Using The EVA® Financial Management System To Make The Wrong Decision

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ABSTRACT

EVA may result in underinvestment problems and suboptimal strategies used to boost near-term performance at the expense of the future. To solve these problems, a new measure, CFMAC, is developed. This paper describes the types of problems associated with the EVA Financial Management System that includes use of the EVA measure and compensation schemes touted by EVA proponents. A new annual measure, cash flow minus amortized capital (CFMAC) is developed to address the problems inherent to EVA.

INTRODUCTION

𝒮tern Stewart and Company developed and trademarked EVA as a performance measure and recommend its use in evaluating and compensating managers.[1] EVA stands for 'economic value added'; however, it does not show how much value is added to a company or unit – not even on a one-year basis. In fact, EVA may be positive during times when value is being destroyed or EVA may be negative during times when value is being added. While EVA has some benefits over earnings as a measure used for evaluation and compensation, it possesses some of the same problems. Evaluation and compensation based on either EVA or earnings may result in incentives for managers to avoid value-adding projects or to pursue value-destroying activity. In some cases, EVA exacerbates this problem.

To be fair, several authors other than Stewart support the use of EVA (see, for example, Tully, 1993, Dierks and Patel, 1997, Riceman et al, 2000). Other authors bring forth various criticisms of EVA (e.g., Kramer and Pushner, 1997, Keys et al, 2001, Fernandez, 2001, McLaren, 2003). In this paper, I discuss two particular problems inherent with the EVA Financial Management System (with EVA as a performance measure tied to compensation). I describe a new measure of annual performance that eliminates some of the problems associated with EVA and comment on revising management compensation schemes so that the incentive is given to make truly value-adding decisions. First, though, I provide a brief review of what is EVA and how it relates to the more familiar annual performance measure called earnings.

HOW DOES EVA COMPARE TO EARNINGS?

Recall from any introductory accounting text that earnings equals revenues less expenses. Expenses include (among other items) various real operating expense items, an allocation for the use of assets (depreciation), costs associated with debt financing (interest), and taxes. In the simplest sense, without considering accruals, EVA differs from earnings in that an additional cost, the cost of equity financing, is subtracted.[2]

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[1] See Stewart (1991) for a thorough discussion on EVA. Chapter 4 defines EVA and makes the argument that EVA be used "for goal setting, capital budgeting, performance assessment, incentive compensation, and communication" (p. 119). Chapter 6 discusses incentive compensation schemes based on EVA.

[2] To keep this part of the analysis simple, I assume that the equity equivalent adjustments suggested by Stern Stewart (of which 164 possible adjustments have been identified) are not required. These adjustments are mainly to undo the following: various non-cash expenses and reserves (with the exception of depreciation) like goodwill amortization, the non-capitalization of R&D under GAAP, and differences between reported (under GAAP) and actual taxes.

More formally, EVA is defined as follows:

$$\mathrm{EVA = NOPAT - Capital \times WACC} \tag{1}$$

where NOPAT is net operating profit after tax from the firm, capital is the total debt and equity amounts used to fund the firm, and WACC is the weighted average cost of capital defined as follows:

$$\mathrm{WACC = \frac{Debt}{Debt + Equity} \times K_d \times (1 - T_c) + \frac{Equity}{Debt + Equity} \times K_e} \tag{2}$$

where K_d and K_e are the before-tax costs of debt and equity respectively and T_c is the corporate tax rate.

Expanding the NOPAT term in equation 1, and substituting (Debt + Equity) for Capital so as to multiply through the terms in WACC, we see that EVA is equivalent to the following:

$$\mathrm{EVA = (Rev - Exp - Dep) \times (1 - T_c) - Equity \times K_e - Debt \times K_d \times (1 - T_c)} \tag{3}$$

where Rev is revenues, Exp is expenses excluding depreciation, and Dep is depreciation. Note that since earnings are defined as

$$\mathrm{Earnings = (Rev - Exp - Dep - Int) \times (1 - T_c)} \tag{4}$$

and interest (denoted as Int) equals $\mathrm{Debt \times K_d}$, it is easy to see that[3]

$$\mathrm{EVA = Earnings - Equity \times K_e} \tag{5}$$

WHY IS EVA BETTER THAN EARNINGS?

The main advantage of having managers consider EVA instead of just earnings is that it forces managers to consider whether NOPAT is greater than the overall cost of capital (in units of currency) used to generate it (see equation 1). Equivalently, it forces managers to consider whether the residual earnings available to equity holders are greater than the opportunity cost of the equity (in units of currency) used to finance the firm (see equation 5). This is important because a firm that *consistently* generates positive accounting earnings that are less than the opportunity cost of the equity employed to generate them is, in effect, destroying value.

