

THE RHODESIAN JOURNAL OF ECONOMICS

The Quarterly Journal of the Rhodesian Economic Society

Editorial Board:

A. M. Hawkins (Editor), R. J. Davies, J. A. C. Girdlestone, A. F. Hunt,
D. I. Ramsay and M. L. Rule.

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VALUE ADDED AT CONSTANT PRICES

Estimates for Rhodesian Manufacturing Industries and some Observations

D. I. RAMSAY*

Economic analysis of an empirical nature requires reliable data to fit to the theoretical relationship between the variables under investigation. Absolutely correct statistics are rarely available, but official sources of economic statistics generally present a reasonably useful reference for the economist.

One such indicator is the volume index for manufacturing industries. Trends in the actual volume of the various outputs at constant prices are found useful for some economic studies. However, the volume index in several countries goes further than this. It is held to be an indicator of changes in value added or net output at constant factor cost. These factors are, broadly, the labour and capital inputs. The real value added by productive enterprise is significant information to the economist because from this data may be derived such concepts as value added per head and the respective shares of labour and capital — that is the funds at constant factor prices out of which come the rewards for the various productive factors, land, labour, plant and machinery, entrepreneurial enterprise, together with payments for capital consumption and taxation.

The concept of net output in the Census of Production usually differs from that of value added.¹ Here net output also includes payments for services rendered to firms such as repairs, maintenance, insurance and other commercial services. Generally these amounts are a relatively constant and minor proportion of total gross output. The analytic concept of net output however refers only to value added.

The volume index² for any industry is calculated from quantity relatives and 'weighted' by the respective net outputs of its productive sources. The index is then held to be an indicator of changes in net output. The significance of this will be examined in some detail later in this paper, but briefly it is sufficient here to state that the volume index will reflect movements in value

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¹ *Census of Production 1972/73*, page 3 (CSO, Salisbury 1974)

Census of Production, Provisional Results for 1970, page ii, (HMSO, London 1971)
National Accounts Statistics: Sources and Methods Studies in Official Statistics No. 13, page 77 (HMSO, London 1968)

² *Monthly Digest of Statistics, September 1974*. Explanatory Note to Table 31 (CSO, Salisbury)

added at constant prices provided that net output (or more precisely, value added) remains in the same proportion to gross output at constant prices.

It is evident that the Rhodesian economy has been necessarily exposed to some degree of structural change since UDI. In particular the manufacturing sector has not only received some stimulation through the need for import substitution but the mix of goods produced will have changed over time. Also to some extent a proportion of the capital and material inputs which were previously imported are now produced by the domestic sector. To the extent that such inputs are either unavailable or occasion an unacceptably high opportunity cost it is likely some factor substitution has taken place. Thus the assumption of constant factor proportions might be held questionable.

Thus briefly examined are some of the problems which prompt this investigation into the validity of the present volume index as an indicator of value added by Rhodesia's manufacturing industries.

VALUE ADDED AND GROSS OUTPUT

Value added in money terms or at current prices is by definition the sum of money wages, salaries and gross profits — the latter including depreciation expenditures but not stock appreciation. Thus value added plus the value of all material inputs, including purchases of fuel and power, payments for work given out and payments for services such as maintenance, advertising, rent, rates, insurances and bank charges, comprises gross output. The conventional Census of Production definition of net output is value added plus payments for services.³

The total of values added in each sector of the economy equals gross domestic product. The several industries which contribute to the manufacturing sector are collected together by industry groups. Firms and industries although classified within fairly homogeneous groups are not all of the same size in regard to their contributions to value added, net output or gross output. It is necessary only to sum each total to arrive at an aggregate. Analytically this simple procedure should be adequate for the other concepts of value added and net output and in current money terms there is no real problem except that of collecting more data.

An alternative measure which would give the same results is to 'weight' the individual firms, and then industries, by their relative significance by value of their respective output performance over a time period — say one year. Thus *changes* in the aggregate value of output one year with another will

³ See footnote 1

be determined by summing together the proportionate contributions of each firm or industry.

However, as in practice it is simple to calculate gross values from current data the 'weighting' method is not necessary for statistics at current prices. But for the more significant and useful data required at constant prices there are a number of problems that arise which require alternative indicators to the basic data outlined above for an appropriate solution.

To deflate gross output at current prices (1) to obtain a value at base year prices or constant prices, a current-weighted price index of the Paasche type (2) is required—

$$\frac{(1) \quad \Sigma P_1 q_1}{\Sigma P_0 q_0} \div \frac{(2) \quad \Sigma P_1 q_1}{\Sigma P_0 q_1} = \frac{(3) \quad \Sigma P_0 q_1}{\Sigma P_0 q_0}$$

The result is a quantity index at base prices (3). Rearranging the equation we have

$$\frac{\Sigma P_1 q_1}{\Sigma P_0 q_1} \times \frac{\Sigma P_0 q_1}{\Sigma P_0 q_0} = \frac{\Sigma P_1 q_1}{\Sigma P_0 q_0}$$

The significance of this is that there is consistency between the ratio of current to base year values and indices of the Paasche type (for prices) and Laspeyre type (for quantities).

Statisticians find it easier to calculate quantity rather than price indices for final outputs although technically the latter might be more reliable because prices have been generally less variable than quantities. However, recent inflationary experience may well upset this conventional preference.

In Rhodesia there is not a direct index of prices of final manufactured goods either by industry groups or in aggregate, but there is a volume or quantity index of the Laspeyre type.⁴ It can be seen easily that a price index (Paasche) could be derived even though its validity would be dependent upon the degree of accuracy represented by the volume index.

