RELATIVE   PRICE   CHANGES   AND   THEIR EFFECTS

ON   SECTORAL CONTRIBUTIONS   TO   NATIONAL   INCOME

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INTRODUCTION

Much attention is given to the relative performance of different sectors of an economy. The shares of manufacturing, mining, agriculture, etc., or exports in GDP are closely monitored for descriptive purposes and for determining economic strategies. The shares might be measured as a ratio calculated in money-of-the-day prices. However, more often than not, these shares are expressed in 'real terms'. The statistical procedure for measuring such shares is rather to deflate both sectoral output and 'national income output (GDP)' by their respective deflators, before calculating their ratio. In this paper, it is argued that the use of 'real sectoral ratio' can be highly misleading and should not be used for descriptive and policy purposes.

The paper is divided into three sections:

- In Section I, the problem is illustrated using cross country comparative data;

- in Section II, the source of the problem is demonstrated;

- in Section III, the discussion is generalised within the framework of the U.N. system of National Accounts; use is made of South African data to illustrate these issues.

SECTION I: OBSERVATION OF THE PROBLEM

As may be seen in Table 1, a comparison between export/GDP ratios in nominal and constant price terms reveals the following:

i)   the 'ratio' in constant prices deviates from that in nominal terms;

ii)   the more open the economy, the larger the differential between the two ratios; and

iii) the more homogeneous the country's exports, the larger such differences.

In Table 1, a comparison of export/GDP ratios is made for a selection of 9 countries. The selection of the countries, as well as the period of study, was determined by the availability of data. Saudi Arabia with export/GDP ratio of 65% is the most open, while the U.S. is the least open with a ratio of 6%. In terms of the degree of homogeneity of exports, Saudi Arabia also tops the list, with oil constituting 92% of exports. For the U.S., by contrast, the largest share of exports is provided by manufactures (9.3%).

Table 1 demonstrates some of the anomalies inherent in the mechanical use of national accounting statistics. For example, export/GDP ratios in constant terms exceed 100 in the case of Saudi Arabia and Venezuela! This is obviously erroneous as exports are a part of the GDP. For countries like Germany and the U.K. with well diversified exports, the ratio measured in constant price terms sometimes fall below the nominal ratio. It will be shown that differences in this ratio are attributable to changes in the relative prices of exports, i.e. to movements in the export deflator relative to that of the GDP deflator.

TABLE 1: DIFFERENTIAL BETWEEN EXPORT/IMPORT RATIO IN CURRENT PRICE TERMS (1980=100) IN SELECTED COUNTRIES 1968-1985

YEAR	SAUDI ARABIA			SOUTH AFRICA			GERMANY			VENEZUELA			UNITED KINGDOM		
	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL
1968	119.3	76.7	27.8	46.7	18.9	22.5	19.7	-2.8	27.4	122.4	95.0	20.5	21.0	0.6
1969	135.0	76.1	29.5	45.9	18.4	23.0	20.3	-2.7	27.1	121.6	96.5	21.6	22.5	0.9
1970	137.8	70.6	23.1	42.6	19.6	22.7	22.3	-0.5	23.7	108.4	84.7	22.5	23.6	1.1
1971	145.7	79.5	22.8	41.8	19.0	23.2	25.6	0.5	99.5	73.9	22.5	24.6	1.9
1972	135.7	63.4	26.9	44.4	17.9	23.5	25.5	1.0	80.7	65.4	21.4	23.8	2.4
1973	74.0	70.3	26.9	41.3	14.4	25.1	29.0	1.4	85.1	54.2	23.5	26.0	2.4
1974	142.5	26.9	41.3	28.8	8.5	27.6	44.4	-0.8	65.4	21.1	24.0	1.3
1975	99.3	68.5	28.8	36.4	7.8	26.4	33.3	-1.2	42.5	12.2	25.3	1.3
1976	82.0	15.0	37.1	36.4	8.4	27.9	30.4	0.7	42.0	11.6	25.5	0.3
1977	73.1	41.1	36.4	37.6	7.9	27.2	27.2	1.3	27.8	10.2	27.1	2.7
1978	68.4	58.0	29.2	40.7	5.9	26.8	28.3	1.5	24.8	11.4	26.0	2.5
1979	62.9	36.8	32.7	41.4	2.1	27.1	0.2	40.5	9.7	26.0	1.5
1980	60.3	34.3	31.5	40.8	0.0	28.6	0.0	35.6	0.0	27.4	1.0
1981	67.0	10.6	40.8	34.5	3.3	31.6	-0.7	31.6	-0.9	26.8	0.7
1982	70.8	0.0	34.9	3.1	31.7	-0.7	25.8	-0.3	27.5	-0.8
1983	67.6	7.5	34.9	5.8	31.5	-0.6	30.5	4.8	26.0	0.1
1984	52.9	4.6	35.8	2.0	31.4	-0.6	n/a	26.9	-1.0
1985	39.5	5.1	38.1	1.7	34.2	-1.2	n/a	28.1	-0.9