Another advantage of EVA is that there are several adjustments to EVA that remove the ability to use accruals to artificially increase it (as is done more easily with earnings). This statement does not imply that EVA eliminates accruals. Depreciation of assets, capitalization and amortization of some costs (e.g., R&D, marketing, training and restructuring costs) as assets, and capitalization of operating leases into debt are all forms of accruals that are recommended (see Stewart 1994).

SO WHAT IS WRONG WITH EVA?

Stewart (1991) and other authors argue that EVA can not only be employed at the firm level, but also at the division and lower levels and should be used for capital budgeting, evaluation, and management compensation. Thus we can imagine that for every project a manager considers, the EVA implications should be analyzed. The problem

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[3] For simplicity, I assume that the current cost of debt is the same as when the debt was issued so that interest charges on the income statement equal the current cost of debt financing.

with EVA is that it is a one-period measure – as are earnings and cash flows. This year's EVA, despite its name, does not measure economic value added this year because it does not consider how a decision made this year affects cash flows in future years. Stewart (1991, 1994) describes and Hartman (2000) proves how the present value of future EVA's generated by a project is the same as the project's NPV. Thus, if the net present value of future EVA's from a project are used to determine the project's acceptance, then a correct decision (consistent with traditional NPV) will be made. However, when linking EVA to a manager's compensation, Stewart (1991, 1994) suggests a system that is actually backward looking instead of forward. He advocates establishing an EVA bonus bank. The EVA-based bonus that is earned in one year is partially paid out in that year and the rest is banked and paid out in future years. This is supposed to make managers forward looking as they anticipate bonuses to be paid in future years. Unfortunately, the current-year bonus a manager receives only reflects what was already in the bank and what has been added to the bank and does not look forward to future years' EVA amounts. While Stewart discusses how the present value of future EVA's is equivalent to NPV, the present value of future EVA's is simply not used in the compensation schemes! For a particular year's bonus, only EVA's from that year and prior years are used.[4] There is no a priori reason to expect managers to avoid short sighted strategies that boost current EVA (and the current bonus) at the expense of the future EVA's (and bonuses) just as managers with earnings-based bonuses have been known to boost current earnings and bonuses at the expense of the future.

Correct capital budgeting decisions are unlikely if managers' current bonuses are based on current and past EVA's and potentially penalize them for making positive NPV decisions. Such bonuses obscure the fact that the NPV (or the present value of *all future* EVA's) really determines if value is being added to a company. Two general problems arise with the use of EVA and such EVA-based compensation systems; these are described below.

Problem 1: Negative EVA Causes Rejection Of A Positive NPV Investment

Problem 1 (see Table 1 below) is an example of how a value adding project may actually show negative EVA's in the year it is adopted and even in future years. A manager most concerned about the current bonus (or even the next couple bonuses) may reject such a project because of the two years of negative EVA's (and thus depressed near-term bonuses).

Table 1
Problem 1: An investment with positive NPV but negative initial EVA's

Calculations assume a corporate tax rate of 40% and a WACC of 10%. Capital is calculated as capital contributed to the project less accumulated economic depreciation and equals net assets as shown.

Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	NOPAT	Capital x WACC	EVA
0	$100,000	$0	$100,000	$0	$0	-$100,000	$0		
1	$0	$2,500	$97,500	$10,000	$6,000	$3,400	$900	$10,000	-$9,100
2	$0	$2,500	$95,000	$40,000	$24,000	$10,600	$8,100	$9,750	-$1,650
3	$0	$2,500	$92,500	$80,000	$48,000	$20,200	$17,700	$9,500	$8,200
4	$0	$2,500	$90,000	$80,000	$48,000	$20,200	$17,700	$9,250	$8,450
5	$0	$2,500	$87,500	$80,000	$48,000	$20,200	$17,700	$9,000	$8,700
6	-$85,000	$2,500	$0	$50,000	$30,000	$98,000	$10,500	$8,750	$1,750
					NPV =	$8,686		NPV of EVA's =	$8,686
					IRR =	12%			

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[4] There is some discussion about using part of the annual EVA bonus to buy stock options; see, for example, Stewart (1994), Stern, Stewart, and Chew (1995). Presumably, if the managers' performance has a significant impact on the stock price, then this gives managers an incentive to make value-adding decisions.

It is clear that any bonus scheme for year 1 that penalizes the manager for a lower or negative EVA in year 1 leads to the wrong incentives. Such an EVA-based compensation scheme penalizes the manager for accepting the project because of the negative incremental EVA in year 1 (and year 2) if the project is accepted. If the project is rejected, the incremental EVA is zero and no negative incremental bonus effect occurs.