But we have arrived only at gross output at constant prices which is not the objective and indeed the volume index would give the required information itself. For a strict interpretation of real movement in gross output the volume index would require 'weighting' by gross values.

The emphasis in this section upon gross output is thought to be relevant because it is indicators of gross outputs which form the basis of calculation

⁴ *Monthly Digest* op.cit.

of values added at constant prices. The volume index somewhat adjusted by net output weights is currently used as an indicator for net output and value added. It needs to be emphasised that this index is calculated from data provided by firms giving information upon final quantities produced although alternative indicators are used when this is not possible.⁵ The resultant measure therefore relates to gross output which includes the contributions not only of value added but all the earlier stages of production. Thus to suggest that a change in net output is represented by this measure is often erroneous because a change in the real ratio of value added to gross output would render the index, as an indicator, inaccurate to that degree.

The reason why values added or net outputs are not measured directly at constant prices are examined below.

ALTERNATIVE METHODS OF CALCULATING VALUE ADDED

As there are three conventional methods of looking at gross domestic product or national income — i.e. the income, expenditure and output approaches — it would seem reasonable to apply these methods to value added at constant prices.

The Income Approach

This would require accurate deflators for wages, salaries and profits. The main problem here is that these factor incomes may only be deflated to the extent of actual expenditure out of income (savings is excluded and this presents further difficulties) which requires full details of the goods and services purchased by each set of factor incomes.

With ultimate aggregation for the whole economy total expenditure equals total factor income and thus the price index derived from total expenditure at constant prices would be a reasonable indicator by which to deflate total factor income. However, with disaggregation it cannot be assumed that an industry's factor incomes are either (a) spent in the same way as for the whole economy, or (b) spent on the goods produced by that industry — especially gross profits — and thus the derived price index for any particular industry's output should not be used to deflate its factor incomes.

The income approach is, therefore, rejected.

The Expenditure Approach

It might be possible to deflate wages and salaries by an index of wage and salary rates or labour costs (not available in Rhodesia) but "this does not take full account of changes in labour productivity".⁵ Also there is no

⁵ *ibid.*

satisfactory measure of expenditure with regard to gross profits unless all the directions of expenditure out of profits are known and suitable indicators exist. Profits are less homogeneous than wages from the expenditure side, but a break down might be estimated since detail is available for investment expenditure and its direction (e.g. buildings, plant, vehicles) and there are appropriate indicators. However, there are difficulties with the residual of gross profit which might render this approach somewhat unrealistic. "The only satisfactory revaluation of profit incomes is obtained by taking the difference between deflated gross output and deflated inputs including labour costs, which is not distinct from the output approach."⁶

The statistical difficulties which require to be resolved before either the income or expenditure approaches could give other than, at best, a very crude indicator of value added by industry or sector have led to the adoption of the output approach, in Rhodesia and elsewhere, as the most statistically realistic and relevant.

The Output Approach

This is generally regarded the most satisfactory approach. However, there are two methods by which real value-added or net output might be derived. "Conceptually net output should be estimated at constant prices by revaluing at constant prices both the gross output and inputs of materials, fuel, services and so on, and subtracting the latter from the former. This is known as 'double deflation'. In practice this method is difficult to apply because it requires a great deal of information. Unless full information on all transactions is available at frequent intervals the method can give unreliable results, as the output and input data must be consistent and relate to the same period. This applies especially if net output is small in relation to gross output"⁷ The reason for this final observation is because unreliable indicators for the major proportion of gross output will render the residual (value added) even more unreliable.

Thus the disadvantages of this otherwise fairly precise method of estimating real net output or value added as a residual are apparent. (In fact the method would never be perfectly precise because of the natural bias with the index number indicators used.⁸) The problems mentioned are more significant at this time in Rhodesia where the last published exercise on input-output data was in 1965. It would seem logical to dismiss the 'double deflation' approach. However, there are available sufficient indicators⁹ as price index number series which can provide the required deflators for output and

⁶ *Sources and Methods* op.cit., page 43.

⁷ *ibid.* page 77.

⁸ *ibid.* pages 79/80.

⁹ See Appendix B below.

the relevant inputs *provided that* the various material inputs are being used in the same proportions as in 1965. Now this would be most unlikely so that any value added so derived would be, to say the least, questionable, — the 'ceteris paribus' conditions being too rigid under present circumstances.

But 'double deflation' can add something to the exercise. If the relative price movements of the 1965 inputs are known for the period 1964-72 then assuming the relative quantities unchanged would enable a calculation of the relative price effect alone. The significance of this will become apparent later in this paper.

The practical alternative to all the foregoing methods which have been shown to have overriding disadvantages is to *estimate* net output at constant prices by the use of another index series which is purported to show changes in net output.

The most frequently used indicator is gross output — "provided that the ratio of net output to gross output remains unchanged at constant prices, changes in net output at constant prices will be measured by changes in gross output at constant prices".¹⁰ It is pointed out that for GDP as a whole any ratio changes between industries will tend to be "somewhat reduced in the aggregate for all industries".¹¹ This implies that, increased work done by one industry, 'ceteris paribus', will be offset by less work done in one or a number of other industries. The 'ceteris paribus' condition would be that there is either a closed economy or that foreign trade is a relatively constant proportion of GDP.

