flows:

**Proposition 1.** *If  $CF_0, CF_1, \dots, CF_n, \dots$  are the cash flows of a financial project at times  $0, 1, \dots, n, \dots$ ,  $oc_0, oc_1, \dots, oc_n, \dots$  are the outstanding capitals (arbitrarily chosen except  $oc_0 = -CF_0$ ),  $IRR_s$  is the period internal rate of return for  $s = 1, 2, \dots, n, \dots$ , and the series:*

$$\sum_{s=1}^{+\infty} \frac{CF_s}{(1+i)^s}$$

converges, then:

$$\sum_{s=1}^{+\infty} q_s = NPV(i) .$$

*Proof.* It is:

$$\begin{aligned} \sum_{s=1}^{+\infty} q_s &= \sum_{s=1}^{+\infty} \frac{oc_{s-1}(IRR_s - i)}{(1+i)^s} = \sum_{s=1}^{+\infty} \frac{oc_{s-1}}{(1+i)^s} \left[ \frac{CF_s + oc_s - oc_{s-1}}{oc_{s-1}} - i \right] = \\ &= \sum_{s=1}^{+\infty} \left[ \frac{CF_s + oc_s - oc_{s-1}(1+i)}{(1+i)^s} \right] = \frac{oc_1 - oc_0(1+i)}{1+i} + \frac{oc_2 - oc_1(1+i)}{(1+i)^2} + \\ &\quad \dots + \frac{oc_s - oc_{s-1}(1+i)}{(1+i)^s} + \dots + \sum_{s=1}^{+\infty} \frac{CF_s}{(1+i)^s} . \end{aligned}$$

In the addenda which do not contain  $CF_s$  all the terms eliminate each other except  $-oc_0$ . Hence:

$$\sum_{s=1}^{+\infty} q_s = -oc_0 + \sum_{s=1}^{+\infty} \frac{CF_s}{(1+i)^s} . \quad \square$$

The analogy between the structure of MVA and the formula expressing period quotas of NPV is remarkable. Thus, it becomes very natural to investigate the relations<sup>10</sup> between MVA and  $\sum_s q_s$ .

<sup>9</sup> An analogous proposition holds also for the Adjusted Present Value (APV) - the project is (completely or partially) financed - and for the Generalized Adjusted Present Value (GAPV) - besides financing, forward period opportunity costs of equity are considered (see [19], [24], [25]).

<sup>10</sup> Let us remind that a first comparison between the market value of a firm as the present value of expected dividends (as in neoclassical models) and as the economic-book value plus the present value of future expected residual incomes is developed in [22] and in [23].

It is quite obvious that the two concepts may be transformed into each other, but if we state that the valuations of a firm through EVA method and NPV (at least technically) coincide<sup>11</sup>, we wonder: the NPV of what?

The answer is in the following:

**Proposition 2.** *The sum of the present values of all future EVA's is the NPV of a financial project whose cash flows (discounted at WACC) are the difference between Nopats and net new investments at every time  $s = 1, 2, \dots$  with  $NP_0 = 0$ . Moreover every discounted EVA is a period quota.*

*Proof.* Let  $u_s \geq 0$  be the net new investment undertaken by the firm at  $t = s$ , that is the global amount invested in one or more projects at time  $s$  and:

$$oc_s = \sum_{t=0}^s u_t \quad s = 0, 1, \dots$$

Let us consider a financial project whose flows are the free cash flows to shareholders, that is the differences between the Nopats of a period and the net new investments undertaken at the end of the same period:  $FCF_s = NP_s - u_s$  at  $t = s$ . It is:

$$\begin{aligned} \sum_{s=1}^{+\infty} \frac{(r_s - WACC)C_{s-1}}{(1 + WACC)^s} &= \sum_{s=1}^{+\infty} \frac{(\frac{NP_s}{oc_{s-1}} - WACC)oc_{s-1}}{(1 + WACC)^s} = \\ &= \sum_{s=1}^{+\infty} \frac{oc_s + FCF_s - oc_{s-1}(1 + WACC)}{(1 + WACC)^s} = \\ &= \sum_{s=0}^{+\infty} \frac{FCF_s}{(1 + WACC)^s} = NPV(Wacc). \end{aligned} \quad (3)$$

