PRIMARY PRODUCTION, FINANCIAL CONSTRAINTS AND ECONOMIC INSTABILITY: ZAMBIA SINCE INDEPENDENCE

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APPENDIX I.1 THE DUAL-GAP ANALYSIS OF DEVELOPMENT, AND CAPITAL INFLOWS

National income accounting identities indicate that total income (or expenditure or output) is equal to the sum of private and government consumption, investment and net exports. Algebraically we have an ex-post identity

$$Y = C + I + E - M$$

where Y is total expenditure

C is total consumption

I is investment and

E-M is the difference between exports and imports.

Successive rearrangements of the identity show the following:

$$S = I + E - M$$

where $S = Y - C$ with S as savings

and $S - I = E - M$

Thus if total actual investment exceeds total savings then of necessity imports of goods and services must be greater than exports by an equal amount. Expressed alternatively, the gap between savings and investment is equal to the gap between exports and imports. Or in yet another way, if domestic saving is insufficient to cover total investment, then saving must be made by the foreign sector in the form of a payments deficit; this view being occasionally referred to as imported saving.

Whereas the above relationship is necessarily true ex post, there is no such necessity in the ex ante sense, and dual-gap analysis shows that growth is limited by the larger of the two gaps and provides a valuable basis for the theoretical analysis of the role of capital inflows in developing economies.

The analysis may be developed in two stages, one a very simple description and the second a slightly more elaborate one to demonstrate the effects of different levels of savings and imports during the process of development.

The starting point is the basic inequality

$$I \leq F + S \qquad (1)$$

where I - investment
S - savings
F - capital inflows from abroad

which incorporates the saving-investment gap.

It is also true that

$$M \leq F + E \qquad (2)$$

where M - imports
E - exports

representing the export-import gap.

Assume that there is a fixed average propensity to import, m, out of GDP, Y, such that:

$$M = mY \qquad (3)$$

and that savings represent a fixed proportion of income

$$S = sY \qquad (4)$$

while GDP is determined according to the following

$$Y = \frac{1}{k} I \qquad (5)$$

where k may be interpreted as the proportion of GDP devoted to investment.

Thus inequality (1) may be restated as

$$I \leq F + sY$$

$$\leq F + \frac{s}{k} I$$

$$\text{and } I \leq \frac{i}{1 - \frac{s}{k}} F \qquad (1a)$$

Inequality (2) may be written

$$mY \leq F + E$$

$$m.\frac{1}{k} I \leq F + E$$

$$I \leq \frac{k}{m} (F + E) \qquad (2a)$$

Thus, if F and E are exogenously determined then investment and, by virtue of equation (5), output are seen to be constrained by either (1a) or (2a), and these are simply re-arrangements of the original savings-investment and export-import gaps respectively.

Various observations may be made. As k increases, i.e. as the proportion of GDP devoted to investment rises, then the savings-investment gap is likely to be the dominant constraint, since the ratio $\frac{k}{m}$ will rise in (2a) and the denominator will fall in (1a). Conversely as s rises, the import-export gap is more likely to be dominant. Finally if m can be reduced then the foreign resource constraint is likely to diminish in importance. The Dual-gap analysis has a particular utility in planning over a given time horizon. Consider first the savings-investment gap in the base year, 0

$$F_0 = I_0 - S_0$$

$$= cr^* Y_0 - sY_0$$

$$= (cr^* - s)Y_0 \qquad (6)$$

where F, I, S, Y and s are as above but with time subscripts and a Harrod-Domar type association is assumed between investment and GDP with r* as a target growth rate and c the incremental capital-output ratio.

$$r^* = \frac{s}{c}$$

$$= \frac{s}{Y} \cdot \frac{1}{c} = \frac{I}{Y} \cdot \frac{1}{c}$$

$$\therefore \quad I = cr^*Y \tag{7}$$

The expected level of saving in period t, S_t

$$S_t = sY_0 + s'(Y_t - Y_0) \tag{8}$$

where s' is the marginal savings ratio

From (7) we have investment in period t

$$I_t = cr^*Y_t$$

and the savings-investment gap in time period t is given by

$$F_t = I_t - S_t = cr^*Y_t - [sY_0 + s'(Y_t - Y_0)]$$

$$= (cr^* - s')Y_t - (s - s')Y_0 \tag{9}$$

A necessary condition for decreasing dependence on capital inflows from abroad is that

$$F_t < F_0$$

i.e. from equations (6) and (9)

$$(cr^* - s')Y_t - (s-s')Y_0 < (cr^* - s)Y_0$$

which may be reduced to

$$(cr^* - s') (Y_t - Y_0) < 0$$

so that $F_t < F_0$

only if

$$cr^* < s'$$

that is $s < s'$ since $cr^* = \frac{I}{Y} = \frac{S}{Y} = s.$

Thus a country can expect a declining level of dependence on capital inflows only if its marginal propensity to save is greater than its average propensity, i.e. only if the economy manages to save an increasing proportion of income.