The importance of this follows from an examination of likely developments following a high degree of import substitution. As a generalisation for Rhodesia it is suggested that increased work done as a result of import substitution would not be compensated or offset by other domestic industries. For example there might have been increased efficiency and economies with the use of material inputs and services which would be reflected by an upward movement in the real ratio of net to gross output. Increased utilisation of plant and machinery and/or increased use of labour to produce domestic substitutes for previously imported intermediate inputs would also tend to raise the ratio.

There are also instances where net output might fall relative to gross output. The increased protection granted to domestic industry by the consequences of UDI could have led to the inefficient use and wastage of materials and poor maintenance of machinery,¹² but this would be considered most

¹⁰ *Sources and Methods*, op.cit., page 78.

¹¹ *ibid.*

¹² See, for example, "Tariff Protection, Import Substitution and Investment Efficiency", R. Soligo and J. J. Stern in *Pakistan Development Review*, No. 5, 1965, pages 249/70.

unlikely. Alternatively "the price of domestic substitutes for intermediate inputs may be higher than the previously imported price,"¹³ or there might not be corresponding substitution possibilities within the domestic economy in which event industrial capacity diminishes or imported intermediate inputs are made available at an increased cost.

Thus two significant points are apparent. First, a gross output indicator for any one industry, and to some extent a sector of the economy, will not be sufficient as an indicator for net output if the real ratio changes. Second, import substitution causing a change in work done in any unit of gross output would render the indicator inappropriate. It is important to note that the main opportunities for import substitution in Rhodesia have been in the manufacturing sector.¹⁴

DERIVATION OF THE VOLUME INDEX

The conventional indicator for gross output is a base weighted quantity index. The statistician collects, from each source, data on final quantities produced to obtain for any given year (*i*) a quantity relative

$\frac{q_i}{q_0}$ where the base is year (*o*).

To enable the gross output indicator to reflect net output changes each source's net output is 'weighted' by its relative significance to the aggregate net output. Thus for any given classification (firms or industries) the volume

index representing net output is $\Sigma \frac{w_i q_i}{q_0} / \Sigma w_i$ where w_i is the relative weight of each firm or industry.

The weights used are those from the Census of Production which of course are not necessarily the correct weights to evaluate value added. However, as mentioned earlier the proportion of commercial services is regarded as relatively insignificant and not subject to fluctuation.

Now w_i may vary over time for each firm within the industry or each industry group within the aggregate of all manufacturing industries. The variation may happen as a result of structural change arising from economic development where some firms and industries grow faster than others. Changing the base year at frequent intervals and linking successive indices would

¹³Ibid.

¹⁴The Input-Output Table, *National Accounts and Balance of Payments of Rhodesia 1965* (CSO, Salisbury).

overcome this problem at each level of aggregation although over long periods of time the resulting index would be increasingly less useful for comparison with the original base year because the actual mix of goods produced and the technical combination of inputs may have changed significantly.

However, there is a more crucial conceptual problem which might arise over relatively short periods. As stated before the very important condition upon which is founded the basis of comparison for net outputs at constant prices is that the real ratio of net output to gross output is unchanged. If the actual work done by the labour and capital inputs, as value added, rises (or falls) relative to the material inputs this would not be reflected by the relative weights w_i used in the construction of the volume index. This problem will be more apparent where industries are exposed to further structural changes especially with regard to the availability of material inputs or the used of these intermediate goods and services following a change in relative prices where unitary substitution cannot take place.

Since annual changes to the volume index are conventionally measured by changes in the quantity relative $\frac{q_i}{q_o}$, which is the main indicator, when the weights w_i are changed — even as frequently as annually — the index may not reflect any real ratio shifts because these weights are the ratios of a firm's (or industry's) net output to the total aggregated net output within each classification and not net to gross output ratios.

Thus despite sincere protestations to the contrary it ought to be accepted that under contemporary Rhodesian conditions the volume index may be neither a useful indicator for gross output (because it has net output weights) nor for net output (because these weights have not been adjusted to correct for any fundamental changes *within* gross output).

However, it is the intention of the volume index to represent changes in net output and value added and thus the preceding argument should not be taken as a case for rejecting this approach especially as the alternative methods have been rejected.

It is necessary now to examine how the volume index might be adapted in the light of changing economic conditions to provide realistic estimates of value added.

VALUE ADDED AT CONSISTANT PRICES

The following Table I shows how much the ratio of value added to gross output has varied over the years 1964-1972 for different industry groups at the prices prevailing in each of the years.

TABLE 1**VALUE ADDED AS A PERCENTAGE OF GROSS OUTPUT AT CURRENT PRICES**

Year	INDUSTRY											
	Food	Drink and Tobacco	Textiles	Clothing	Wood	Paper	Chemicals	Non Metallic Minerals	All Metals	Transport	Other	All
1964	16,1	46,3	31,7	34,1	37,8	44,6	27,4	50,0	39,1	29,2	39,8	31,0
1965	18,5	46,9	29,8	35,0	36,8	45,7	27,3	52,5	36,1	29,0	42,7	31,1
1966	15,8	41,6	31,9	36,6	35,2	45,9	28,8	51,7	37,0	36,9	41,2	31,1
1967	15,4	46,1	29,4	35,6	39,6	45,6	31,1	51,9	35,8	41,2	41,4	32,0
1968	16,7	44,7	28,6	35,2	37,3	45,1	32,5	52,3	35,7	45,4	44,8	32,2
1969	16,4	45,8	21,1	35,8	37,6	44,7	32,2	53,0	38,0	38,8	44,3	32,3
1970	16,5	45,8	27,5	34,9	39,0	43,6	32,4	52,0	39,2	40,7	42,5	33,2
1971	16,6	47,8	25,5	35,7	37,7	43,7	30,1	50,5	42,2	41,1	43,5	33,7
1972	17,3	46,8	28,0	38,4	36,2	42,7	32,5	49,6	39,9	39,4	41,8	33,6

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SOURCE: The Census of Production 1972/3 (CSO Salisbury)

Such ratio shifts are in current value terms $\frac{(P_v Q_v)}{(P_g Q_g)}$ where v represents

value added and g represents gross output. If the relative prices $\frac{P_v}{P_g}$ remain unchanged then each ratio represents quantity changes only and it would be necessary only to adjust the existing volume index figure for each year by the appropriate figure above divided by the 1964 figure to calculate a revised volume index to movements to value added based on the year 1964. The results are shown in Appendix A.