From (3), it follows immediately that, taking  $oc_s = \sum_{t=0}^s u_t$  as outstanding capitals, every discounted EVA is a period quota of NPV. Moreover:

$$r_s = \frac{NP_s}{oc_{s-1}}$$

is the  $s$ -th period internal rate of return as the following identity shows:

$$\begin{aligned} oc_{s-1}(1 + IRR_s) &= \sum_{t=0}^{s-1} u_t \left(1 + \frac{NP_s}{\sum_{\tau=0}^{s-1} u_\tau}\right) = \\ &= FCF_s + \sum_{t=0}^s u_t = CF_s + oc_s. \quad \square \end{aligned}$$

<sup>11</sup> Let us remark that the well known equivalence between EVA and NPV methods does not mean that the whole value of a company is a NPV, but only that the MVA, one of the two terms which form such a value together with the economic book value, is a NPV.

The decomposition of NPV is a tool which allows a rich and detailed profitability analysis and permits to fill the classical gap between accounting-economical approach and financial approach to comparative valuations. The result of Peccati shows the absence of conflict between a financially correct valuation approach, based on NPV, and an accounting one, which usually indicates the return on equity (ROE) or a sort of ROE (the period internal rate, in this case), as the main parameter to value firm profitability.

In other words, as EVA moves from annual data it is quite natural to use accounting data for its calculation, whereas in the decomposition of NPV (because the process starts from a global valuation) it is not so. But if we introduce accounting data in Peccati decomposition (that is balance - sheet values), we immediately obtain EVA valuation. The keystone is the choice of balance - sheet values as outstanding capitals.

*Remark* - It is well known that a positive feature of NPV and similar criteria is their subjectivity due to the freedom in the choice of the discount rate. In EVA context, as usual in business problems, WACC is the discount rate. Indeed, it would be more rigorous to introduce here the concepts of APV and GAPV, but we follow the approach in [27].

Furthermore, the WACC considered by Stewart is a constant rate calculated on the basis of the structure of the capital at  $t = 0$ . Taking into account a WACC, based, for every period, on the features of the capital (in terms of equity and debt) of the period, could improve the analysis precision. In particular, in [19], we propose an extension by introducing a period WACC and a generalized EVA for the  $s$ -th period:

$$EVA_s = (r_s - WACC_s)C_{s-1} .$$

The consequent *Generalized Market Value added* (the sum of the present value at the period WACC's of all future generalized EVA's) may be seen as the GAPV of a financial project (which can also include a financing) with net flows equal to the difference between Nopats and investments at every time  $s = 1, 2, \dots$

Moreover, every discounted  $EVA_s$  may be decomposed in the sum of two quotas for equity and debt.<sup>12</sup>

Let us conclude this section with a simple example.

Let  $C_0 = 1,000$ ,  $NP_1 = 150$  and  $WACC = 0.05$ . It is:

$$EVA_1 = (0.15 - 0.05)1,000 = 100 .$$

Suppose that the management of the firm (or the market) foresee that future Nopats will develop according to the rule:

$$NP_s = 100 + 0.05C_{s-1}$$

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<sup>12</sup> For further results, see [19].

which implies that EVA will remain constant and equal<sup>13</sup> to 100. The value of the firm according to (2) is:

$$V = 1,000 + \sum_{s=1}^{+\infty} \frac{100}{(1+0.05)^s} = 3,000 .$$

The MVA  $\sum_s 100/(1+0.05)^s = 2,000$  is the NPV at 5% of an investment whose cash flows are  $(100 + 0.05C_{s-1}) - (C_s - C_{s-1}) = 100 + 1.05C_{s-1} - C_s$ , that is the difference between Nopats and investments at every time  $s = 1, 2, \dots$  with  $NP_0 = 0$ :

$$\begin{aligned} NPV(0.05) &= -1,000 + \frac{100 + 1.05 \cdot 1,000 - C_1}{1.05} + \\ &\frac{100 + 1.05 \cdot C_1 - C_2}{1.05^2} + \dots + \frac{100 + 1.05C_{s-1} - C_s}{1.05^s} + \dots = \\ &= \sum_{s=1}^{+\infty} \frac{100}{(1+0.05)^s} = 2,000 . \end{aligned}$$

