IAS15 inflation adjustments and EVA: Empirical evidence from a highly variable inflation regime

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Abstract

Inflation can have a pronounced effect on the financial performance of a firm. This study makes inflation adjustments to a firm's cost of sales, depreciation, level of gearing and assets in line with International Accounting Standard 15 (IAS15) in order to calculate an inflation-adjusted version of the economic value added (EVA) measure. The study was conducted using data from South African industrial firms during a period characterised by highly variable inflation levels (1991-2005). The results indicate that during this period there were significant differences between the nominal and real values of the firms' EVAs.

Keywords: financial performance under inflation, IAS15 inflation adjustments, nominal EVA values, real EVA values, South African industrial firms' EVAs

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1 Introduction

Value-based financial performance measures have been proposed as an improvement over traditional financial measures because value-based measures appear to overcome some of the limitations of traditional measures. Amongst other things, the inclusion of a firm's cost of capital in the calculation of the value-based measures facilitates the evaluation of value creation (Fabozzi & Grant, 2000:68). Furthermore, these measures aim to remove some of the accounting distortions that result from the use of accounting information (Young & O'Byrne, 2001:205).

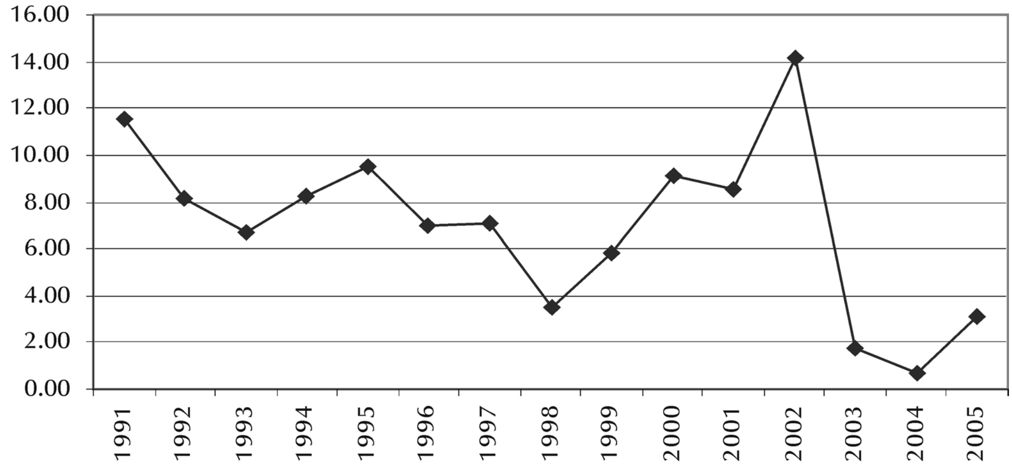
Economic Value Added (EVA) is one of the best-known of these value-based measures. This measure, which compares a firm's profit with the cost associated with the capital employed to generate that profit, has been proposed as a major improvement over the traditional measures. Its proponents report high levels of correlation between the measure and share returns (Stewart, 1991:66; Stewart, 1994:75, 136; Walbert, 1994:110; Grant, 1996:44; Grant, 2003:37; Bacidore, Boquist, Milbourne & Thakor, 1997: 17; Lehn & Makhija, 1996:36; O'Byrne, 1996:117; 1997:50; Worthington & West, 2004: 201).

During the last two decades, the South African economy has experienced a dramatic change in the local levels of inflation. During this period, inflation decreased from relatively high to substantially lower levels. The average annual levels of the Production Price Index (PPI) for the period from 1991 to 2005 are set out in Figure 1.

Figure 1 indicates that substantial fluctuations in the level of inflation occurred during this period. The PPI levels decreased from 11.5 percent to 3.5 percent between 1991 and 1998, but then increased from 3.5 percent to 14.2 percent from 1998 to 2002. During 2003, the PPI levels experienced a pronounced decrease. They remained at low levels during the last three years of the study (1.7 percent to 3.1 percent), from 2003 to 2005.

These changes in inflation could exert a pronounced effect on the financial performance of a South African firm. When the financial performance of a firm is evaluated, it is therefore essential to understand the influence of changing levels of inflation on the performance measures that are applied. Since inflation influences a firm's assets (such as property, plant and equipment and inventories), as well as its capital (debt capital and cost of capital), the level of inflation could have an impact on a firm's EVA.

Figure 1
Average annual PPI



Stewart (1991:227) does not consider inflation adjustments to the measure EVA to be important when inflation is low. Although absolute levels of EVA may be distorted by inflation, changes in EVA are normally calculated to evaluate a firm's financial performance. Stewart assumes that these EVA changes are not influenced by changes in inflation.

Black, Wright and Davies (2001:76) identify asset age and inflation as two of the factors that could result in a distortion of published financial statements. Since assets are indicated net of accumulated depreciation in the balance sheet, older assets have lower book values than newer additions. As a result of inflation, the replacement values of these assets are also higher than their initial cost prices. Black et al. (2001) argue that it is important to adjust asset values to represent current replacement values, rather than historical book values when one evaluates a firm's shareholder value creation. Failure to address these distortions result in higher levels of EVA, which would be greatly reduced if the assets were valued at their replacement values.