YEAR	CANADA			AUSTRALIA			JAPAN			UNITED STATES		
	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL	CURRENT	CONSTANT	DIFFERENTIAL
1968	21.8	27.6	5.8	13.9	14.7	0.7	10.4	8.2	-2.3	5.1	6.2	1.1
1969	22.1	28.6	6.5	14.6	15.6	1.0	11.0	8.6	-2.4	5.1	6.4	1.3
1970	23.2	30.4	7.2	15.2	17.3	2.1	9.1	6.9	-2.2	4.5	5.4	1.1
1971	22.1	29.6	7.5	14.6	17.4	2.8	10.2	8.1	-2.1	4.0	5.2	1.1
1972	22.1	30.2	8.1	15.4	17.2	1.8	11.2	9.1	-1.2	5.4	1.2
1973	23.6	30.8	7.3	15.6	15.2	-0.3	10.8	10.3	-0.3	5.5	7.0	1.0
1974	25.1	28.1	3.0	15.3	14.9	-0.4	14.5	12.4	-2.1	6.8	7.0	0.2
1975	23.1	25.8	2.7	15.3	16.6	1.3	13.7	12.5	-1.4	6.8	6.9	0.1
1976	22.6	27.1	4.4	15.3	17.2	1.9	13.9	13.9	-0.4	6.2	6.3	0.2
1977	23.8	28.2	4.4	15.6	17.2	1.6	14.1	14.1	0.5	6.5	0.3
1978	25.6	29.7	4.1	16.8	18.8	2.0	15.0	15.4	0.5	6.5	6.9	0.4
1979	27.6	29.0	1.4	17.9	17.9	0.4	12.6	12.6	1.6	7.4	7.6	0.2
1980	28.6	28.6	0.0	16.6	16.2	0.4	14.9	14.9	6.9	8.2	7.8	0.0
1981	27.6	28.7	1.2	16.4	16.5	2.2	16.0	16.0	6.8	7.8	7.8	0.0
1982	27.6	29.4	5.4	15.1	16.5	2.3	16.5	16.5	6.8	7.1	0.5
1983	26.0	29.4	3.4	14.7	17.0	3.6	16.3	17.9	6.9	6.4	0.4
1984	29.0	35.4	6.5	15.2	18.8	3.6	16.5	17.9	5.8	6.4	0.7
1985	28.8	35.5	6.8	16.8	19.6	2.8	16.5	17.8	5.4	6.3	0.9

3.

SECTION II: THE EFFECTS OF CHANGES IN RELATIVE PRICES

Some simple calculations will demonstrate why changes in relative prices affect relative shares; for example, the relative share of exports.