However, it would not be correct to stop the analysis at this point because relative price changes between P_v and P_g imply price movements between value added and material inputs, m . Two possible outcomes need to be considered—

- (a) The relative price change results in no substitution between value added and materials used. In this event the value ratio expressed above will be a spurious indicator of changes in 'quantities' of work done by value added and the original volume index would be the appropriate indicator.
- (b) The relative price change does precipitate changes in relative quantities as between value added and material inputs in which event the adjusted index either over-estimates or under-estimates the true situation. The degree of error introduced by the new index will depend both on the direction of the relative price changes (i.e. $\frac{P_v}{P_m}$ rises or falls) and the amount by which the quantities adjust (i.e. $\frac{Q_v}{Q_m}$ falls or rises).

In practice it is likely that (b) has occurred in which case it would be necessary to eliminate the price effect to arrive at a substitution effect alone.

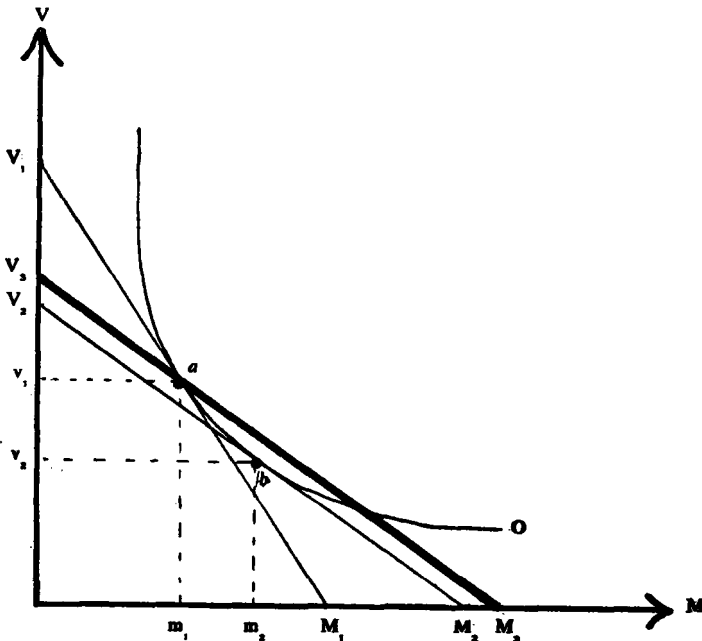
This is a great deal easier to manage in theory than in practice.

To summarise the argument at this point there may have been quantity shifts alone caused by post UDI and technical reasons, but also operating would have been relative price changes which may have, or may have not, caused quantity shifts depending upon the degree of substitution available or permitted between the various factor inputs (in this particular context substitution is considered only between work done by labour and capital together and work done by the material inputs).

The following geometric analysis endeavours to illustrate the points argued so far—

Consider value added (V) and material inputs (M) to comprise gross output shown by the isoquant (O). The axes (V and M) represent quantities and the isoquant illustrates one level of real output for different combinations of V and M.

DIAGRAM I



1. Initially the industry is operating at a using (v_1, m_1) of value added and materials. The relative prices are given by the slope of V_1M_1 .
2. If the price of material inputs P_m falls relative to P_v then there will be a new price ratio given by V_2M_2 .
3. With substitution possibilities indicated by the isoquant the industry will shift its factor proportions to $b (v_2, m_2)$. Since V_1 represented total gross output in terms of V alone then the initial ratio of value added to gross output was v_1/V_1 and shifts to v_2/V_2 . The ratios will be unchanged if the elasticity of substitution is unity. However v_2/V_2 will be greater or less than v_1/V_1 if the elasticity of substitution between V and M is less than or greater than one.
4. It could be that production possibilities for V and M are fixed, similar to the Leontief-type of production function. In which case it would not be possible to move from a despite a shift in relative prices. For equi-

rium at a a new price line $V_3 M_3$ parallel to $V_2 M_2$ is necessary. The ratio of value added to gross output is now v_1/V_3 which is greater than v_1/V_1 .