When depreciating assets are depreciated according to the straight-line method, over time, this usually results in increasing levels of EVA. These increases are not generated by more efficient use of the assets, but are the result of a lower capital charge, calculated on the assets' decreasing book values. Fabozzi and Grant (2000:164) refer to this as the "old plant trap". They also point out that inflation exacerbates the problem, since new assets added to the balance sheet are included at higher replacement values. This could have a negative effect on the growth of the firm, as management may postpone replacement and expansion in an attempt to maintain the lower asset values in the balance sheet (Fabozzi & Grant, 2000: 164).

The distorting effect of inflation on EVA has also been reported in a number of other studies. De Villiers (1997:285) investigated the effect of inflation on EVA and reported that the measure cannot be applied to estimate a firm's actual profitability during periods of inflation. An adjusted EVA measure was proposed where the capital base and the accounting return are adjusted for inflation (De Villiers, 1997:298).

Erasmus and Lambrechts (2006:14) developed a theoretical model, comparing the values of EVA in nominal and real terms calculated for a large number of different scenarios. They reported differences in the behaviour of the two measures under similar circumstances, concluding that EVA in nominal terms is not a suitable financial performance measure to use during periods of inflation.

Warr (2005:119) proposed inflation adjustments to depreciation, nominal debt, the book values of a firm's assets and its weighted average cost of capital (WACC) when EVA is being calculated. The results of his study indicate that inflation distorts the measure during periods of inflation significantly. Similar results were also obtained during periods of low inflation (Warr, 2005:120). His study also investigated the measure's sensitivity to inflation levels and changes in inflation; and he reported significant distortions (Warr, 2005:135).

The present study followed the same procedure as the one Warr (2005) used in order to investigate the effects of using International Accounting Standard 15 (IAS15) to undertake inflation adjustments to EVA. Inflation adjustments to the cost of sales, depreciation, assets and the level of financial gearing were calculated according to the IAS15 guidelines and were included in the calculation of an inflation-adjusted EVA value. This study was conducted for South African industrial firms during a period in which decreasing, increasing, and low levels of inflation were experienced, namely the period from 1991 to 2005. These changing levels of inflation provided this study with the ideal background against which to extend the study conducted by Warr and to investigate the possible influence of such inflation changes on EVA.

The results of the study reported in the current article indicate that there are statistically significant differences between the nominal and the real values of EVA for the full period under review, as well as the three inflation sub-periods. These results are similar to those reported by Warr (2005:120). When the differences between the nominal and the real values of the measure are investigated, it becomes clear that inflation plays a key role. It is also important to consider the firm's level of gearing, as well as its asset age and asset structure, since these firm-specific characteristics influence the extent of the inflation distortion. The results of the study reported in this article correspond to those reported by Warr (2005:135). If EVA is applied to evaluate and compare the financial performance of firms during periods of inflation, it is therefore important to bear in mind that firm-specific characteristics may influence the firms' EVA values.

If Stewart's (1991:227) assumptions are correct, changes in inflation should not have any effect on EVA changes. However, the results of the current study indicate that, during periods of low, decreasing inflation (when inflation levels dropped below four percent), the median nominal EVA values exceed the median real values. For all other periods, the opposite is observed, with the median real EVA values exceeding the median nominal values. These results appear to indicate that EVA changes are influenced by inflation changes under certain conditions. When analysts apply EVA as a financial performance measure in such circumstances, analysts should be aware that the changes in the EVA values are the result of the inflation changes, rather than of a change in the firm's performance.

2
The effect of inflation on EVA

EVA is calculated as the difference between operating profit and a capital charge based on the firm's cost of capital and the invested capital at the beginning of the period (Stewart, 1991:137):

$$EVA_{nom;t} = NOPAT_{nom;t} - (c^{*} \times IC_{nom;t-1}) \qquad (1)$$

where

$NOPAT_{nom;t}$ = the nominal net operating profit after tax for time period t;

c^{*} = the after-tax cost of capital; and

$IC_{nom;t-1}$ = the nominal invested capital at the beginning of the period.

All three components of EVA indicated in Equation 1 are influenced by inflation. In order to investigate the effect of inflation on the measure in this study, the nominal value of EVA (EVA_{nom}) was compared to an inflation-adjusted EVA value (EVA_{real}). To calculate EVA_{real} four inflation adjustments were made, in line with IAS15, namely a cost of sales adjustment, a depreciation adjustment, a gearing adjustment and an inflation adjustment to property, plant and equipment. These adjustments are discussed in detail below.