In his book, Stewart (1991) describes several EVA-based compensation schemes. Some use targets based on past EVA results. One suggests forecasting EVA into the future and using the forecasts as targets (this method is downplayed as too complex and the suggestion is that if going this far, managers might just as well be given common stock in their unit). Stewart (1991), Stewart (1994), Stern et al (1995) and others suggest linking management compensation to EVA levels and, in particular, to growth in EVA based on current and past EVA values; Wallace (1997) provides, as an example, such an EVA compensation system used by Crane Company. Stewart (1991) provides a fairly complete description of such a compensation scheme as follows:

For those for whom the additional accuracy of projections is not worth the salt, my colleague David Glassman, has devised what may be the simplest and most elegant, but still theoretically sound approach, one that in practice has met with great enthusiasm among operating people. David recommends abandoning the concept of a target entirely and instead basing the bonus on a percent of the annual change in EVA and a percent of the level of EVA (but only if EVA is positive), as follows:

Bonus = M1% × change in EVA + M2% × EVA

where   M1 = a percent of the change in EVA, no matter whether the change is positive or negative and
M2 = a percent of EVA, if EVA is positive, and 0% if EVA is negative. (p. 247)

Reexamining the EVA's in Problem 1, we can see that an EVA compensation scheme that rewards either increasing or positive EVA (as suggested by Stewart and his colleague) will severely penalize the manager by lowering the bonus paid in year 1 (and possibly year 2) in spite of the fact that correctly accepting the project that year actually adds $8,686 to the current value of the company. So, here is the problem: EVA for year 1 is negative but the value added by accepting the project is a positive $8,686. The EVA for year 1 does not show how much value is added by accepting the project in year 1.

The problem of the sign of EVA running counter to the sign of NPV illustrated in Problem 1 can be generalized to multiple business situations. Recalling the equivalence of NPV and the present value of future EVA's demonstrated by Stewart (1991) and proved by Hartman (2000), we can transform equation 1 as follows:

$$\text{NPV} = \sum_{t=1}^{n} \frac{\text{EVA}_t}{(1+\text{WACC})^t} = \sum_{t=1}^{n} \frac{\text{NOPAT}_t - \text{Capital}_t \times \text{WACC}}{(1+\text{WACC})^t} \qquad 6$$

where the subscript, t, indicates the time period of the observed variables. The amount, Capital_t, refers to the capital employed at the beginning of the tth period; other subscripted amounts occur at the end of the year. The number, n, is defined as the total number of periods of the investment project.

Let PVN be a present value operator for the series of NOPAT amounts and PVC be a present value operator for the series of Capital amounts over the life of the project. See Appendix 1 for a detailed description of PVN and PVC. Equation 6 can then be rewritten as follows:

$$\text{NPV} = \text{NOPAT}_1 \times \text{PVN} - \text{Capital}_1 \times \text{WACC} \times \text{PVC} \qquad 7$$

EVA_1 will be less than zero when NPV is greater than zero when the following two conditions hold simultaneously:

$$\text{NOPAT}_1 < \text{Capital}_1 \times \text{WACC} \qquad 8$$

and $NOPAT_1 \times PVN > Capital_1 \times WACC \times PVC$.   9

In effect, the current negative EVA (that results if equation 8 is true) and its negative contribution to NPV is overcome by growing NOPAT or reducing Capital such that, eventually, the present values of future positive EVA's dominate and make overall NPV positive (the result if equation 9 is true).

Assume equation 8 is satisfied, i.e., $EVA_1 < 0$, then, upon examining PVN and PVC (see Appendix 1, equations A1-A4), it is easy to see how equation 9, the positive NPV, is satisfied. One obvious situation is when a project's cash flows follow a typical lifecycle (start low, grow rapidly, level off, eventually decline or stop). A second situation arises when NOPAT remains constant but capital decreases through time due to asset sales or depreciation. The fact that these two examples are not contrived and rare occurrences, but are common to many projects a manager may analyze, should give EVA advocates pause before recommending EVA-based compensation systems like the ones previously mentioned.

It could be argued that for some reason managers are less myopic and less concerned about their current bonuses when they use EVA numbers instead of earnings, cash flow, or other numbers because they should be able to see the eventual positive EVA's and the eventual positive effects on future bonuses. Unfortunately, the immediate (year 1 and year 2) EVA numbers appear more extreme than earnings or cash flow numbers. Cash flow is actually positive $3,400 and earnings are $900 minus interest after tax – certainly more than the EVA of *negative* $9,100. Thus, although Stewart (1991) is correct in that using EVA will help reduce the error of accepting projects that do not cover their cost of capital and have negative NPV's; it is also true that using EVA (and his recommended EVA-based compensation system) may also contribute to the error of rejecting positive NPV projects. Thus EVA may induce an underinvestment problem. Wallace (1997) finds that relative to control firms, adopters of EVA reduce new investment and increase the disposition of assets. He also finds that over a 24 month period surrounding the adoption of EVA there is no statistically significant cumulative average abnormal return (CAAR) for EVA adopters. In fact, 22 of the firms Wallace studied had positive cumulative abnormal returns (CAR's) while 14 had negative CAR's. These results are consistent with both the avoidance of negative NPV projects by some firms and an underinvestment problem in other firms. Unfortunately, the problems with EVA and EVA-based compensation systems do not stop here.