Relative shares in real terms are defined as

$$\frac{X_r}{Y_r} = \frac{X_n}{Y_n} \cdot \frac{P_y}{P_x} \qquad (1)$$

where:

Y_n = nominal income (GDP)

X_n = nominal export value (income)

Y_r = real income (GDP)

X_r = real export value (income)

P_y = income (GDP) deflator

P_x = export price deflator

Thus if P_d is the domestic price deflator and if α is the proportional weight of 'export price index' in the GDP deflator then $(0 < \alpha < 1)$

$$P_y = \alpha P_x + (1 - \alpha) P_d \qquad (2)$$

then it follows that

$$\frac{X_r}{Y_r} = \frac{X_n}{Y_n} \cdot \left(\alpha + \frac{(1-\alpha)P_d}{P_x} \right) \qquad (3)$$

This equation can be applied in three cases:

Case 1: If the country were a one-product exporting country, then, $P_y = P_x$ and from Equation (1), it would follow that:

$$\frac{X_r}{Y_r} = \frac{X_n}{Y_n} \qquad (4)$$

In this case, ratios in constant and current prices would be identical.

Case 2: If domestic (GDP) prices rose faster than export prices, i.e. if $P_d > P_x$ from Equation (3) it would follow that

$$\frac{X_r}{Y_r} > \frac{X_n}{Y_n} \qquad (5)$$

Thus counter to economic intuition, the more export prices lag behind prices in general, the larger will become the exports share if both exports and GDP are measured in constant prices.

Case 3: If export prices rise faster than other domestic prices, i.e. $P_x > P_d$ then from Equation (3) it would follow that

$$\frac{X_r}{Y_r} < \frac{X_n}{Y_n} \qquad (6)$$

In other words, applying the standard statistical transformation for constant price terms results in a decline in the relative share of exports.

Thus it may be seen that differences in the movement of domestic and export prices account fully for differences in the measured ratios. Such results that follow mechanically from statistical procedures should surely not be allowed to confuse judgments of sectoral performance over time.

The 'Base Year' and Sectoral Shares of GDP

In addition to (export) commodity price fluctuation, the divergence between the ratios in Table 1 will also be affected by the choice of the base year used for export and GDP deflators. Theoretically, the impact of a change in the 'base year' on the ratio of any given sector, i.e. exports over GDP, is measured as follows:

By definition:

$$\left(\frac{X}{Y}\right)^i / \left(\frac{X}{Y}\right)^j = \frac{P_y^i \cdot P_x^j}{P_y^j \cdot P_x^i} \qquad (7)$$

where: $(X/Y)^i$ = Export/GDP ratio with base year (i)

$(X/Y)^j$ = Export/GDP ratio with base year (j)

P_x^i = Export deflator with base year (i)

P_x^j = Export deflator with base year (j)

P_y^i = GDP deflator with base year (i)

P_y^j = GDP deflator with base year (j)

Thus every change in the base year results in a once and for all shift of the trend equivalent to $\dfrac{P_y^i \cdot P_x^j}{P_y^j \cdot P_x^i}$. This, what has been described as the coefficient of adjustment, has been calculated for seven countries after a shift from 1975 to 1980 as the base year, as follows:

COEFFICIENT OF ADJUSTMENT IN EXPORT/GDP RATIO CAUSED BY A CHANGE
  OF THE BASE YEAR FROM 1975 TO 1980   (SELECTED COUNTRIES)

YEARS	AUSTRALIA	CANADA	GERMANY	JAPAN	S.A.	U.K.	U.S.
1968-85	0.92	0.89	1.05	1.11	0.79	1.01	0.98

The magnitude of $\dfrac{P_y^i \cdot P_x^j}{P_y^j \cdot P_x^i}$ depends, inter alia, on the magnitude of the export price deflator P_x. This influence is particularly important for countries with homogeneous exports. For example, in the case of Saudi Arabia the price of oil would be critical for South Africa it is the price of gold, and so on. Where exports are heterogenous, it is possible that relative price changes cancel out and the net effect may not be as pronounced. However, for exporters of primary products, wide fluctuations in export prices render the export/GDP ratio, in real terms, totally unreliable as a measure of economic

performance.   It   should   be recognised that the   ratio   of   the

nominal   values of export and GDP is affected by foreign exchange

fluctuations.   Thus   changes in this ratio may   not   necessarily

reflect real economic forces.