Furthermore, we can decompose such a NPV in period quotas by taking  $oc_s = C_s$  as period outstanding capitals (that is the total amount invested up to  $s$  included). Such a choice of the outstanding capitals gives the period internal rate of return:

$$\begin{aligned} IRR_s &= \frac{CF_s + oc_s - oc_{s-1}}{oc_{s-1}} = \frac{[NP_s - (C_s - C_{s-1})] + C_s - C_{s-1}}{C_{s-1}} = \\ &= \frac{100 + 0.05C_{s-1}}{C_{s-1}} = r_s \end{aligned}$$

and

$$\begin{aligned} q_s &= \frac{C_{s-1} [(100 + 0.05C_{s-1})/C_{s-1} - 0.05]}{(1+0.05)^s} = \\ &= \frac{100}{(1+0.05)^s} = \text{discounted } EVA_s . \end{aligned}$$

#### 4 EVA and the Value - Driver Model

Modigliani and Miller predict<sup>14</sup> the market value  $V$  of a firm as the sum of its entire debt  $D$  and its equity  $E$  capitalization (for different proposals, see, among others, [3], [4], [9], [13], [15] and [16]):

$$V = E + D .$$

<sup>13</sup> In fact:

$$EVA_s = \left( \frac{100 + 0.05C_{s-1}}{C_{s-1}} - 0.05 \right) C_{s-1} = 100 .$$

<sup>14</sup> See [20], [21].



But often buyers, lenders and shareholders are interested not only in the total market value of a company, but also in the value of its future businesses, that is in its capacity to create value in the future. Thus, mainly two methods are proposed to analyze such a possibility.

According to the EVA method (and, for what presented above, to the NPV method), one can set:

$$V = C_0 + MVA .$$

A second method is based on the *Value - Driver Model*<sup>15</sup>: we will briefly hint to the version presented by Stewart (see also [20], [21]). The Author discusses such a theory in three steps and "shows", but only through examples, that the valuations provided by the model coincide with EVA valuation.

Preliminarily, we have to specify something about the different costs of capital which contribute to WACC.

At  $t = 0$ , let:

$$\begin{aligned} WACC &= \frac{E \cdot i + D\delta(1 - \tau)}{E + D} = \\ &= \frac{E(j + D(j - \delta)(1 - \tau)/E) + D\delta(1 - \tau)}{E + D} = j\left(1 - \frac{D\tau}{E + D}\right) \end{aligned}$$

where  $i = j + D(j - \delta)(1 - \tau)/E$  is the cost of equity which is the interest rate  $j$  which compensates investors for bearing business risk plus a financial risk premium  $D(j - \delta)(1 - \tau)/E$  for accepting debt,  $\tau$  is the tax rate and capital  $C_0$  is seen as the sum of the equity  $E$  and the debt  $D$  (for a discussion about the different costs of capital, see, for instance, [2], [20] and [27]).

The *Value - Driver Model* generalizes the so called *fundamental principle of valuation* which<sup>16</sup> states:

$$\frac{r}{WACC} = \frac{\text{firm value}}{\text{capital}} . \quad (4)$$

The future of a firm depends also on its leverage policies and on investments. Three different scenarios about the possible behaviour of a company are considered:

- i) if there are not debt and new investments and future Nopats are supposed to be constant and equal to the Nopat  $NP$  foreseen for the first period, the

<sup>15</sup> The term *value-driver* is usually found in the accounting literature and refers to aspects of the firm's operations which are causal factors in the creations of future profits and cash flows. One of these is the level of new investments, which is what Stewart focuses on, but it is not the only value-driver (other examples are defect levels, inventory management policies and employee and customer relations).

<sup>16</sup> We present expression (4) in the form proposed by Stewart, even if a ratio of rates,  $r/WACC$ , may appear unfit in a formula of valuation. Anyway, the Author emphasizes that "the relation between the rate of return  $r$  that a company earns within its business and its required return (...) is what drives a company's market value to a premium or discount to the level of its capital employed." (see [27], p. 69).

value  $W$  is defined as the sum of the present values of Nopats discounted at  $WACC = j$ :

$$W = NP \cdot a_{\infty|j} = \frac{NP}{j} = \frac{NP}{WACC}$$

which, because of the no debt assumption, gives exactly (4). In this case EVA valuation and *Value - Driver Model* lead to the same estimate:

$$\begin{aligned} W &= \frac{NP}{WACC} = C + \frac{(\frac{NP}{C} - WACC)C}{WACC} = \\ &= C + \sum_{s=1}^{+\infty} \frac{(\frac{NP}{C} - WACC)C}{(1 + WACC)^s} = V ; \end{aligned}$$