2.1 Cost of sales adjustment

The operating profit reflected in the income statement of a firm is conventionally stated in nominal terms and no adjustments are normally made to reflect the effect of changing prices. Inventory plays an important role in determining a firm's cost of sales, since the opening and closing inventory values are included in its calculation. However, inventory is influenced by inflation and a firm needs to make provision for the higher replacement value of inventory when calculating the cost of sales. Failure to do so could result in a decrease in capital. Consequently, it is necessary to include a cost of sales adjustment to the operating profit. IAS15 proposes the following formula for the adjustment:

$$COSAdj_t = Inv_{t-1} \times \left(\frac{Infl_{begin}}{Infl_{middle}} - 1\right) + Inv_t \times \left(1 - \frac{Infl_{middle}}{Infl_{end}}\right) \quad (2)$$

where

$COSAdj_t$ = the cost of sales adjustment for time period t;

Inv_t = the inventory; and

$Infl_n$ = a suitable inflation index, measured at the beginning, middle and end of the financial year.

This adjustment is subtracted from the operating profit, since it indicates the increase in the cost of sales required to make provision for the higher replacement value of the items sold.

2.2 Depreciation adjustment

The conventional depreciation amount included in the calculation of the net operating profit after tax (NOPAT) is based on the straight-line depreciation of the historic cost of assets included in the balance sheet. No provision is therefore made for the current replacement value of these assets. In order to calculate EVA_{real}, a depreciation adjustment based on the replacement value of the assets is calculated according to the approach advocated in IAS15. This adjustment is calculated by first estimating the average age of the property, plant and equipment (PPE), and then adjusting the depreciation by the change in inflation since the estimated acquisition date of the PPE:

Average age of PPE

$$= \frac{\text{Accumulated depreciation}}{\text{Depreciation for the current year}} \quad (3)$$

Based on the average age, the estimated acquisition date of the PPE is determined. By comparing the value of an inflation index on this date with its current value, the depreciation figure is adjusted as follows:

$$DeprAdj_t = Depreciation_t \times \left(\frac{Infl_{end}}{Infl_{acquisition}} - 1\right) \quad (4)$$

where

$DeprAdj_t$ = the depreciation adjustment;

$Depreciation_t$ = the depreciation for the current financial year; and

$Infl_{acquisition}$ = the inflation index on the estimated acquisition date.

The depreciation adjustment represents the additional depreciation that needs to be provided on the PPE and is subtracted from NOPAT during periods of inflation. If deflation occurs, the adjustment is added to NOPAT.

2.3 Gearing adjustment

The capital structures of most firms consist of a combination of equity and debt capital. When one considers the effect of inflation on the financial performance of a firm, it is important to focus on the different kinds of influence it exerts on these two types of financing. In the case of equity, the firm itself carries the inflation risk; and the firm needs to make provision for the higher replacement value of the capital in future. In the case of debt capital, however, the capital providers are exposed to the decreasing purchasing value of the debt capital.

IAS15 indicates that, when the inflation gearing adjustment is calculated, a distinction needs to be made between a net monetary asset situation, where the firm finances the majority of its capital, and a net monetary liability situation, where debt providers carry the bulk of the inflation risk. Monetary assets consist of cash and all items that will result in cash inflows. Monetary liabilities are all amounts payable in cash. Depending on the type of situation prevalent in the firm, the gearing adjustment could be calculated based on the following formulae:

Net monetary asset situation:

$$GearAdj_{asset;t} = NetMonAsset_t \times \left(\frac{Infl_{end}}{Infl_{begin}} - 1\right) \quad (5)$$

Net monetary liability situation:

$$GearAdj_{liab;t} = \left(\frac{NetMonLiab_t}{NetMonLiab_t + NonMonLiab_t + PPEAdj_t}\right) \times (COSAdj_t + DeprAdj_t) \quad (6)$$

where

$GearAdj_{asset;t}$ = gearing adjustment for net monetary asset situation;
$GearAdj_{liab;t}$ = gearing adjustment for net monetary liability situation;
$NetMonAsset_t$ = the net monetary assets;
$NetMonLiab_t$ = the net monetary liabilities;
$NonMonLiab_t$ = the non-monetary liabilities; and
$PPEAdj_t$ = inflation adjustment to PPE.

In the event of a net monetary asset situation, the operating profit needs to be reduced by the adjustment amount in order to make provision for the higher replacement value of the capital. In a net monetary liability situation, the operating profit is increased by the gearing adjustment amount to reflect the inflation risk absorbed by the debt capital providers.

2.4 Inflation adjustment to property, plant and equipment

The PPE value indicated in a balance sheet usually includes only the historical book value of the items. It does not represent the current replacement value of these items. When one is calculating the capital charge based on balance sheet values, no provision is made for the higher replacement value of the PPE. As a result, EVA may be overstated. IAS15 calls for the estimation of the current replacement value of the PPE and for its inclusion in the calculation of EVA_{real}:

$$PPEAdj_t = PPE_{nom;t} \times \left(\frac{Infl_{end}}{Infl_{acquisition}} - 1\right) \quad (7)$$

where

$PPEAdj_t$ = the inflation adjustment to the PPE; and
$PPE_{nom;t}$ = the nominal carrying value of the PPE.