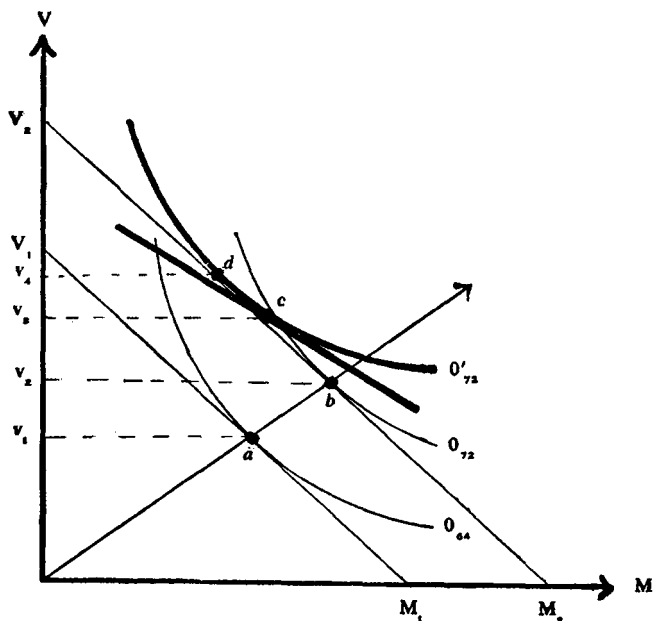
5. The situation described in 3 above illustrates outcome (b) on page 200 whilst 4 above shows outcome (a) *provided that the volume index is adjusted for the change in the ratio v/V .*

However, all this relates to the static situation and does not consider changes in the production process over time. For the published volume index to represent values added under these conditions it is required that real value added remains a constant proportion of real gross output. That is Leontief-type functions are assumed.

If some substitution is permitted, as a result of relative price changes, an 'isoquant' with some continuity at least is assumed. This implies a ratio adjustment to the volume index to arrive at real value added.

Over time since UDI it has been an implicit hypothesis in this paper that the technical combinations within firms and industries may have changed. The diagram which follows endeavours to illustrate such a change for 1964-1972. O_{64} represents the 1964 technical factor combination, O_{72} similar technical conditions for 1972, but O'_{72} the same level of real output as O_{72} yet with a clear shift to V as a result, for example, of increased economies with the use of material inputs.

DIAGRAM II



1. The movement from $a \rightarrow d$ represents what actually has taken place in real terms — i.e. assuming relative prices unchanged which gives v_4 at constant or 1964 prices (V_1M_1 and V_2M_2 have the same slope).
2. The volume index measures v_2 because its calculation assumes a move, $a \rightarrow b$ with a constant $\frac{V}{M}$ ratio.
3. The ratio adjusted volume index (Appendix A) measures v_3 because the ratio correction is at current prices and thus assumes, for example, a move $a \rightarrow c$.

To transpose these hypothetical situations into reality both v_1 and v_3 are known, v_2 may be derived from the index of volume and real value added is theoretically provided by v_4 . An index v_4/v_1 is required. The theory explains that the relative price effect needs to be removed from v_3/v_1 , which is the series provided by Appendix A.

It is to be appreciated that the exposition of the theory has not been rigorous yet it may have been sufficient to isolate the significant features which determine the problem. That this section of the paper has relied upon the neo-classical body of theory for its framework is not a constraint, for the exposition is qualitative only. The next section seeks to provide an empirical solution.

ALTERNATIVE INDEX OF VALUE-ADDED

A theoretical analysis is usually more satisfying in performance than its application to real situations. It is not so much a question of the validity of applied economics or statistics, but the difficulties involved in obtaining sufficient 'pure' data to bring about a satisfactory result. An historical interpretation, which this is, is of course less hazardous than a predictive exercise.

To isolate the relative price effects it is a basic requirement to have available—

- (a) reasonably accurate price index series for each of the inputs
- (b) a reasonably accurate picture of the actual input values.

Rhodesian statistics may be derived to satisfy requirement (a) although the purist will question the significance of aggregation. For instance, the import unit value index does not discriminate between capital goods or raw materials or consumer goods. There is a separate index series for imported machinery but not for raw materials and so on. Since there is no later input-output table than that published for 1965 there is no way of estimating a 'weighted' price index for the imported inputs of the various manufacturing industries

since 1965. Similar problems exist with the domestic unit value series for both mining and agricultural inputs. How do we distinguish between copper, nickel and asbestos or between fruit and meat as intermediate inputs?

However, prices tend to move together for homogenous collections of goods and so the problems of aggregation here might not be too significant.

A real problem would seem to be the lack of an up-to-date input-output table. Provided that the price index numbers were reliable the required value added, v_4 from diagram II, could be directly derived by 'double deflation' from input-output data. However, as previously mentioned, countries do not produce this information on an annual basis.

However, there is an alternative. Real value-added, v_4 or in index form as v_4/v_1 , is given by the following relationship:

$$\frac{v_4}{v_1} = \frac{v_2}{v_1} \times \frac{v_4}{v_2}$$

Now v_2/v_1 is given by the volume index. Neither v_4 nor v_2 are required separately, all that is needed is the ratio v_4/v_2 . It is feasible to apply 'double deflation' to hypothetical 1972 values assuming that relative quantities had remained unchanged from 1964 (1964 and 1965 inputs are assumed unchanged by relative quantities). This would provide an estimate of v_2 (v_2^*) under somewhat rigid conditions. If the same 1972 deflators were applied to the actual 1972 values for material inputs and gross output a v_4 (v_4^*) could be derived. Neither v_2 nor v_4 so calculated would be precise because of errors in the price index numbers and because, for v_4 there is no information available on 1972 quantities. But the errors involved with these estimates of v_2 and v_4 as far as price indicators are concerned would be uniform. Therefore all that

is necessary is to adjust the volume index $\frac{v_2}{v_1}$ by $\frac{v_4^*}{v_2^*}$ as an estimate for $\frac{v_4}{v_2}$,
 to arrive at an alternative value-added series, $\frac{v_4}{v_1}$.

The detail involved in estimating this index is given under Appendix B. A summary of the results so far for 1972 follows in Table II.