Problem 2: Positive EVA's From Negative NPV Strategies

We have seen that the EVA may be negative at the time an economic-value-adding investment is made. Next I show how EVA may be positive when an economic-value-destroying decision is made. Essentially, we see this situation if we reexamine equations 8 and 9 and reverse the inequalities.

A common strategy where this occurs is when a manager tries to manipulate his or her bonus by taking operating actions that boost current performance at the expense of future performance. Consider a company that sells its product to distributors that resell to consumers. If a manager gives incentives to distributors to purchase excessive inventory in the current year, then current performance for the manager will look better (even when measured by EVA). However, in the next year the distributor likely will not purchase as many units as they can run down their inventory. In addition, for some products, there may be further losses as consumers become dissatisfied from purchasing stale or obsolete products that have been held by the distributor.[5] As can be seen in Table 2, this operating strategy that can be used to manipulate earnings is equally efficient at manipulating EVA.

Now consider the manager's bonus by applying the management bonus system recommended by Stewart and Glassman (Stewart, 1991), using Stewart's example values of M1=10%, M2=5%, and a bonus bank that pays one third out per year. We can see in Table 3 that the manipulated strategy that leads to the reduced value (and reduced NPV) results in a higher year 1 bonus, higher cumulative bonuses over the first 6 years, and also a higher present value of bonuses over the first 6 years.

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[5] See, for example, Burrough and Helyar (1990) for examples of the common use of "loading" at RJ Reynolds and other tobacco companies (p. 58) and RJR Nabisco (p. 511).

Table 2

Problem 2: Positive incremental initial EVA from a negative NPV strategy

Calculations assume a corporate tax rate of 40% and a WACC of 10%. Capital is calculated as capital contributed to the project less accumulated economic depreciation and equals net assets as shown.

| | | | | | | | | Panel A: Original (Optimal) Operating Strategy | |
Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	NOPAT	Capital x WACC	EVA
0	$100,000	$0	$100,000	$0	$0	-$100,000	$0		
1	$0	$2,500	$97,500	$47,500	$28,500	$12,400	$9,900	$10,000	-$100
2	$0	$2,500	$95,000	$47,500	$28,500	$12,400	$9,900	$9,750	$150
3	$0	$2,500	$92,500	$47,500	$28,500	$12,400	$9,900	$9,500	$400
4	$0	$2,500	$90,000	$47,500	$28,500	$12,400	$9,900	$9,250	$650
5	$0	$2,500	$87,500	$47,500	$28,500	$12,400	$9,900	$9,000	$900
6	-$85,000	$2,500	$0	$47,500	$28,500	$97,400	$9,900	$8,750	$1,150
						NPV =	$1,986	NPV of EVA's =	$1,986
						IRR =	10.5%		

| | | | | | | | | Panel B: Manipulated Operating Strategy | |
Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	NOPAT	Capital x WACC	EVA
0	$100,000	$0	$100,000	$0	$0	-$100,000	$0		
1	$0	$2,500	$97,500	$51,000	$30,600	$13,240	$10,740	$10,000	$740
2	$0	$2,500	$95,000	$45,000	$27,000	$11,800	$9,300	$9,750	-$450
3	$0	$2,500	$92,500	$46,000	$27,600	$12,040	$9,540	$9,500	$40
4	$0	$2,500	$90,000	$47,000	$28,200	$12,280	$9,780	$9,250	$530
5	$0	$2,500	$87,500	$47,500	$28,500	$12,400	$9,900	$9,000	$900
6	-$85,000	$2,500	$0	$47,500	$28,500	$97,400	$9,900	$8,750	$1,150
						NPV =	$1,901	NPV of EVA's =	$1,901
						IRR =	10.5%		

Considering the results in tables 2 and 3, clearly the incentive given to the manager is to follow the value-destroying strategy as it results in higher near-term EVA, the highest immediate bonus, cumulative bonus, present value of bonuses and balance left in the bonus bank.

Is There A Better Way Than EVA?

To avoid the general problem of EVA signs contradicting the NPV sign, EVA (if it is to be used) needs to be recalculated. For the most part, EVA accounts for the cost of capital by taking the WACC and multiplying by the amount of capital employed to determine the annual capital charge.[6] In situations where there is no initial NOPAT or where NOPAT must grow before it covers the capital charge, the EVA may be negative when NPV is positive.