2.5 Cost of capital

A firm's cost of capital is normally estimated by means of its weighted average cost of capital (WACC). This value is usually calculated in nominal terms. When calculating EVA_{real}, the WACC should therefore be adjusted to reflect the effect of inflation. The inflation-adjusted WACC is calculated as follows:

$$WACC_{real} = \left(\frac{1 + WACC_{nom}}{1 + Infl_{year}}\right) - 1 \quad (8)$$

where

$WACC_{real}$ = the real WACC;
$WACC_{nom}$ = the nominal WACC; and
$Infl_{year}$ = the change in the inflation index during the financial year.

3 Research method

3.1 Selection of the sample

During the period from 1991 to 2005, South African inflation values exhibited highly variable levels. Sharp decreases from 1991 to 1998 were followed by substantial increases for the period from 1999 to 2002. These levels were in turn trailed by relatively low levels of inflation from 2003 onwards. Conducting a study against this background made it possible to determine whether increasing and decreasing levels of inflation have the same effect on EVA. All firms listed in the Industrial Sector of the Johannesburg Securities Exchange (JSE) during this 15-year period were included in the sample. A total of 358 firms, providing a total of 3 070 complete observations, were included. In order to produce a more homogenous sample, firms listed in the Mining and Financial sectors were excluded from the study.

3.2 Calculation of the measures

The information required to calculate the measures investigated in this study was obtained from the McGregor BFA Database (2005). In the case of listed companies, annual EVA_{nom}, $WACC_{nom}$ and standardised financial statement values were downloaded from the database. No EVA_{nom} and $WACC_{nom}$ values were available for those companies that had delisted during the period under review. In order to reduce survivorship bias, these values were estimated by applying a similar approach to the one employed in the database. EVA_{nom} was calculated by applying the following formula:

$$EVA_{nom;t} = (NOPAT_t + AcctAdj_{op;t}) - [WACC_{nom} * (IC_{t\text{-}1} + AcctAdj_{c;t})] \quad (9)$$

where

$NOPAT_t$ = the net operating profit after tax for period t;
$WACC_{nom}$ = the firm's estimated nominal WACC;
$IC_{t\text{-}1}$ = the amount of capital invested in the firm at the beginning of the period;
$AcctAdj_{op;t}$ = adjustments to remove the accounting distortions from operating profit; and
$AcctAdj_{c;t}$ = adjustments to remove the accounting distortions from capital.

In this study, the inflation adjustments as recommended by IAS15 were calculated and included in the calculation of EVA_{real}. For the purpose of the inflation adjustments, the production price index (PPI) values were obtained from the Bureau for Economic Research (BER) (2005). PPI values were used for the inflation adjustments rather than the changes in the general GDP deflator applied by Warr (2005:126), because the PPI values reflect changes in the prices of the items used in the production processes of the industrial firms investigated in this study.

According to IAS15, three adjustments to NOPAT are required, as well as an adjustment to the book value of PPE. In order to calculate EVA_{real}, the following formula was applied:

$$EVA_{real;t} = NOPAT_{real;t} - (IC_{real;t\text{-}1} \times WACC_{real;t}) \quad (10)$$

$$= (NOPAT_{nom;t} - COSAdj_t - DeprAdj_t \pm GearAdj_t) - [(IC_{nom;t\text{-}1} + PPEAdj_t) \times WACC_{real;t}] \quad (11)$$

where

$EVA_{real;t}$ = EVA in real terms, calculated after the inflation adjustments to NOPAT and capital had been included;
$NOPAT_{real;t}$ = NOPAT after including the cost of sales, depreciation and gearing adjustments;
$WACC_{real;t}$ = the inflation-adjusted WACC; and
$IC_{real;t\text{-}1}$ = the invested capital after including the PPE inflation adjustment.

4
Empirical results

4.1 Descriptive statistics

The descriptive statistics of EVA_{nom}, EVA_{real} and their components are provided in Table 1.

Table 1
Descriptive statistics for the full period

Variable	Valid N	Mean	Median	Std.Dev.
$NOPAT_{nom}$	3 070	202 591	25 208	1 407 857
$NOPAT_{real}$	3 070	137 701	12 517	1 359 378
COSAdj	3 070	19 216	2 947	49 124
DeprAdj	3 070	46 180	4 888	185 091
GearAdj	3 070	505	293	83 112
IC_{nom}	3 070	1 432 786	217 026	3 966 782
IC_{real}	3 070	1 905 969	271 185	5 683 931
$WACC_{nom}$	3 070	13.86	13.90	5.64
$WACC_{real}$	3 070	6.41	6.62	5.99
EVA_{nom}	3 070	8 348	–2 215	1 238 557
EVA_{real}	3 070	8 921	–952	1 299 812
Inflation	3 070	7.10	7.59	3.75

$NOPAT_{nom}$ is the net operating profit after tax in nominal terms.