TABLE II

ESTIMATES OF VALUE-ADDED FOR 1972 AT 1964 PRICES

INDUSTRY	v_1	V	v_2	v_2^*	v_4^*	v_4	V^*	v_3	V^{**}
	\$m	Volume Index (V) 1964=100	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)
			$(V \times v_1)$			$(v_2 \times \frac{v_4^*}{v_2^*})$	$(\frac{v_4^*}{v_1})$		$(\frac{v_3}{v_1})$
							1964=100		1964=100
Food	15,0	184,3	27,7	32,1	34,3	29,5	196,6	29,7	198,0
Drink and Tobacco	15,6	123,6	19,3	16,1	16,4	19,6	125,9	19,5	124,9
Textiles	8,0	254,8	20,4	15,6	13,0	17,0	212,3	18,0	225,1
Clothing	8,9	154,7	13,8	10,8	12,7	16,2	181,9	15,5	174,2
Wood	5,1	179,9	9,2	9,1	8,7	8,8	172,0	8,8	172,3
Paper	9,1	171,2	15,6	16,0	15,3	14,9	163,7	14,9	163,9
Chemicals	15,5	188,1	29,2	36,7	41,1	(32,7)	210,7	(34,6)	223,1
Non-metallic Minerals	4,4	248,4	10,9	8,2	8,6	11,5	260,5	10,8	246,4
All Metals	23,2	239,1	55,5	50,4	51,5	56,7	244,3	56,4	243,0
Transport	9,5	112,4	10,7	8,1	13,7	(18,1)	190,1	(14,4)	151,7
Other	1,1	148,7	1,6	-0,3	0,4	1,6	149,7	1,7	156,2
ALL INDUSTRIES	115,3	(e)	(e)	(e)	(e)	226,6	196,5	224,3	194,5

SOURCES: v_1 , (value added 1964) from the Census of Production 1972/3. (CSO Salisbury)

V, Monthly Digest of Statistics, September 1974 (Table 31)

v_3 See Appendix A.

NOTES: (a) v_2^* and v_4^* are estimates from 'double deflation' — see Appendix B.

(b) V^* is the resultant estimate of real value added.

(c) V^{**} is a crude estimate of real value added which includes the relative price effect.

(d) The figures for 'ALL INDUSTRIES' have been derived from the sum of the individual industries.

(e) Deliberately omitted as not necessary to the calculations.

SOME OBSERVATIONS

It is interesting to see that for most industries the relative price effect (v_4 minus v_3) is very small. This means that substitution between V and M where it has taken place, has been mainly as a result of the quantity change arising from a new technical combination of inputs — illustrated by the shifting isoquant in diagram II.

Another point of interest, and not least of reassurance, is that for every industry group both v_3 and v_4 (also V^* and V^{**}) lie to the same side of the volume index V. This does tend to confirm the direction of change required to published statistics.

It might be argued that since the relative price effect is almost negligible the simple ratio-adjusted index V^{**} should be satisfactory as an indicator.

This might not be so for two reasons—

- (i) Table II shows the results for 1972 only and data for previous years may not reflect the same pattern.
- (ii) One industry, Transport, shows up a distinct relative price bias and Textiles, Clothing, Chemicals and Non-Metallic Minerals have differences which might have a disturbing effect in economic analysis.

But on the other hand there are two strong arguments for accepting V^{**} —

- (i) It would not be expected that substitution between V and M could take place to any significant extent as a result of relative price changes. For example the work done by labour and capital inputs cannot reasonably be done by raw materials, although additional imports of semi-manufactured goods might reduce work done by value-added. This is certainly a most unlikely event for Rhodesia since 1965 but it might well be featured of a later date and the evidence is that the ratio of net to gross output before 1964 tended to decline (for all manufacturing industries 34,7% in 1960 to 31% in 1964). It has been strongly suggested in this paper that it is likely there has been an economy drive with the use of raw materials and semi-manufactured inputs since UDI. But it would not appear that price differentials have played a significant role. Import quotas and the high domestic opportunity cost of substitution for some products would have had a quantity rather than a price effect upon input combinations. Some support for this suggestion is provided by the unit value index for imports which 1972 was 124,2 against a derived price index for domestic manufactured goods of 125,5 (1964=100).
- (ii) The V^* is not only somewhat complex in construction but one critical assumption has been necessary due to lack of information in the published

statistics. This is that all imported inputs deemed to be 'competitive with domestic' have been assumed substituted by domestic production. This means that the appropriate domestic price indices have been preferred to the import price index more than they should have been if import substitution were to be less than indicated by the 1965 input-output table. Some caution needs to be exercised here because a particular import is deemed to be 'competitive with domestic production' if it falls under the same S.I.T.C. code as an article which is produced locally in significant quantities. It does not mean that the particular article will or can be produced locally in sufficient quantities to absorb the import demand. It will be a question of capacity to absorb and the opportunity cost of production.

This latter argument might well explain the difference between V^* and V^{**} for Transport. In 1965, Transport (SITC 282-286) had an 80% import content out of total inputs but nearly 90% of this was classified as 'competitive with domestic'. Since domestic prices of manufactured or semi-manufactured goods have (up to 1972) risen faster than the foreign equivalent this has given the inputs a lower figure at 1964 prices than it might have been, given less than 90% import substitution. Thus value added would have risen but not to as high as v_4 (\$18,1m). As imported inputs for transport represented nearly 60% of gross output in 1964 the assumption of import substitution is quite crucial. Given the limited capacity of motor vehicle assembly in Rhodesia relative to 1965 import demand it would perhaps have been somewhat over optimistic to have suggested that domestic production could make good the import shortfall. Present-day observation provides no evidence that the situation would have changed to the extent suggested above.