Consider a new measure that I denote CFMAC (cash flow minus amortized capital). Rather than charging depreciation and a capital charge to get EVA, the after-tax cash flows are reduced by a proportionate amount of the initial capital to get CFMAC. The proportion used is based on an index of present value, PI, otherwise known as the profitability index. For all projects (or for firms), using this method produces annual CFMAC amounts that are always

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[6] Stewart (1994) indicates that for "investments with long-deferred payoffs, we have also developed a procedure for keeping such capital off the books (for internal evaluation purposes) and then gradually readmitting it into the manager's internal capital account" (page 77). Unfortunately, specifics are not provided.

consistent in sign with the NPV. In effect, this method is a way to consistently and correctly amortize the capital that is used to generate positive cash flows.

Table 3

EVA-Based Bonuses for Optimal Strategy vs. Lower-NPV Manipulated Strategy

The EVA Bonus is calculated as per Stewart (1991) where M1 is multiplied by the change in EVA and M2 is multiplied by the EVA (when positive). M1 and M2 values are 10% and 5% respectively and are the same as the example values in Stewart (1991). The EVA Bonus is depositied into the Bonus Bank each year. One third of the Bonus Bank is paid out as a Cash Bonus each year following the description of Stewart (1991). PV calculations assume a discount rate of 10% (the same as the firm's WACC).

Panel A: EVA and Bonus Results for Original (Optimal) Operating Strategy					
Year	EVA	EVA Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus
0			$0.00		
1	-$100	-$10.00	-$10.00	-$3.33	-$6.67
2	$150	$32.50	$25.83	$8.61	$17.22
3	$400	$45.00	$62.22	$20.74	$41.48
4	$650	$57.50	$98.98	$32.99	$65.99
5	$900	$70.00	$135.99	$45.33	$90.66
6	$1,150	$82.50	$173.16	$57.72	$115.44
Sum	$3,150	$277.50		$162.06	
NPV	$1,986	$180.88		$102.93	
Panel B: EVA and Bonus Results for Manipulated (Lower NPV) Operating Strategy					
Year	EVA	EVA Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus
0			$0.00		
1	$740	$111.00	$111.00	$37.00	$74.00
2	-$450	-$119.00	-$45.00	-$15.00	-$30.00
3	$40	$51.00	$21.00	$7.00	$14.00
4	$530	$75.50	$89.50	$29.83	$59.67
5	$900	$82.00	$141.67	$47.22	$94.44
6	$1,150	$82.50	$176.94	$58.98	$117.96
Sum	$2,910	$283.00		$165.04	
NPV	$1,901	$189.93		$109.49	

THE CFMAC METHOD

First determine the project's NPV utilizing the initial required investment and subsequent cash flows (after tax) excluding interest costs or interest tax shields.[7] Next, determine the project's PI calculated as follows:

$$PI = \frac{\sum_{t=0}^{n} \dfrac{CF_t^+}{(1+r)^t}}{\sum_{t=0}^{n} \dfrac{-CF_t^-}{(1+r)^t}} \qquad\qquad 10$$

where CF_t^+ is time t's net cash flow if it is positive, otherwise it is set to zero; CF_t^- is time t's net cash flow if it is negative, otherwise it is set to zero; n is the number of cash flows over the life of the project and r is the appropriate discount rate (e.g., r = WACC for projects of equal risk to the firm).

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[7] Note: an APV methodology that includes the value of debt tax shields and other financing benefits may also be used.

Next determine the annual amortized capital (AC) amounts as follows:

$$AC_t = \frac{CF_t^+}{PI} \qquad\qquad 11$$

Finally the cash flow minus amortized capital, CFMAC, for time period t is calculated as follows:

$$CFMAC_t = CF_t^+ - AC_t \qquad\qquad 12$$

CFMAC essentially charges off against each positive cash flow a proportionate amount of the capital used to generate that cash flow. Let PV^+ and PV^- represent the present values of the positive and negative cash flows respectively. The proportion of AC to the present value of capital (i.e., to the PV^- amount) is based on the proportion of the positive cash flow to the present value of all positive cash flows (PV^+).[8]

As long as the NPV is positive, the projected CFMAC will be positive for each projected positive cash flow. If NPV is negative, the projected CFMAC will be negative for each projected positive cash flow. This improves upon an EVA calculation that allows projected EVA to be negative even when a positive NPV project is being accepted and positive economic value (in the true sense) is being added. Tables 4 and 5 give examples of projected CFMAC amounts and compare them to the corresponding projected EVA amounts in the contexts of problems 1 and 2 described above.

Problem 1 Revisited With CFMAC

First consider CFMAC in the context of Problem 1. Recall that the investment in problem 1 had a positive NPV and had smaller initial cash flows that grew over the life of the project. In Table 4, we see that the CFMAC signs are all positive and all consistent with the positive NPV. Recall the problem with EVA was that the negative initial results applied to a bonus scheme may actually penalize the manager for accepting the positive NPV project. With a bonus scheme as per Stewart (1991) as outlined above, replacing the EVA amounts with CFMAC amount will lead to a positive bonus effect for the manager in year 1 rather than a negative effect that runs counter to the desired accept/reject decision.