$NOPAT_{real}$ is the net operating profit adjusted for inflation by including the cost of sales, depreciation and gearing adjustments. The cost of sales, depreciation, and gearing adjustments were calculated according to accounting guideline IAS15. The cost of sales and depreciation adjustments were subtracted from the NOPAT to make provision for the higher replacement value of inventory and PPE respectively. The gearing adjustment was added to NOPAT in a net monetary liability situation, and subtracted in a net monetary asset situation.

IC_{nom} is the invested capital in nominal terms as used in the calculation of EVA.

IC_{real} is the invested capital in real terms, calculated by adding the PPE adjustment to the nominal invested capital.

$WACC_{nom}$ and $WACC_{real}$ are the WACC in nominal and real terms used to calculate EVA.

Inflation is the annual inflation, calculated as the change in the PPI over a firm's financial year.

The average inflation during the period under investigation was 7.1 percent. The inflation adjustments to NOPAT resulted in an average $NOPAT_{real}$ value that was lower than the average $NOPAT_{nom}$. The average IC_{real} was higher than the average IC_{nom}, while the average $WACC_{nom}$ was substantially higher than the average $WACC_{real}$. The average EVA_{real}, however, was only 6.86 percent higher than EVA_{nom}, indicating that the lower $NOPAT_{real}$ and higher IC_{real} values were offset by the lower $WACC_{real}$. On average, the inflation distortions resulted in lower EVA_{nom} values.

In order to investigate the effect of the changing inflation levels on the values of the measures, descriptive statistics for the three inflation sub-periods 1991 to 1998, 1999 to 2002, and 2003 to 2005 were also calculated. Similar patterns than for the full period data were observed in the case of NOPAT, IC and WACC. However, when the values of EVA_{nom} and EVA_{real} are compared, some differences become apparent. During the first and third inflation sub-periods, when inflation levels decreased, the average EVA_{real} value was lower than EVA_{nom}. During the second sub-period, when inflation levels increased, the average EVA_{real} was higher than the average EVA_{nom}. When the median values are considered, EVA_{real} was higher than EVA_{nom} during the first two inflation sub-periods and lower for the third sub-period.

4.2 Differences between EVA_{real} and EVA_{nom}

In order to determine whether inflation has a significant effect on EVA, the statistical significance of the difference between EVA_{real} and EVA_{nom} was investigated. The results from repeated measures analyses of variance are provided in Table 2.

Table 2

Parametric tests of differences between EVA_{nom} and EVA_{real}

	Full period	1991-1998	1999-2002	2003-2005
EVA_{real} minus EVA_{nom}	1.550	4.253**	18.777***	7.334***

Table 2 presents *F*-values from repeated measures analyses of variance. The first column contains the results for the full period. The other columns present the data for the three inflation sub-periods 1991-1998, 1999-2002, and 2003-2005.

*** Significant at the 1 percent level

** Significant at the 5 percent level

If the results for the full period are considered, the differences between EVA_{real} and EVA_{nom} were not statistically significant. To investigate the effect of changing levels of inflation, the tests were also conducted for all three inflation sub-periods. These results indicated that statistically significant differences existed between the nominal and real values of all the variables during all three sub-periods.

A closer examination of the data reveals the inclusion of a large number of outliers. Consequently, non-parametric test were also conducted to investigate the differences between the variables. The results of these tests are provided in Table 3.

Table 3

Non-parametric tests of differences between EVA_{nom} and EVA_{real}

	Full period	1991-1998	1999-2002	2003-2005
EVA_{real} minus EVA_{nom}	8.969***	3.550***	19.918***	12.513***

Table 3 presents the *Z*-values from Wilcoxon matched pairs tests. The first column contains the results for the full period. The other columns present the data for the three inflation sub-periods 1991-1998, 1999-2002, and 2003-2005.

*** Significant at the 1 percent level

The results from the non-parametric tests indicated that at the 1 percent significance level, EVA_{real} was significantly larger than EVA_{nom}.

One reason why EVA_{nom} is lower than EVA_{real} in times of high inflation is that WACC is adjusted based on the inflation factor for that year, and not the average expected inflation for the future. This could mean that $WACC_{real}$ would be too low for that specific year, explaining the difference between the two EVA values.

The correlations between the major components of EVA_{nom} and EVA_{real} are provided in Table 4.