A very good example of such effects is provided by the South

African economy.   Substantial rises and fluctuations in the price

of gold in the 1970's and 80's have meant that a change of the

base year from 1975 to 1980, changes the 'real export/GDP ratio'

from 32,8% to 41,8% in 1971.   Similar variations occur in Saudi

Arabia and Venezuela.   The degree of openness and the homogeneity

of exports are again the two pivotal variables in this regard, as

is illustrated in Table 2:

TABLE 2: EXPORT/GDP RATIOS IN 1975 AND 1980 PRICES;
SELECTED COUNTRIES 1968 - 1985

YEAR	AUSTRALIA		CANADA		GERMANY		JAPAN		SAUDI ARABIA		SOUTH AFRICA		UNITED KINGDOM		UNITED STATES		VENEZUELA	
	1975	1980	1975	1980	1975	1980	1975	1980	1975	1980	1975	1980	1975	1980	1975	1980	1975	1980
1968	13,5	14,7	24,7	27,6	20,7	19,7	9,1	8,2	90,1	135,3	36,6	46,7	21,2	21,0	6,1	6,2	89,5	122
1969	14,4	15,6	25,6	28,6	21,3	20,3	9,5	8,6	88,6	133,0	34,5	43,9	22,8	22,5	6,3	6,4	88,9	121
1970	16,0	17,3	27,2	30,4	23,4	22,3	10,1	9,1	91,7	137,8	33,5	42,6	23,9	23,6	5,3	5,4	79,2	108
1971	16,1	17,4	26,5	29,6	24,3	23,2	11,4	10,2	97,0	145,7	32,8	41,8	24,7	24,4	5,1	5,2	72,7	99
1972	15,9	17,2	27,0	30,2	24,7	23,5	11,2	10,1	102,4	153,7	34,9	44,4	24,1	23,8	5,3	5,4	65,0	88
1973	14,1	15,2	27,6	30,8	26,3	25,1	11,4	10,3	94,9	142,5	32,4	41,3	24,9	24,6	6,2	6,3	60,8	83
1974	13,8	14,9	25,2	28,1	28,9	27,6	13,8	12,4	66,1	99,3	29,2	37,1	26,5	26,2	6,8	7,0	47,8	65
1975	15,3	16,6	23,1	25,8	26,4	25,2	13,7	12,3	82,0	123,1	28,6	36,4	25,6	25,3	6,8	7,0	33,3	45
1976	15,9	17,2	24,2	27,1	29,2	27,9	15,4	13,9	74,0	111,1	29,5	37,6	26,7	26,3	6,7	6,8	30,7	42
1977	15,8	17,2	25,2	28,2	29,2	27,9	15,7	14,1	70,1	105,3	31,9	40,7	27,4	27,1	6,4	6,5	30,7	42
1978	15,5	16,8	26,5	29,7	29,8	28,4	14,9	13,4	64,7	97,2	32,5	41,4	26,3	26,0	6,8	6,9	27,9	38
1979	16,5	17,9	26,0	29,0	29,7	28,3	15,0	13,5	47,2	70,9	32,0	40,8	27,1	26,7	7,4	7,6	26,5	36
1980	16,2	17,5	25,6	28,6	30,0	28,6	16,5	14,9	44,6	67,0	30,1	38,3	27,8	27,4	8,1	8,2	29,6	40
1981	15,3	16,6	25,7	28,7	32,1	30,6	18,1	16,3	52,1	78,2	27,1	34,5	27,8	27,5	7,7	7,8	24,6	33
1982	16,0	17,4	26,2	29,4	33,3	31,7	17,8	16,0	48,1	72,2	27,4	34,9	27,6	27,3	7,0	7,1	22,3	30
1983	15,7	17,0	22,4	30,7	33,0	31,4	18,0	16,3	38,6	57,9	26,5	33,8	27,2	26,9	6,2	6,4	18,6	25
1984	17,3	18,8	31,7	35,4	34,7	33,1	19,9	17,9	30,4	45,6	27,3	34,8	28,4	28,1	6,4	6,5	22,1	30
1985	18,1	19,6	31,8	35,5	35,9	34,2	19,8	17,8	25,8	38,7	29,9	38,1	29,0	28,6	6,1	6,3	n/a	n/a