- ii) whenever the company maintains a constant (and positive) leverage level in its capital structure against a constant level of net assets,  $W$  is obtained by adding the tax saving perpetuity (the sum of present values  $\tau D\delta$  discounted at the cost of debt  $\delta$ ). It is:

$$W = \frac{NP}{j} + \text{tax savings} \cdot a_{\infty|\delta} = \frac{NP}{j} + \tau D .$$

In particular, if the interest rate  $j$  which compensates investors for bearing business risk is simply the ratio between the Nopat and the sum of equity and debt taking into account tax savings:

$$j = \frac{NP}{E + D(1 - \tau)} , \quad (5)$$

one easily gets:

$$W = \frac{NP}{WACC} .$$

If (5) holds, again  $W = V$ .

The two valuations seem to coincide, but:

- if (5) does not hold,  $W \neq NP/WACC$  which invalidates the equality of  $V$  and  $W$ ;

- the result does not hold if the structure of the model even slightly changes.

Let, for instance,  $NP_1 = 100$  and suppose that 3% is the forecast growth rate of the future Nopats:

$$NP_s = 100(1 + 0.03)^{s-1}$$

with  $WACC = 0.07$ . It is:

$$\begin{aligned} W &= \frac{100}{0.07} \cong 1,428.571 < 2,500 = \\ &= C_0 + \sum_{s=1}^{+\infty} \frac{[100(1 + 0.03)^{s-1}/C_0 - 0.07] C_0}{(1 + 0.07)^s} = \frac{100}{0.07 - 0.03} = V . \end{aligned}$$

The two valuations do not coincide;

iii) finally, if the Nopat grows and new investments are undertaken so that EVA increases, a third addendum contributes to form the value  $W$ . In particular, let  $I$  be the amount invested each year for  $T$  years from the end of the first year. Let  $NP$  and  $r$  be the Nopat and the return rate of the first period, respectively. According to Stewart<sup>17</sup>, it is:

$$W = \frac{NP}{WACC} + \frac{I(r - WACC)T}{WACC(1 + WACC)}. \quad (6)$$

Unfortunately, expression (6) is not consistent with (4), unless  $WACC = r$ . Finally, in some examples Stewart uses (6) also for increasing new investments: in such a case the amount  $I$  to be considered in the formula is the sum invested at the end of the first year. Such an extension may cause some perplexities: how could any arbitrary pattern of investment yield the same value of the constant pattern of (6)? Maybe this "generalization" must be seen as a proposal of a sort of lower bound for the firm's value. Moreover, the last part of the model is not easy to read.

Anyway, in such hypotheses,  $V$  is, in general, different from  $W$ . The two valuations do not coincide, even for constant investments. But Stewart states such a coincidence, apparently basing his conclusions<sup>18</sup> on a numerical example.

If  $C_s$ , the capital committed to the business until the  $s$ -th year, grows for  $T$  years, the sum of the initial capital and forecast discounted EVA's is:

$$V = C_0 + \sum_{s=1}^T \frac{(r_s - WACC)C_{s-1}}{(1 + WACC)^s} + \frac{(r_{T+1} - WACC)C_T}{(1 + WACC)^T WACC}$$

which, in general, is different from (6) and the two valuations do not coincide, even for constant investments as the following counter example shows.

If only at the end of the first year the Nopat is entirely invested ( $T = 1$ ,  $I = NP = NP_1$ ,  $r = r_1$ ,  $C_1 = C_0 + NP$ ), according to (6) it is:

$$W = \frac{NP}{WACC} + \frac{NP(r - WACC)}{WACC(1 + WACC)} = \frac{r(1 + r)C_0}{WACC(1 + WACC)}$$

<sup>17</sup> See [27], p. 288: for derivation of (6), a reference is given to [21]. Indeed, in note 15 of [21] concerning a further particular case of a particular case, Modigliani and Miller give a formula close to (6), but such a result is obtained under numerous hypotheses which Stewart does not assume.

In the general case of iii), it should be:

$$\begin{aligned} & \frac{NP}{WACC} + \frac{I(r - WACC)}{WACC} \left[ \frac{1}{1 + WACC} + \frac{1}{(1 + WACC)^2} + \dots + \frac{1}{(1 + WACC)^T} \right] = \\ & = \frac{NP}{WACC} + \frac{I(r - WACC)}{WACC} \frac{1 - (1 + WACC)^{-T}}{WACC} \neq \\ & \neq \frac{NP}{WACC} + \frac{I(r - WACC)T}{WACC(1 + WACC)} = W. \end{aligned}$$

This is however a technical quibble. We too will refer to (6).