Table 4

Correlations between components of EVA_{nom} and EVA_{real}

	$NOPAT_{nom}$	**$NOPAT_{real}$**	**COSAdj**	**DeprAdj**	**GearAdj**	**IC_{nom}**	**IC_{real}**	**EVA_{nom}**	**EVA_{real}**	**Inflation**	**$WACC_{nom}$**
$NOPAT_{real}$	0.9915***										
COSAdj	0.1981***	0.1115***									
DeprAdj	0.3302***	0.2197***	0.5155***								
GearAdj	0.1300***	0.1161***	0.2067***	0.5305***							
$Capital_{nom}$	0.4870***	0.3887***	0.5241***	0.8193***	0.2436***						
$Capital_{real}$	0.4500***	0.3429***	0.5386***	0.9088***	0.3281***	0.9720***					
EVA_{nom}	0.9308***	0.9580***	–0.0199	0.0625***	0.0296	0.1700***	0.1351***				
EVA_{real}	0.9021***	0.9371***	0.0040	–0.0204	0.0002	0.1452***	0.0807***	0.9748***			
Inflation	–0.0198	–0.0265	0.1837***	–0.0223	–0.0397	–0.0473***	–0.0371**	–0.0120	0.0327*		
$WACC_{nom}$	0.0033	0.0025	0.0822***	0.0098	0.0557***	–0.0191	–0.0051	–0.0625***	–0.0652***	0.1449***	
$WACC_{real}$	0.0155	0.0190	–0.0422**	0.0231	0.0741***	0.0139	0.0195	–0.0475***	–0.0775***	–0.4926***	0.7888***

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

The correlation between EVA_{nom} and EVA_{real} was high (0.9748). The correlations between EVA_{real} and the three inflation adjustments COSAdj, DeprAdj, and GearAdj were all low, and not statistically significant. The correlations between EVA_{real}, $NOPAT_{real}$, IC_{real} and $WACC_{real}$ were statistically significant at the 1 percent level, while the correlation between EVA_{real} and annual inflation was statistically significant at the 10 percent level.

The correlation between the annual inflation and COSAdj was statistically significant at the 1 percent level, but the correlation with DeprAdj and GearAdj was not significant. A possible explanation could be that DeprAdj is calculated by using the total inflation over the estimated asset age, rather than the annual inflation. GearAdj is calculated by considering the net monetary asset/liability position of the firm, and does not directly incorporate the annual inflation.

4.3 Regression analyses

4.3.1 Differences between EVA_{nom} and EVA_{real}

In order to investigate the differences between EVA_{nom} and EVA_{real}, the variables were standardised to size by dividing by the invested capital (IC) amount. The following variable, as defined by Warr (2005:129), was then calculated:

$$\text{EVADIFF} = \frac{\text{EVA}_{\text{real}}}{\text{IC}_{\text{real}}} - \frac{\text{EVA}_{\text{nom}}}{\text{IC}_{\text{nom}}} \tag{12}$$

$$= \left[\frac{\text{NOPAT}_{\text{real}} - (\text{WACC}_{\text{real}} \times \text{IC}_{\text{real}})}{\text{IC}_{\text{real}}}\right] - \left[\frac{\text{NOPAT}_{\text{nom}} - (\text{WACC}_{\text{nom}} \times \text{IC}_{\text{nom}})}{\text{IC}_{\text{nom}}}\right] \tag{13}$$

$$= \left[\left(\frac{\text{NOPAT}_{\text{real}}}{\text{IC}_{\text{real}}}\right) - \text{WACC}_{\text{real}}\right] - \left[\left(\frac{\text{NOPAT}_{\text{nom}}}{\text{IC}_{\text{nom}}}\right) - \text{WACC}_{\text{nom}}\right] \tag{14}$$

$$= (\text{ROIC}_{\text{real}} - \text{WACC}_{\text{real}}) - (\text{ROIC}_{\text{nom}} - \text{WACC}_{\text{nom}}) \tag{15}$$

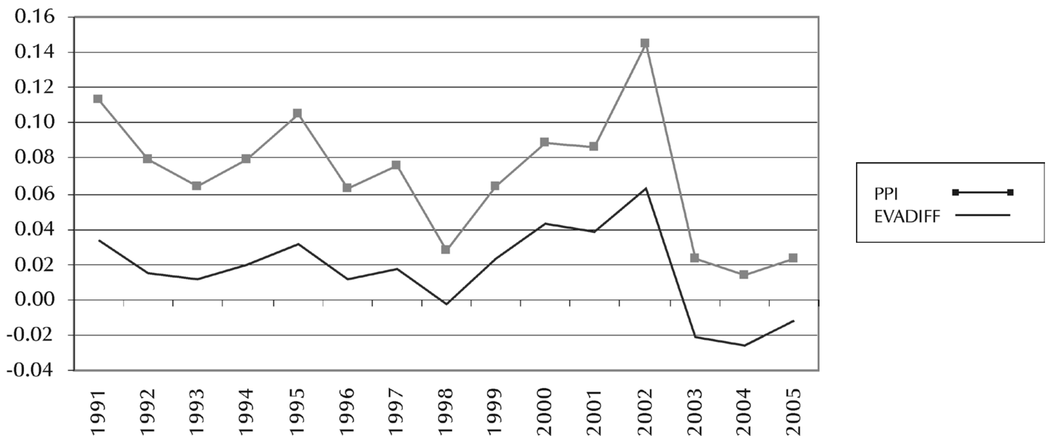
where:
$ROIC_{real}$ = the return on invested capital in real terms; and
$ROIC_{nom}$ = the return on invested capital in nominal terms.