Source: International Financial Statistics Yearbook 1986; IMF

SECTION 111:   WHY RELATIVE PRICES MATTER?

Relative price changes of course have 'real effects' on the economy because they influence the allocation of productive resources.   For example, an increase in the relative prices of exports would normally be expected to result in the expansion of the export-orientated sectors.   This would lead to a rise in the nominal export/GDP ratio.   In other words, following economic theory the differential between the real and nominal sectoral ratio should be related to the ratio between the 'export deflator' and 'GDP deflator'.   Using least square regression for 9 countries, the following has been tested:

$$\text{Log(Export/GDP)} = \alpha + \beta \cdot \log \left(\frac{\text{export deflator}}{\text{GDP deflator}} \right) \qquad (8)$$

where the ratios are calculated in both nominal and constant price terms.   The results are summarised in Tables 3:

TABLE 3:   CORRELATION BETWEEN EXPORT/GDP RATIO IN NOMINAL TERMS, IN REAL TERMS (1980=100) AND RELATIVE EXPORT PRICES FOR SELECTED COUNTRIES

PERIOD	AVERAGE X/GDP RATIO 1960-1985	SHARE OF LARGEST EXPORT 1970-1983	NAME OF COUNTRY	NOMINAL EXPORT/GDP RATIO			REAL EXPORT/GDP RATIO		
				ADJUSTED R^2	β COEFFICIENT (T-STAT)	DURBIN WATSON STAT	ADJUSTED R^2	β' COEFFICIENT (T-STAT)	DURBIN WATSON STAT
1970-1985	63.38*	1970-1982 92.23	Saudi Arabia	0.11	0.27 (1.70)	0.77	0.57	-0.73 (-4.57)	0.77
1961-1985	29.99	1970-1985 40.34	South Africa	0.66	1.09 (6.95)	1.35	-0.03	0.09 (0.57)	1.35
1961/1985	24.97	13.98	Germany	0.30	0.78 (3.33)	2.53	-0.01	-0.22 (-0.92)	2.53
1961-1983	29.84	1970-1981 62.43	Venezuela	0.56	0.67 (5.34)	2.16	0.21	-0.33 (-2.62)	2.16
1961-1985	23.74	7.94	U.K.	0.76	1.39 (8.73)	1.54	0.18	0.39 (2.47)	1.54
1961-1985	23.08	19.08	Canada	0.91	0.47 (2.59)	1.94	0.24	-0.53 (-2.92)	1.94
1961-1985	15.40	11.58	Australia	0.23	0.54 (1.82)	2.14	0.16	-0.46 (-2.38)	2.14
1961-1985	12.56	17.48	Japan	0.60	1.30 (6.04)	2.42	0.04	0.30 (1.39)	2.42
1961-1985	5.69	9.33	U.S.A.	0.62	1.94 (6.28)	1.96	0.25	0.99 (3.03)	1.96

* All data from 1960-1985, except Saudi Arabia 1963-1985.

A comparison between the results, using nominal and constant prices, shows that:

i) In all but one case, i.e. Saudi Arabia's, the measure of correlation (i.e. R^2 between 'export/GDP ratio' and relative export prices is more satisfactory when the ratio is calculated in nominal terms; and

ii) the sign, the value of coefficients and their significance, as measured by 'T.Stat' in parenthesis, are more acceptable when nominal ratios are used. This is true even in the case of the U.S. which is the least open economy in the sample under study.