Another interesting feature to note about the CFMAC calculations is that the largest AC and the largest CFMAC amounts occur in the years that have the largest projected cash flows. Thus we see the final year having the largest CFMAC because of the dominance of the salvage value in the overall NPV calculation for the project. Note, though, that the final year also has the largest AC allocation so that the absolute effect of the $77,800 higher cash flow (compared to year 5) is reflected in CFMAC being $6,218 higher than the year 5 amount. For EVA, the final asset value is only important as it affects the interim yearly depreciation amounts. Although the timing of depreciation amounts does not affect the present values of all EVA's (see Hartman, 2000), a particular year's EVA's may be manipulated through manipulation contemporaneous depreciation. If depreciation is deferred to later years, initial EVA results may be overstated and lead to overly high near-term bonuses for managers. Keys et al (2001) have other concerns regarding the use of depreciation in EVA.

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[8] This is shown by dividing both sides of equation 11 by PV^- and substituting PV^+/PV^- into PI.

$$\frac{AC_t}{PV^-} = \frac{CF_t^+ \div PI}{PV^-} = \frac{CF_t^+ \div \dfrac{PV^+}{PV^-}}{PV^-} = \frac{CF_t^+}{PV^+}$$

Table 4
Comparison of Projected CFMAC and EVA for the Positive NPV Project from Problem 1

Also shown, for comparson, are the annual cash flows and earnings amounts. Calculations assume a corporate tax rate of 40% and a WACC of 10%. For EVA, capital is calculated as capital contributed to the project less accumulated economic depreciation and equals net assets as shown. PI is calculated as the present value of inflows over the present value of outflows (in absolute value terms). Amortized capital, AC, is equal to the projected positive cash flow divided by the projected PI. Projected CFMAC is the projected positive cash flow minus amortized capital. If the projected positive cash flow is actually negative, then CFMAC is set to zero.

Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	Earnings	EVA	Amortized Capital for CFMAC	CFMAC
0	$100,000		$100,000			-$100,000				
1		$2,500	$97,500	$10,000	$6,000	$3,400	$900	-$9,100	$3,128	$272
2		$2,500	$95,000	$40,000	$24,000	$10,600	$8,100	-$1,650	$9,753	$847
3		$2,500	$92,500	$80,000	$48,000	$20,200	$17,700	$8,200	$18,586	$1,614
4		$2,500	$90,000	$80,000	$48,000	$20,200	$17,700	$8,450	$18,586	$1,614
5		$2,500	$87,500	$80,000	$48,000	$20,200	$17,700	$8,700	$18,586	$1,614
6	-$85,000	$2,500	$0	$50,000	$30,000	$98,000	$10,500	$1,750	$90,168	$7,832
					NPV =	$8,686		$8,686		$8,686
Tax	40%				PI	1.0869				

At this point it should be clear that evaluating investments based on EVA and tying managers' bonuses to current and historical EVA may lead to the wrong decisions. The reason is that the initial EVA's (to which managers will be most sensitive as they affect their near-term bonuses) may have signs that run counter to the sign of the project's NPV. To make the correct investment decision, a manager really must look at measures like NPV or CFMAC (if an annual measure is desired so that it can be tied to bonuses).

The next question to address is whether CFMAC outperforms EVA in the context of a manager considering manipulating operating strategy to boost near-term performance at the expense of both long-term performance and NPV. Here we return to problem 2.

Problem 2 Revisited With CFMAC

The data from Table 2 is now used to calculate CFMAC amounts and is presented in Table 5. What is immediately visible is that with the same manipulation of cash flows, it is much more difficult to manipulate CFMAC than EVA. The reason for this is that CFMAC allocates amortized capital, AC, to a period based on the size of the cash flow in the period divided by the project's PI (see equation 11). Because the manipulated strategy has both a higher cash flow in year 1 and a lower PI, both the numerator and denominator for AC cause it to be larger for year 1 – thus dampening the effect on CFMAC of the larger cash flow in that period. This results in CFMAC (cash flow minus AC) only rising from $241 to $247 – much less dramatic than EVA that rises from -$100 to +$740. Thus, a manager has much more difficulty in manipulating his or her bonus if it is tied to the year 1 CFMAC number instead of the year 1 EVA number.

Table 5
Comparison of Projected EVA and CFMAC for Problem 2

Also shown, for comparison, are the annual cash flows and earnings amounts. Calculations assume a corporate tax rate of 40% and a WACC of 10%. For EVA, capital is calculated as capital contributed to the project less accumulated economic depreciation and equals net assets as shown. PI is calculated as the present value of inflows over the present value of outflows (in absolute value terms). Amortized capital, AC, is equal to the projected positive cash flow divided by the projected PI. Projected CFMAC is the projected positive cash flow minus amortized capital. If the projected positive cash flow is actually negative, then CFMAC is set to zero.