The EVADIFF, therefore, measures the difference between the excess return earned on the invested capital above WACC (in real terms), and the excess return earned on the invested capital above WACC (in nominal terms).

Figure 2 contains the median EVADIFF and median PPI values for the period under investigation.

Figure 2

Median EVADIFF and PPI values for the period from 1991 to 2005



From the figure it is clear that EVADIFF was positive for most years. Negative values could only be observed for periods of decreasing inflation in which the inflation rate decreased to a level below four percent.

The correlations between the variables used in the regression analyses are provided in Table 5.

Table 5

Correlations between the variables used in the regression analyses

	EVADIFF	Inflation	NetMonLiab Ratio	PPE Ratio	NetMonLiab Ratio × Inflation	PPE Ratio × PastInfl	AssetAge
Inflation	0.1390***						
NetMonLiab-ratio	0.2685***	–0.0042					
PPE-ratio	0.2067***	–0.0182	0.5129***				
NetMonLiab Ratio x Inflation	0.2915***	0.0391**	0.8745***	0.4138***			
PPE Ratio x PastInfl	–0.0182	0.0367**	0.2099***	0.2119***	0.1459***		
AssetAge	–0.1193***	–0.0579***	–0.0048	0.0357**	0.0107	0.6005 ***	
PastInfl	–0.0677***	0.0367**	–0.0382**	–0.0114	–0.0152	0.6228 ***	0.7336 ***

EVADIFF = (EVA_{real}/IC_{real}) - (EVA_{nom}/IC_{nom}).

NetMonLiab-ratio quantifies the gearing effect, and is calculated as net monetary liabilities divided by the sum of net monetary liabilities, non-monetary liabilities and the PPE adjustment.

The PPE-ratio is the PPE divided by the invested capital.

AssetAge is the estimated average age of the PPE.

PastInfl is the change in the inflation index over the estimated asset age.

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Statistically significant correlations between EVADIFF and most of the variables included in the regression analyses are reported. The only exception is the variable PPE ratio × PastInfl, where the correlation was not significant.

Table 6 shows the results of the regression analyses of EVADIFF against inflation, leverage and asset structure. The purpose of these regression analyses was to determine the relationship between EVADIFF and firm-specific characteristics.

Table 6

Regression analyses of the difference between EVA_{real} and EVA_{nom} and inflation, level of gearing and asset structure

	Panel A: Full sample	
	Model 1	**Model 2**
Intercept	–0.0182 (–1.89)	0.0033 (0.35)
Inflation	0.6479*** (7.67)	0.5818*** (6.88)
NetMonLiab ratio	0.0491*** (10.93)	–
PPE ratio	0.0404*** (5.22)	–
NetMonLiab ratio × inflation	–	0.7803*** (16.68)
PPE ratio × past inflation	–	–0.0005 (–0.16)
Asset age	–0.0069*** (–5.83)	–0.0067*** (–5.40)
Past inflation	0.0022 (1.78)	0.0019 (1.44)
N	3070	3070
Adjusted R^2	0.1111	0.1137
	Panel B: 5 years + data	
	Model 1	**Model 2**
Intercept	0.0016 (0.57)	–0.0059** (–2.15)
Inflation	0.6158*** (24.76)	0.5920*** (23.71)
NetMonLiab ratio	0.0287*** (21.89)	–
PPE ratio	–0.0279*** (–12.24)	–
NetMonLiab ratio × inflation	–	0.2797*** (20.16)
PPE ratio × past inflation	–	0.0036*** (3.73)
Asset age	–0.0044*** (–12.61)	–0.0051*** (–14.02)
Past inflation	0.0002 (0.47)	–0.0002 (–0.49)
N	2885	2885
Adjusted R^2	0.3450	0.3423

The dependent variable was EVADIFF = $(EVA_{real}/IC_{real}) - (EVA_{nom}/IC_{nom})$.

NetMonLiab-ratio quantifies the gearing effect, and was calculated as net monetary liabilities divided by the sum of net monetary liabilities, non-monetary liabilities and the PPE adjustment.

The PPE-ratio is the PPE divided by the invested capital.

AssetAge is the estimated average age of the PPE. PastInfl is the change in the inflation index over the estimated asset age.

Panel A contains the results for all the observations in the sample.

Panel B includes only firms providing at least five years' data.

** Significant at the 5% level

*** Significant at the 1% level

Panel A of Table 6 contains the results for all observations. In Model 1, the relationship between EVADIFF and the inflation rate, level of gearing and asset structure is investigated. The annual inflation exhibited a statistically significant positive relationship with EVADIFF. This implies that increasing levels of inflation result in larger differences between the two measures. The PPE ratio and the NetMonLiab ratio were both positively related to EVADIFF. This could be seen as an indication that the level of gearing, as well as the asset structure of the firm, influenced the extent of the inflation distortion to EVA_{nom}. The estimated asset age was negatively related to EVADIFF. This result was expected, since a lower asset age should result in lower depreciation and PPE adjustments, reducing the difference between the two measures. The regression coefficient of the past inflation was positive and not significant, indicating that changes in inflation over the estimated asset age do not contribute significantly to EVADIFF.