It is also possible to calculate the number of years which will be required before foreign assistance reduces to zero. Consider the terminal year, T, such that

$$F_T = (cr^* - s')Y_T - (s - s')Y = 0$$

$$\therefore \quad Y_T = \frac{s - s'}{cr^* - s'}$$

It is also true that $Y_T = (1 + r^*)^T Y_0$

$$\therefore \quad (1 + r^*)^T = \frac{s - s'}{cr^* - s'}$$

and therefore T, may be calculated.

The Export-Import Gap

Consideration is now turned to the situation in which the export-import gap is dominant, i.e.

where $F_0 = M_0 - X_0$

$= mY_0 - X_0$ where m is the average propensity to import.

Imports and exports in year t are given respectively by

$M_t = mY_0 + m'(Y_t - Y_0)$ where m' is the marginal propensity to import

$X_t = (1 + r_e)^t X_0$ where r_e is the average annual growth of exports.

Thus the foreign resource gap in year t, F_t is

$$F_t = M_t - X_t = mY_0 + m'(Y_t - Y_0) - X_t$$

Reliance on capital inflows declines if

$$F_t < F_0$$

that is, if

$$m'(Y_t - Y_0) - (X_t - X_0) < 0$$

then $m' < \frac{\Delta X}{\Delta Y}$ where ΔX and ΔY represent the changes in X and Y respectively.

This yields a formal demonstration of the expected result that the requirement for foreign capital inflows falls only if the marginal

propensity to import is less than the "marginal propensity to export" or the proportion of additional output which is exported.

It has been shown that the larger of the two gaps becomes a dominant constraint on development, and the role of foreign capital inflows in filling both gaps has been demonstrated, together with the conditions necessary from this model for the elimination of the need for foreign assistance.

Appendix III.1 DEFLATION PROCEDURES AND BASE YEAR CONVERSIONS

The Implicit Deflator

Substantial use is made of implicit deflators, and it is necessary to outline the principles underlying their use.

The current year value of GDP, V_c is given by

$$V_c = \Sigma P_i^c Q_i^c \qquad (1)$$

where P_i^c and Q_i^c represent the current year price and volume of the ith good. In practice P_i and Q_i represent the aggregation of several similar goods into one sector, with P_i a composited weighted price index.

The value in constant (base year) prices of the same years GDP, V_b is

$$V_b = \Sigma P_i^b Q_i^c \qquad (2)$$

where P_i^b is the base year price of good i.

It is common practice to calculate the implicit price index or deflator, I^D, as

$$I^D = \frac{V_c}{V_b} \qquad (3)$$

The effect of this is to regard GDP or national output as one homogenous good with a notional price measured by I^D.

A similar procedure may be applied to individual sectors.

The conversion of base years

It is frequently necessary to construct continuous data series from two or more overlapping series with different base years. Thus given two base years b_1 and b_2 and data series for the years 0,1,2,....t as follows:

(1) Base year, b_1 : $\Sigma P_{b1}Q_0, \Sigma P_{b1}Q_1, \ldots\ldots, \Sigma P_{b1}Q_{b2}$

(2) Base year, b_2 : $\Sigma P_{b2}Q_{b2}, \ldots\ldots, \Sigma P_{b2}Q_t$

then it is possible to prepare an estimated series with a common base year by calculating the implicit deflator for the year b_2, i.e.

$$I^D_{b2} = \frac{\Sigma P_{b2}Q_{b2}}{\Sigma P_{b1}Q_{b2}} = \frac{V_{b2}}{V_{b1}} \qquad (4)$$

This deflator is then applied to data series (1) to bring it to the prices of year 2. Alternatively the inverse of I^D_{b1}, I^D_{b2}, could be used to form a series in the prices of b_1.

Thus for a given year, j, (0<j<b2), given at b_1 prices, the conversion to b_2 prices would be as follows:

$$\Sigma P_{b2}Q_j = I^D_{b2}\Sigma P_{b1}Q_j \qquad (5)$$

It will immediately be apparent that this is not mathematically correct.

The full specification of (5), using (4) is:

$$\Sigma P_{b2}Q_j = \frac{\Sigma P_{b2}Q_{b2}}{\Sigma P_{b1}Q_{b2}} \cdot \Sigma P_{b1}Q_j \qquad (5a)$$

which would be correct only in the case of one good, or if all prices were identical and showed the same relative change. In the latter case (5a) would become

$$P_{b2}\Sigma Q_j = \frac{P_{b2}\Sigma Q_{b2}}{P_{b1}\Sigma Q_{b2}} P_{b1}\Sigma Q_j$$

which would give the desired result.