Panel A: Original (Optimal) Operating Strategy

Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	EVA	Amortized Capital for CFMAC	CFMAC
0	$100,000	$0	$100,000	$0	$0	-$100,000			
1	$0	$2,500	$97,500	$47,500	$28,500	$12,400	-$100	$12,159	$241
2	$0	$2,500	$95,000	$47,500	$28,500	$12,400	$150	$12,159	$241
3	$0	$2,500	$92,500	$47,500	$28,500	$12,400	$400	$12,159	$241
4	$0	$2,500	$90,000	$47,500	$28,500	$12,400	$650	$12,159	$241
5	$0	$2,500	$87,500	$47,500	$28,500	$12,400	$900	$12,159	$241
6	-$85,000	$2,500	$0	$47,500	$28,500	$97,400	$1,150	$95,504	$1,896
					NPV =	$1,986	$1,986		$1,986
					PI =	1.0199			

Panel B: Manipulated Operating Strategy

Year	Asset Purchases (Sales)	Dep.	Net Assets	Rev.	Exp.	Cash Flow	EVA	Amortized Capital for CFMAC	CFMAC
0	$100,000	$0	$100,000	$0	$0	-$100,000			
1	$0	$2,500	$97,500	$51,000	$30,600	$13,240	$740	$12,993	$247
2	$0	$2,500	$95,000	$45,000	$27,000	$11,800	-$450	$11,580	$220
3	$0	$2,500	$92,500	$46,000	$27,600	$12,040	$40	$11,815	$225
4	$0	$2,500	$90,000	$47,000	$28,200	$12,280	$530	$12,051	$229
5	$0	$2,500	$87,500	$47,500	$28,500	$12,400	$900	$12,169	$231
6	-$85,000	$2,500	$0	$47,500	$28,500	$97,400	$1,150	$95,583	$1,817
					NPV =	$1,901	$1,901		$1,901
					PI =	1.0190			

Table 6 shows the bonus scheme of Stewart (1991), described earlier, as applied to the CFMAC numbers.

Table 6
Comparison of Bonuses Based on Projected EVA vs. CFMAC for Problem 2

Performance bonuses are calculated as per Stewart (1991) where M1 is multiplied by the change in the variable (either EVA or CFMAC) and M2 is multiplied by the level of the variable (when positive). M1 and M2 values are 10% and 5% respectively and are the same as the example values in Stewart (1991). The Performance Bonus is depositied into the Bonus Bank each year. One third of the Bonus Bank is paid out as a Cash Bonus each year following the description of Stewart (1991). PV calculations assume a discount rate of 10% (the same

Panel A: Origianl (Optimal) Operating Strategy

Year	EVA-Based Bonuses					CFMAC-Based Bonuses				
	EVA	EVA Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus	CFMAC	CFMAC Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus
0			$0.00					$0.00		
1	-$100	-$10.00	-$10.00	-$3.33	-$6.67	$241	$36.21	$36.21	$12.07	$24.14
2	$150	$32.50	$25.83	$8.61	$17.22	$241	$12.07	$36.21	$12.07	$24.14
3	$400	$45.00	$62.22	$20.74	$41.48	$241	$12.07	$36.21	$12.07	$24.14
4	$650	$57.50	$98.98	$32.99	$65.99	$241	$12.07	$36.21	$12.07	$24.14
5	$900	$70.00	$135.99	$45.33	$90.66	$241	$12.07	$36.21	$12.07	$24.14
6	$1,150	$82.50	$173.16	$57.72	$115.44	$1,896	$260.30	$284.44	$94.81	$189.62
Sum	$3,150	$277.50		$162.06		$3,103	$344.79		$155.16	
NPV	$1,986	$180.88		$102.93		$1,986	$214.63		$99.28	

Panel B: Manipulated Operating Strategy

Year	EVA-Based Bonuses					CFMAC-Based Bonuses				
	EVA	EVA Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus	CFMAC	CFMAC Bonus	Bonus Bank Before Cash Bonus	Cash Bonus	Bonus Bank After Cash Bonus
0			$0.00					$0.00		
1	$740.00	$111.00	$111.00	$37.00	$74.00	$247	$37.05	$37.05	$12.35	$24.70
2	-$450.00	-$119.00	-$45.00	-$15.00	-$30.00	$220	$8.32	$33.02	$11.01	$22.01
3	$40.00	$51.00	$21.00	$7.00	$14.00	$225	$11.68	$33.69	$11.23	$22.46
4	$530.00	$75.50	$89.50	$29.83	$59.67	$229	$11.90	$34.36	$11.45	$22.91
5	$900.00	$82.00	$141.67	$47.22	$94.44	$231	$11.79	$34.70	$11.57	$23.13
6	$1,150.00	$82.50	$176.94	$58.98	$117.96	$1,817	$249.40	$272.53	$90.84	$181.69
Sum	$2,910	$283.00		$165.04		$2,969	$330.14		$148.45	
NPV	$1,901	$189.93		$109.49		$1,901	$205.56		$95.04	