Indeed to some extent the foregoing argument in principle might apply to other industries. However, Chemicals is the only other industry group to have had an import content of over 50% but the proportion 'competitive with domestic' was as low as 30%. Relatively inelastic substitution possibilities might well explain the lower figure for V^* compared with V^{**} .

CONCLUSION

The most crucial reason why the volume index is not a good indicator of real value added in Rhodesia is because since UDI there has been a structural change in many industries changing the real ratio of net to gross output.

A fairly broad analysis of the problems underlying the derivation of value-added at constant prices has revealed that provided relative prices are

not at variance over the period under examination, the volume index¹⁵ adjusted to the net/gross output ratio at current prices will provide a suitable indicator for value-added (see Appendix A).

The relative price effect has not been found to be significant in most industries, and where it was significant the result is somewhat questionable.

It is not expected that any index number series covering such aggregate data as do the volume or value-added indices will provide an exact picture but it would appear that, in general, the performance of manufacturing industries since 1964 has been underestimated by the official statistics.

¹⁵ The volume index itself has been assumed accurate as a quantity index for the purpose of this paper. However, it is evident from the Census of Production that net output 'weights' are shifting markedly enough to perhaps influence the final results. The dilemma is explained in (1) p. 80 — "In practice a choice has to be made between continuity and the use of up-to-date relative prices. Continuity is achieved by retaining the same base year (1964) — *my italics*). Though changes in relative prices cannot be taken into account during this period and the appearance of new products is difficult to allow for, any bias in the estimates is unlikely to become serious if the base year is changed at sufficiently frequent intervals. The relative prices are more appropriate if the base year is changed frequently. In practice this is difficult to do because, so long as changes in net output are estimated by indicators, the information required for the base year is much more detailed than that required for other years."

For further reading on the changing mix of quantities and qualities over time, see (5). The problem for Rhodesian statisticians is whether the expediency of maintaining a 1964 base year and infrequent re-weighting (only in 1966 and 1970 but some allowance was made *after* 1970 for the changes 1966-70) sufficiently compensates for the changes which have taken place in Rhodesian manufacturing industries since 1964.

APPENDIX A

AN INDEX OF VALUE ADDED IN MANUFACTURING PRODUCTION
(OR NET OUTPUT AT CONSTANT PRICES)

1964 = 100

Year	INDUSTRY											
	Food	Drink and Tobacco	Textiles	Clothing	Wood	Paper	Chemicals	Non Metallic Minerals	All Metals	Transport	Other	All
1964	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
1965	126,5	96,4	107,3	108,2	108,8	115,6	118,6	108,4	100,7	110,3	88,5	109,1
1966	111,2	81,5	115,8	112,5	110,1	100,4	97,9	100,4	94,7	95,9	81,7	98,9
1967	111,1	90,2	131,7	128,3	127,5	105,8	111,3	114,8	107,9	100,6	85,5	110,7
1968	128,2	87,7	136,9	125,9	123,8	109,4	133,8	161,5	121,6	130,8	102,8	121,7
1969	134,8	95,4	144,7	135,5	135,5	118,1	148,7	171,7	149,3	130,5	102,5	137,7
1970	159,2	105,9	174,1	133,2	161,6	138,7	183,5	203,3	186,0	139,8	122,5	158,5
1971	176,4	115,8	179,9	144,9	172,4	147,6	185,5	228,1	229,9	160,5	143,6	178,1
1972	198,0	124,9	225,1	174,2	172,3	163,9	223,1	246,7	244,0	151,7	156,2	195,7

VALUE ADDED AT CONSTANT PRICES

NOTE: This index has been derived from the volume index for each manufacturing industry group (See Appendix C). The volume index was adjusted by the ratio of value added to gross output at current prices (see Table II).

APPENDIX B

Gross output = Value Added + Materials and Services

$$G = VA + MS$$

To derive an estimate for VA at 1964 prices, deflators are required for both G and MS.

For G $G(1972)$ may be written as $P_{72} Q_{72}$ — that is at 1972 value in 1972 prices and quantities. Similarly $G(1964)$ may be shown as $P_{64} Q_{64}$.

$$\text{The Volume Index (Laspeyre) gives } \frac{P_{64} Q_{72}}{P_{64} Q_{64}} = I_1$$

$$\text{The Value Index is } \frac{P_{72} Q_{72}}{P_{64} Q_{64}} = I_2$$

$$\text{Thus the Price Index (Paasche) } \frac{P_{72} Q_{72}}{P_{64} Q_{72}} = \frac{I_2}{I_1}$$

The 1972 price index (1964=100) or unit value index, for each industry is as follows—

Food	105,8	Chemicals	112,3
Drink	134,0	Minerals	159,7
Textiles	137,5	Metals	134,7
Cloth	146,4	Motor	137,7
Wood	125,2	Other	197,7
Paper	123,1	All	125,5*

For MS The price indices used to deflate material and service inputs from domestic and imported origin were (1964=100)

	1972	Source
Agriculture	99,0	Unit value index — MDS
Mining	115,9	Unit value index — MDS
* Manufacturing	125,5	See above
Electricity	101,9	CPI for Europeans — MDS
Imports	124,4	Unit value index — MDS
Services	135,9	CPI (Miscellaneous) — MDS

MDS — Monthly Digest of Statistics (CSO Salisbury)

* As price indices are also available for the final products of each industry group, the separate indices were used as an alternative to the aggregate when appropriate.