<sup>18</sup> See [27], p. 313 and the following.

whereas EVA valuation gives:

$$\begin{aligned} V &= C_0 + \frac{(r - WACC)C_0}{1 + WACC} + \frac{(r_2 - WACC)C_1}{WACC(1 + WACC)} = \\ &= \frac{r_2(1 + r)C_0}{WACC(1 + WACC)}. \end{aligned}$$

It is  $W \neq V$  unless  $r = r_2$ .

Nevertheless, some sufficient conditions<sup>19</sup> may be given. For instance, let us consider a company which earns a Nopat  $NP_1$  in a certain year and forecasts a constant growth rate  $g$  for  $T$  years. In particular, let:

$$NP_s = \begin{cases} NP_1(1 + g)^{s-1} & s = 1, 2, \dots, T \\ NP_T & s > T \end{cases}.$$

Besides, let us suppose the company invests for  $T$  years a percentage  $\alpha$  of its previous year Nopat, that is:

$$\begin{aligned} C_s &= \\ &= \begin{cases} C_0 + \alpha \sum_{t=1}^s NP_t = C_0 + \alpha NP_1((1 + g)^s - 1)/g & s = 0, 1, \dots, T \\ C_T & s > T \end{cases}. \end{aligned}$$

Finally, let us assume  $\alpha NP_1 = gC_0$  and suppose that WACC and the growth rate coincide:  $WACC = g$ , which implies a constant return rate  $r = g/\alpha$ . Under such assumptions, EVA valuation and *Value - Driver Model* give the same results. If, in particular,  $\alpha = 1$ , that is in the first  $T$  years all the Nopats are invested into the business,  $r = g = WACC$ . Hence, both the models give:

$$W = V = C_0.$$

Consider, for instance, a company earning  $NP_1 = 200$  in a given year and forecasting a constant growth rate  $g = 0.08$  for 5 years. In particular, let:

$$NP_s = \begin{cases} 200(1 + 0.08)^{s-1} & s = 1, 2, \dots, 5 \\ 200(1 + 0.08)^4 \cong 272.1 & s > 5 \end{cases}.$$

Besides, suppose the company invests for 5 years  $\alpha = 50\%$  of the Nopat of the previous year (which implies  $I = 100$ ) and let  $50\% \cdot 200 = 0.08C_0$ , that is  $C_0 = 1,250$ . It follows:

$$C_s =$$

<sup>19</sup> Such conditions are suggested by a numerical example in [27] (see p. 313 and the following) in which  $V$  and  $W$  coincide, but Stewart omits the assumptions which allow such a coincidence.

$$\begin{cases} 1,250 + 100((1 + 0.08)^s - 1)/0.08 & s = 0, 1, \dots, 5 \\ 1,250 + 100((1 + 0.08)^5 - 1)/0.08 \cong 1,836.66 & s > 5 \end{cases}$$

Finally, suppose that WACC and the growth rate coincide:  $WACC = 0.08$ , which implies a constant return rate  $r = g/\alpha = 0.16$ . Under such assumptions, EVA valuation and *Value - Driver Model* give the same results:  $W = V \cong 2,962.962$ .

If, in particular,  $\alpha = 1$ , that is in the first 5 years all the Nopats are invested into the business,  $r = g = WACC = 0.08$ . Hence, both the models give:

$$W = V = 1,250 .$$

In general, the EVA method and the *Value - Driver Model* do not provide the same valuations. On the other hand, they are *inspired* by very different conjectures and/or philosophies: the meaningful fact is that in many relevant cases the valuations obtained through the two methods coincide (even if in the presence of debt and/or new investments, very strong hypotheses have to be assumed).

Finally, it is suggested<sup>20</sup> to use the *Value - Driver Model* as a way of *representing* the valuation obtained through EVA. For this purpose, in (6) the level of current investments  $I$  is determined as an average of all the discounted projected investments over an opportune period  $T$  and the rate of return  $r$  is *just* chosen in order to get the same value found with the EVA method. But this proposal does not appear satisfactory at all: mathematics is correct, but one cannot conclude that one method confirms the other and *vice versa*.