In this case, the manager is better off to use the original strategy that gives the higher NPV and to avoid trying to manipulate the strategy. Based on CFMAC, the cash bonus is only slightly higher in year 1 under the manipulated strategy ($12.35 vs. $12.07) but the present value of the bonuses, the sum, and the end-of-year-6 balance in the bonus bank are all higher under the original strategy. Note: if different parameters for the bonus scheme were used, if an entirely different scheme was used, or if the manager had time preferences such that a very high discount rate was applied to future bonuses, then it may be possible that using CFMAC-based bonuses will result in the manager choosing the lower-NPV manipulated strategy. What is important to remember, though, is that because of the way AC is calculated, it is much more difficult to manipulate CFMAC than EVA.

Two key components to the EVA Financial System are EVA and the bonus scheme used to motivate management. Replacing EVA with CFMAC helps to solve situations as shown in problems 1 and 2 above. We should also consider replacing the bonus scheme from one that really only rewards current and past performance to one that rewards actions that affect future performance and the true creation of value within the firm. Discussion of such a bonus scheme is left to a future paper.

CONCLUSIONS

In spite of its name, EVA really does not show the economic value added during a particular time period – only NPV does that. EVA is a short-term measure like earnings or cash flows and is subject to many of the same types of manipulations by management. If management compensation is tied to the level of EVA or the change in EVA, then the possibility exists that management will under-invest – avoid taking positive NPV projects – because of initial negative EVA results. There also exists the possibility that managers will pursue value destroying strategies so as to boost near-term EVA and obtain higher bonuses.

If an annual measure is desired to complement NPV, then an alternative to EVA such as CFMAC (cash flow minus amortized capital) can be used. Capital is amortized in a way such that the yearly amounts are proportional to the cash inflows being generated. Thus, the CFMAC amounts each year are always consistent in sign with NPV and the underinvestment problem inherent with EVA is avoided. CFMAC numbers are also more difficult to manipulate than EVA and thus reduce the likelihood of managers attempting manipulations (to boost bonuses) that result in the adoption of suboptimal strategies.

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APPENDIX 1: PVN AND PVC OPERATORS

PVN is defined as a general present value operator for the series of NOPAT amounts received over the life of the project as follows:

$$PVN = \frac{1}{1+WACC} + \frac{1}{(1+WACC)^2} \bullet \frac{NOPAT_2}{NOPAT_1} + \frac{1}{(1+WACC)^3} \bullet \frac{NOPAT_3}{NOPAT_1} + ... + \frac{1}{(1+WACC)^n} \bullet \frac{NOPAT_n}{NOPAT_1}$$

$$= \sum_{t=1}^{n} \left[\frac{1}{(1+WACC)^t} \bullet \frac{NOPAT_t}{NOPAT_1} \right] \qquad \text{A1.1}$$

In the case where NOPAT grows at a constant rate, g, then PVN simplifies to the formula for the present value factor for a growing annuity as follows:

$$PVN = \frac{1}{WACC-g} \bullet \left[1 - \left(\frac{1+g}{1+WACC} \right)^n \right] \qquad \text{A1.2}$$

Multiplying PVN by $NOPAT_1$ gives the present value of the entire series of NOPAT amounts.

PVC is defined as a general present value operator for the series of Capital amounts over the life of the project as follows:

$$PVC = \frac{1}{1+WACC} + \frac{1}{(1+WACC)^2} \bullet \frac{Capital_2}{Capital_1} + \frac{1}{(1+WACC)^3} \bullet \frac{Capital_3}{Capital_1} + ... + \frac{1}{(1+WACC)^n} \bullet \frac{Capital_n}{Capital_1}$$

$$= \sum_{t=1}^{n} \left[\frac{1}{(1+WACC)^t} \bullet \frac{NOPAT_t}{NOPAT_1} \right] \qquad \text{A1.3}$$

In the case where Capital grows (or shrinks) at a constant rate, g, then PVC simplifies to the formula for the present value factor for a growing annuity as follows:

$$PVC = \frac{1}{WACC-g} \bullet \left[1 - \left(\frac{1+g}{1+WACC} \right)^n \right] \qquad \text{A1.4}$$

Multiplying PVC by (WACC x $Capital_1$) gives the present value of the entire series of capital charges.

<u>**NOTES**</u>