In order to investigate the combined effect of inflation and the firm characteristics included in Model 1, Model 2 combined the NetMonLiab ratio with the annual inflation, and the PPE ratio with past inflation. The regression coefficient of the variable (NetMonLiab ratio × Inflation) was both positive and significant. The inclusion of this variable also resulted in a decrease in the coefficient of the inflation variable. The coefficient of the variable (PPE ratio × Past inflation) was negative, but not significant. This could possibly be ascribed to the high levels of variation in past inflation during the period investigated.

In Panel B of Table 6 the same regression analyses are repeated. However, only those firms that provided at least five years' data were included in the analyses. This ensures that all firms that only existed for a short period of time are removed from the sample. Usually these would include those firms that experienced financial difficulty and those that exhibited unstable financial results.

The results obtained were similar in most cases to those in Panel A, but it is important to note that the adjusted R^2 values for Panel B increased from those observed in Panel A. Only two major differences were observed. The regression coefficient of the PPE ratio in Model 1 changed from positive to negative, while the combined effect of PPE and the past inflation investigated in Model 2 changed from a non-significant negative coefficient to a significant positive one.

4.3.2 Changes in EVA_{nom} and EVA_{real}

In most cases, changes in the level of EVA, rather than the absolute annual values, are used to evaluate a firm's financial performance (O'Byrne, 1996:117; 1997:50). Based on these changes in the value of the measure, management and employees could be evaluated and rewarded accordingly. Table 7 contains the results from the regression analyses conducted in order to investigate the sensitivity of changes in EVA_{nom} and EVA_{real} to changes in inflation.

Table 7

Regression analyses of change in EVAreal and EVAnom, and changes in inflation

	Change in EVA_{nom}	**Change in EVA_{real}**
	Full sample	**Full sample**
Intercept	5815*** (4.00)	6139 (1.13)
Change in inflation	–149644*** (–4.94)	1967629*** (17.31)
N	2691	2691
R^2	0.9985	0.9800

The dependent variables are the change in EVA_{nom} and the change in EVA_{real}. The change in EVA_{nom} was calculated as $EVA_{nom;t} - EVA_{nom;t-1}$. The change in EVA_{real} was calculated as $EVA_{real;t} - EVA_{real;t-1}$.
The change in inflation is $inflation_t - inflation_{t-1}$.
t-stats are in parenthesis
*** Significant at the 1% level

If changes in EVA_{nom} are considered, it can be seen that changes in inflation played an important role with a highly significant regression coefficient of –149644. Increased inflation, therefore, would result in decreases in EVA_{nom}. In the case of changes in EVA_{real}, a large, positive regression coefficient was observed for the change in inflation. One possible explanation for this could be that during periods of increasing inflation, leveraged firms generate an inflation gain on their debt capital (Warr, 2005:135). This gain is not taxed, and results in increased levels of EVA_{real} for leveraged firms.

The same regression analyses were also conducted for the three inflation sub-periods. Similar results were obtained.

5 Summary and conclusions

While proponents of the measure EVA argue that changes in the measure are not influenced by inflation rate fluctuations, a number of studies have nevertheless cautioned against the possible distorting effects that inflation could have on the value of the measure. This study investigated the effects of inflation changes on EVA during a period of highly variable inflation rates. This was achieved by calculating an inflation-adjusted version of the measure and comparing it to its nominal value.

The study revealed statistically significant differences between the nominal and real values of the measure during periods of increasing, decreasing and low levels of inflation. When the differences between the nominal and real values of the measure were investigated, it became clear that inflation played a key role. It is also important, however, to consider a firm's level of gearing as well as its asset structure and age, since these firm specific characteristics are likely to influence the extent of the inflation distortion. If the measure EVA is applied to evaluate and compare the financial performance of firms during periods of inflation it is, therefore, important to bear in mind that firm-specific characteristics may influence its value.

Based on the overall results, it would appear that the value of EVA_{nom} is lower than EVA_{real} during periods of inflation. Analysts applying the nominal version of the measure to evaluate a firm's financial performance therefore face the risk of underestimating its value. During periods of low decreasing inflation (inflation levels below four percent), however, the opposite was observed with median nominal EVA values exceeding the median real values. Applying EVA_{nom} under these circumstances would result in an overvaluation of the firm's financial performance.

When applying EVA as financial performance measure under these circumstances, analysts should be aware that the changes in the EVA values are the result of the inflation changes rather than a change in the firm's financial performance. These results are in direct contrast with Stewart's position that inflation changes do not influence EVA changes. Based on the findings of this study, it appears that by using the inflation-adjusted version of the measure this problem could be addressed.

In this study the inflation adjustments proposed by IAS15 were used to quantify the effect of inflation. The results of this study suggest that future research focusing on evaluating the information content of these adjustments is warranted.

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