β and β' are elasticities of supply and ~~the sum of~~ β ~~and~~ β' must equal unity:

$$X/Y = e^{\alpha} \left(\frac{P_x}{P_y} \right)^{\beta} \tag{9}$$

$$X'/Y' = e^{\alpha'} \left(\frac{P_x}{P_y} \right)^{\beta'} \tag{10}$$

where:

$X' = X/P_x$ and $Y' = Y/P_y$

Thus:

$$X'/Y' = \frac{X}{Y} \cdot \frac{P_y}{P_x} \tag{11}$$

Given $\alpha = \alpha'$ by substituting for X'/Y' and X/Y their equivalents in (9) and (10), equation (11) can be written:

$$\left(\frac{P_x}{P_y} \right)^{\beta'} = \left(\frac{P_x}{P_y} \right)^{\beta-1} \tag{12}$$

Thus: $\beta = \beta' = 1$ and Therefore movement in the two elasticities should be in the same duration

Clearly, the values of the coefficients using nominal price ratios accords much better with economic theory. It has been

shown that the measured percentage share of a sector; e.g. mining, will vary depending on whether the ratio is calculated in current or constant prices, and that such shares also depend on the choice of the base year. In Table 4, the percentage share of mining/GDP in South Africa is calculated in nominal as well as in constant prices, using three different base years.

TABLE 4:

ESTIMATES OF MINING SHARE OF THE GDP IN NOMINAL AND CONSTANT PRICES WITH 1970, 1975 AND 1985 AS BASE YEARS (1968-1985)

YEAR	CURRENT	1980=100	1975=100	1970=100
1968	11.43	37.03	19.20	10.56
1969	11.32	35.89	18.61	10.24
1970	10.10	35:42	18.37	10.10
1971	8.78	32.67	16.94	9.32
1972	10.07	30.10	15.61	8.59
1973	12.02	28.69	14.88	8.18
1974	13.29	25.12	13.03	7.16
1975	12.31	23.74	12.31	6.77
1976	12.04	23.65	12.26	6.74
1977	12.99	24.53	12.72	7.00
1978	15.05	24.04	12.47	6.86
1979	17.94	23.75	12.32	6.77
1980	21.96	21.96	11.39	6.26
1981	15.82	20.74	10.75	5.91
1982	14.16	20.81	10.79	5.94
1983	14.60	21.37	11.08	6.10
1984	13.44	20.86	10.81	5.95
1985	16.12	21.08	10.93	6.01

Source: S.A. Reserve Bank Quarterly Review (Various Issues)

It will be apparent that any change in the percentage share of any sector, e.g. mining, in the GDP will change the proportional share of all other sectors as well; although not equally. Thus it might be concluded from calculations made with 1970 as the base year that the share of the mining sector in the South African economy was relatively low and that of the

manufacturing sector fairly substantial. A mere change of the base year to 1980, increases the share of mining, reduces the share of manufacturing and leads to an opposite conclusion that the economy is not highly industrialised. Such, after all, are the inherent pitfalls with the U.N. System of National Accounts (SNA), if applied universally. The SNA is clearly best suited for a closed economy with relative price stability. If either of the two assumptions does not hold, the SNA measures in real terms lose their accuracy, in proportion to the degree of openness and relative price changes.

Relative Prices and Policy Response

Substantial relative price fluctuations, especially in the case of (exported) exhaustable resources, may also lead to government policies favouring conservation in order to prolong the life of the known stock of the resource. This has meant that as the price rises the taxation or regulation structure could compel or encourage the industry to extract less of the resource over any shorter time period, so extending the life of the industry. This influence, coupled with the use of the conventional Laspeyres-type deflators, can also produce curious measures of real GDP.