The breakdown of MS into the input classifications set out above was estimated from the input-output table for 1965 (see the table of figures at the end of this Appendix). The input columns were adjusted after allowing for import substitution.

Deflating the actual 1972 values of G and MS would give an estimate of VA (v_4 in diagram II). However, this is not the true v_4 , since no information on the quantity distribution between VA and MS is available.

The estimate is treated as v_4^* .

Deflating hypothetical 1972 values of VA and MS out of the real G gives v_2^* — the hypothetical values are those which would have actually happened if there had been no quantity re-distribution between VA and MS since 1964.

The volume index (V) estimates the quantity change in VA, $\frac{v_2}{v_1} \times 100$, assuming no relative quantity shift between VA and MS.

Thus $V \times \frac{v_4^*}{v_2^*}$ provides the 'true' value added (v_4) and $\frac{v_4}{v_1} \times 100$

the value added index number (1964=100).

EXAMPLE — FOOD

Actual 1964 : 92,9=15,0+ 77,9 $\frac{VA}{G}=16,1\%$
 (1) Actual 1972 : 181,2=31,3+149,9

(2) 'Hypothetical'
 1972 : 181,2=29,2+152,0 $\frac{VA}{G}=16,1\%$

Deflate (1) gives 171,2=VA+136,9 ∴ VA=34,3

Deflate (2) gives 171,2=VA+139,1 ∴ VA=32,1

$v_1 = 15,0 \quad v_4^* = 34,3 \quad v_2^* = 32,1 \quad V = 184,3$

$v_4 = V \times \frac{v_4^*}{v_2^*} = 29,5$ and $\frac{v_4}{v_1} \times 100 = 196,6$

The following table shows how the material and service inputs have been calculated for each industry group—

PERCENTAGE INPUT CONTENT OF MANUFACTURING INDUSTRIES 1965

Industry	INPUT						Weighted' Input Price Index 1972 (1964=100)
	Agriculture	Mining	Manufacturing	Electricity	Imports	Other	
Food	51,7	—	21,4	0,8	11,6(1,5)	13,5	109,3
Drink	26,0	—	41,6	2,6	15,6(3,9)	14,2	117,4
Textiles	11,8	—	39,8	1,1	40,9(15,1)	6,4	124,0
Cloth	—	—	48,8	1,2	31,0(5,9)	19,0	131,4
Wood	4,7	—	34,9	2,3	46,5(0,0)	11,6	124,4
Paper	—	—	35,1	1,8	49,1(3,4)	14,0	126,0
Chemicals	—	1,2	14,9	0,8	76,7(53,7)	6,4	124,8
Minerals	—	10,0	30,0	10,0	30,0(0,0)	20,0	125,6
Metals	—	8,5	24,9	4,2	49,2(7,4)	13,2	127,3
Transport	—	—	13,8	—	80,7(10,5)	5,5	125,5
Other	—	17,6	11,8	—	58,8()	11,8	122,7
All	17,9	2,0	25,3	1,6	42,0(17,8)	11,2	123,1

* The figures in parenthesis show the percentage of inputs 'non-competitive with domestic' after allowing for full import substitution.

APPENDIX C

The classification of industry groups follows that used for the construction of the index of volume of Manufacturing Production published by the Monthly Digest of Statistics (CSO, Calisbury).

Full industry headings are—

- Foodstuffs
- Drink and Tobacco
- Textiles including Cotton Ginning
- Clothing and Footwear
- Wood and Furniture
- Paper, Printing and Publishing
- Chemical and Petroleum Products
- Non-Metallic Mineral Products
- Metals and Metal Products
- Transport Equipment and Workshops
- Other Manufacturing Groups
- All Manufacturing Groups

There are two industry groups where aggregation does not fairly represent the performance of the component industries. This seems likely from the details available from the Annual Census of Production (CSO, Salisbury) and is confirmed, at least from 1970, by figures available at the Central Statistical Office.

- (1) **Drink and Tobacco** — The volume index and the resulting estimates of value-added actually under-estimate quite considerably the growth in Drink and overestimate the development of Tobacco Manufactures.
- (2) **Metals and Metal Products** — This classification under the volume index does not discriminate between the ferrous, non-ferrous and smelting industries called, say, Basic Metals — and Metal Products, which also includes machinery engineering and electrical goods. Basic Metals has much higher capital-output ratio than does Metal Products and it cannot be assumed that the post-UDI situation has had the same effects on each industry. The aggregated indices are representations of the whole and may not actually apply to either industry.

Further disaggregation within the remaining industry groupings might also reveal likely discrepancies but for the most part the remainder is relatively homogeneous within groups.

NOTES—

(a) In line with changes in definition and classification in 1966 some manipulation of the Census figures has been required to obtain more comparable data over the period 1964-72. The 'repair of motor vehicles' group has been deducted from the 'Transport' and 'All' figures for 1964 and 1965. Also 'plastics' has been transferred from 'Other' to 'Chemicals' for 1964 and 1965.

(b) There is not complete uniformity between the time periods over which the volume and value-added indices are calculated. The volume index is calendar yearly but the value-added data has been extracted from the Census of Production where the majority of the statistics relate to the year March-March. Thus, for example, the data here should read 1972/73 yet 1972 is used for ease of presentation. This means that some caution ought to be exercised over comparison between the indices in any given year, yet over a period of time — say 3 years or more — such a comparison would be more justified.

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