## 5 Discussion and conclusions

Surely, EVA is not simply a mathematical transformation of NPV analysis at anything more than its basic level. It is a measure used in a comprehensive management system that is designed to provide incentives for management to seek shareholders value increasing behaviour.

From what emerged in the previous sections, we afford to conclude that EVA and NPV valuation methods are the same thing. But we are in front of a radical change of perspective. Stewart considers well known concepts in residual income models, dresses them up, renames them EVA and proposes them as a new management strategy.

The power of EVA is *just here*: although formally equivalent, the patterns drawn through the decomposition of the NPV and through the EVA valuation are different. Peccati takes the "NPV box", opens it and describes the objects which are part of it. Stewart, on the contrary, *builds* the components and joins them to form the "EVA box": whereas one mechanism "breaks", the other "creates".

The decomposition of NPV may be seen as a sort of *amortization of a credit* rather than of a debt. The amortization procedure spreads a debt on more periods. Usually an amortization plan is built fixing the sequence of capital quotas

<sup>20</sup> See, for instance, [27], p. 345.

or of installments. In our context the problem is to spread a credit on more periods. The solution consists in starting from the sequence of the residual credits and building the capital quotas which, summed up, give the global amount of the credit.

The disaggregation of NPV is very similar to EVA building. The main difference is not in the formulas (which are substantially the same), but in their interpretation. One can start from a NPV and decompose in quotas. EVA starts from periods results (often the firm net operating profits after taxes) and sums them up, reaching the global value (typically the "value" of the firm). The decomposition of NPV, starting from a global result, does not seem to suggest to use accounting data (as EVA does). Yet, it is sufficient to decompose NPV with balance - sheet values as outstanding capitals to find EVA.

Some other comments occur. "EVA approach has the advantage of showing how much value is being added to the capital employed in each year of the forecast"<sup>21</sup> and "EVA is the fuel that fires up a premium in the stock market value of any company or accounts for its discount".<sup>22</sup> We do not want to enter into philosophical issues: surely EVA and NPV provide a different *representation* of the same results. A business manager who looks at EVA gets a more immediate and well-defined picture of the *health condition* of a firm, but some doubts remain.

All the valuations are based on forecast Nopats and forecast investments (as usual, on the other hand, in this type of valuation) but, obviously, nobody may be sure about future. Stewart himself, in order to take into account uncertainty, sometimes suggests to derive indirectly<sup>23</sup> the sum of the discounted future EVA's as the difference between the market prices and the economic-book prices of all the shares. Furthermore, the freedom in the choice of the forecast rates and the forecast Nopats may become an easy source of arbitrariness: the valuation may be too subjective and may allow to handle the data in order to obtain the desired results.

Finally, EVA's world is based on WACC, which may cause some perplexities to financial mathematicians.<sup>24</sup> Moreover, if the business of the firm consists (as it always happens) in various projects with different maturities and conditions, it seems there is no univocal definition of WACC. Of course, the use of WACC in the EVA context is an obvious consequence of its common use for NPV, APV and GAPV.

In conclusion, EVA appears a proper index to obtain a valuation of a firm (at a low cost in terms of required data) in a first investigation. But, in order to improve the analysis, it seems opportune to test the results of the EVA valuation also with other convenience/valuation criteria like, for instance, the *business*

<sup>21</sup> See [27], p. 307.

<sup>22</sup> See [27], p. 3.

<sup>23</sup> See, for instance, [27], p.153.

<sup>24</sup> For some observations in such a sense, see, among others, [6] and [9].

*plan*<sup>25</sup> of the firm which, in the last years, has turned out to be a precious instrument in every valuation problem.

Alternatively, a *random EVA* could be defined. In particular, one might consider a *soft randomness* by assuming a *random Nopat* in the expression of the period EVA, whereas  $C_{s-1}$  is known (that is all the future new investments are determined in  $t = 0$ ). But one might introduce *more randomness* by supposing that also the future investments (and hence all the  $C_{s-1}$ ) are random variables (in this case it could be interesting to study the correlation between the random variables  $NP_s$  and  $C_{s-1}$ ). In such a way, one obtains a richer index (even if more complex and perhaps less immediate) which could provide a more realistic kind of information and could avoid the risk of an excessive arbitrariness in the choice of future Nopats and rates.

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<sup>25</sup> See, for instance, [7] and [14].

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