The response of the South African gold mining industry to the increase in the price of gold in the '70's was to crush more gold bearing ore, which, on average, contained a declining proportion of gold. The industry spent considerably more on capital and labour and became much more profitable doing so. The performance of the gold mining industry in the period 1970-1985 is summarised in Table 5 below:

TABLE 5: SELECTED FEATURES OF THE GOLD MINING INDUSTRY IN THE PERIOD 1970-1985

YEAR	GOLD PRICE US $ PER OZ	GRADE (GRAMS PER TON	ORE MILLED METRIC TONS ('000)	FINE GOLD OUTPUT (Kg)	CAPITAL EXP. (Rm)	WORKING PROFIT PER TON (R)	TOTAL EMPLOY-MENT
1970	35.95	13.28	74 467	1 000 417	N/A	3.90	416 846
1971	40.80	3.11	73 615	976 297	N/A	4.48	416 785
1972	58.13	2.48	72 046	909 631	N/A	7.46	405 102
1973	97.20	1.22	75 154	855 179	106	13.42	422 635
1974	159.14	0.03	74 884	758 559	196	21.52	396 084
1975	161.06	9.42	74 409	713 447	290	17.74	370 595
1976	124.80	9.21	76 242	713 390	375	12.23	395 007
1977	147.72	9.22	74 540	699 887	430	16.09	417 045
1978	193.38	8.85	78 157	704 449	448	25.57	434 422
1979	307.14	8.19	83 529	703 473	689	41.90	450 702
1980	612.76	7.28	89 915	672 875	922	85.03	469 257
1981	459.89	6.92	91 860	655 755	1 222	53.71	478 938
1982	375.89	6.76	94 996	662 626	1 256	45.45	475 769
1983	423.68	6.55	99 910	677 876	1 408	51.37	487 761
1984	362.05	6.44	101 128	679 952	1 645	53.09	498 421
1985	317.32	6.09	104 562	669 486	1 911	70.46	513 832

Source: Annual Reports of Chamber of Mines of South Africa, 1970 to 1983.

As may be seen in Table 5, some 74 million tons of gold bearing ore were crushed in 1970, containing an average gold content of 13,3 grams of gold per metric ton. The output of gold was thus just over 1 000 tons. In 1985, more than 100 million tons of ore was crushed, but with an average gold content of about 6,09 grams per ton. Thus the production of gold in 1985 was only 67% of its 1970 level. It is then clear that when the Laspeyres Price Index is applied to deflate the nominal values it would tend to inflate the mining share for the sub-periods with low gold price and high gold output. This would imply that the sector has become less significant economically as the price of gold rose remarkably. Clearly this is not the case. What this statistical procedure fails to take into account was the substantial rise in the purchasing power of any given amount of pure gold exported over the period.

The conventional measurement of the GDP in constant price terms does not take account of such terms of trade effects, it would be preferable to use real GNP to measure economic performance in such cases. GNP measures however would not completely overcome the problem. This is because while the GNP in constant price terms would incorporate the terms of trade effect,[1] it would not address the 'output issue' inherent in the application of Laspeyres-type indices. By taking account of real relative changes of exports, the GNP in real terms is a better indicator of economic performance than the real GDP, and is particularly so for open economies exporting primary products. Once again, using the South African data, the average economic growth rate over the 1969-1985 period was 2,92% per annum, as measured by the GDP in constant prices, whereas the rate of growth of the GNP in constant price terms over the same period was 3,35% per annum. Moreover, the annual growth rate of the GNP was more closely correlated to the movements in the price of gold, a commodity that constituted more than 40% of the country's nominal export earnings over the period. To establish that the differential between the growth rates of GDP and GNP in real terms were indeed caused by the fluctuations in the price of gold, we have estimated an 'Adjusted Real GDP' by deflating the mining sectors' contribution to the GDP by an 'index of import prices'. It should be understood also that a high proportion of mining output in South Africa is exported. A comparison of the respective growth rates in Table 6 below, shows that:

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1. The GNP deflator incorporates changes in the terms of trade, hence the real GNP reflects these changes.

i) Firstly, average adjusted GDP growth is much higher; i.e. 3,85% per annum, as compared with the conventional (official) rate of 2,92% per annum.

ii) Secondly, these adjusted growth rates are more closely correlated with the growth rates of the GNP in constant prices over the period.

TABLE 6: PERCENTAGE GROWTH RATES OF GDP; GNP AND ADJUSTED GDP
IN CONSTANT PRICE TERMS (1980=100)
SOUTH AFRICA 1969 - 1985

Year	GDP	Adjusted GDP	GNP
1969	5,92	7,55	5,44
1970	5,07	4,07	3,87
1971	5,23	6,54	6,29
1972	2,17	6,00	3,50
1973	3,39	9,79	9,46
1974	6,65	10,56	9,71
1975	2,38	0,44	-1,38
1976	1,66	-0,21	0,14
1977	0,13	-0,26	-0,87
1978	2,76	5,35	3,68
1979	3,36	5,81	5,56
1980	5,39	11,89	10,64
1981	4,43	-1,21	0,24
1982	-0,84	-3,65	-4,11
1983	-2,45	-1,53	-0,70
1984	4,98	4,39	5,18
1985	-0,61	0,18	0,31

Source: South African Reserve Bank Quarterly Bulletin
(various issues). Adjusted GDP our estimates.

CONCLUSIONS AND IMPLICATIONS

The implications of this paper are:

i) to find the _true_ share of export (or any sectoral income) of the GDP, the best measure is the ratio of their nominal values;

ii) economic inferences based on 'real' ratios of national accounting measures can be highly misleading;

iii) the use of a Laspeyres Price Index as deflator for various economic sectors could have misleading side effects in cases where price elasticity of production is negative;

iv) by excluding the terms of trade effect, GDP in real terms may not be the best measure of 'true domestic output (income)' for fairly open economies;

v) the change of the base year for measuring 'real' values for open economies with homogenous exports could generate huge distortions in aggregate national accounting ratios; especially if the export price has been subject to wide fluctuations.

PERIOD	AVERAGE X/GDP RATIO 1960-1985	SHARE OF LARGEST EXPORT 1970-1983	NAME OF COUNTRY	NOMINAL EXPORT/GDP RATIO			REAL EXPORT/GDP RATIO		
				ADJUSTED R^2	β COEFFICIENT (T-STAT)	DURBIN WATSON STAT	ADJUSTED R^2	β' COEFFICIENT (T-STAT)	DURBIN WATSON STAT
1970-1985	63.38*	1970-1982 92.23	Saudi Arabia	0.11	0.27 (1.70)	0.77	0.57	-0.73 (-4.57)	0.77
1961-1985	29.99	1970-1985 40.34	South Africa	0.66	1.09 (6.95)	1.35	-0.03	0.09 (0.57)	1.35
1961/1985	24.97	13.98	Germany	0.30	0.78 (3.33)	2.53	-0.01	-0.22 (-0.92)	2.53
1961-1983	29.84	1970-1981 62.43	Venezuela	0.56	0.67 (5.34)	2.16	0.21	-0.33 (-2.62)	2.16
1961-1985	23.74	7.94	U.K.	0.76	1.39 (8.73)	1.54	0.18	0.39 (2.47)	1.54
1961-1985	23.08	19.08	Canada	0.91	0.47 (2.59)	1.94	0.24	-0.53 (-2.92)	1.94
1961-1985	15.40	11.58	Australia	0.23	0.54 (1.82)	2.14	0.16	-0.46 (-2.38)	2.14
1961-1985	12.56	17.48	Japan	0.60	1.30 (6.04)	2.42	0.04	0.30 (1.39)	2.42
1961-1985	5.69	9.33	U.S.A.	0.62	1.94 (6.28)	1.96	0.25	0.99 (3.03)	1.96

* All data from 1960-1985, except Saudi Arabia 1963-1985.

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