The only means of accurately re-basing these figures would be to disaggregate the accounts completely; clearly not feasible. In most circumstances the procedure described here gives acceptable results. But as the following example shows, this is not always the case.

Rebasing Zambian GDP by kind of economic activity

Zambian national accounts are available for 1965-73 at 1965 prices, and for 1970 onwards at 1970 prices. Thus an example of the situation described above exists. It was desired to obtain a consistent series at 1970 prices; thus for the years 1965-69 the procedure of (5) would be applied, ie. for each year

$j(j = 1965,..,1969)$

$$P^k_{70}Q^k_j = P^k_{65}Q^k_j \cdot I^k_{70} \qquad \text{where } I^k_{70} = \frac{P^k_{70}Q^k_{70}}{P^k_{65}Q^k_{70}}$$

for each sector k

and for total GDP $\Sigma P_{70}Q_j = \frac{\Sigma P_{70}Q_{70}}{\Sigma P_{65}Q_{70}} \cdot \Sigma P_{65}Q_j$

If the procedure were to produce accurate results, then it should be the case that

$$\Sigma P_{70}\, Q_j = \Sigma P_{70}^k Q_j^k \quad (8)$$

As Table III.1.1 shows this is not the case. If (8) were true then the column totals of individually deflated sectoral value added, should sum to the GDP deflated directly. A small error would be acceptable but the variations are as high as 8.2%.

However a closer examination of the figures reveals that a major part of this variation comes from the mining sector. Table III.1.2 shows that when the mining sector is excluded the variation between the two methods is small and relatively constant. This suggested that there is some problem in the deflation of the mining sector, an observation supported by the work of McPherson (1978, Appendix IVB) in which alternative deflators for the mining sector are derived for selected years.

The extent of the variation caused by an incorrect deflation procedure is indicated by Table III.1.3 showing as indices production volume and value added at 1970 prices. The two indices have moved much more closely together in the 1970's, but there is no apparent reason why this particular pattern should have occurred. Rising real costs would cause a reduction in the ratio of value added to gross

Table III.1.1 GDP by kind of economic activity at constant 1965 and 1970 prices, 1965-70 (former SNA)
(Million kwacha)

	1965		1966		1967		1968		1969		1970		
	1965 prices	1970 prices	1965 prices	1970 prices	1965 prices	1970 prices	1965 prices	1970 prices	1965 prices	1970 prices	1965 prices	1970 prices	Deflator
Agriculture - commercial	20.4	23.2	22.4	25.5	21.4	24.4	22.1	25.2	22.9	26.1	26.5	30.2	1.140
subsistence	79.1	91.7	79.6	92.3	80.1	92.9	80.2	93.0	80.8	93.7	81.6	94.6	1.159
Mining	303.0	659.9	241.0	524.9	241.2	525.3	219.1	477.2	240.3	523.3	210.3	458.0	2.178
Manufacturing	48.0	75.5	57.5	90.4	67.4	106.0	75.2	118.2	76.0	119.5	82.1	129.1	1.572
Electricity, gas and water	5.4	4.8	7.3	6.5	7.8	7.0	10.8	9.7	13.8	12.3	21.7	19.4	0.894
Construction	44.7	80.1	50.4	90.3	47.6	85.3	44.0	78.8	48.6	87.1	45.1	80.8	1.792
Wholesale and retail trade	81.9	108.9	74.0	98.4	85.7	113.9	96.7	128.5	69.5	92.4	89.3	118.7	1.329
Hotels and restaurants	4.6	6.1	6.2	8.2	6.0	7.9	8.0	10.6	9.6	12.7	11.2	14.8	1.321
Transport, etc	31.3	38.4	28.4	34.9	40.4	49.6	38.1	46.8	33.9	41.6	32.0	39.3	1.228
Financial and business services	30.7	50.5	32.9	54.1	42.0	69.0	47.2	77.6	47.5	78.1	53.3	87.6	1.643
Public Administration, Defence, Sanitary, etc, services	30.4	34.0	36.0	40.3	36.3	40.6	39.4	44.1	34.0	38.0	45.6	51.0	1.118
Education	15.0	16.8	14.4	16.1	20.0	22.4	21.5	24.1	23.6	26.5	32.0	35.9	1.122
Health	8.3	9.3	8.8	9.9	12.0	13.5	13.4	15.0	14.2	15.9	17.2	19.3	1.122
Other personal and household services (including recreation and cultural sevices)	13.1	19.4	12.8	19.0	14.9	22.1	14.8	22.0	14.1	20.9	16.7	24.8	1.485
Import Duties	14.5	18.5	18.0	23.0	21.5	27.4	23.1	29.5	21.5	27.4	21.7	27.7	1.276
GDP at constant market prices	730.4	1,143.7	689.7	1,079.9	744.3	1,165.6	753.6	1,180.1	750.3	1,175.0	786.3	1,231.3	1.566
Column totals		1,237.1		1,133.8		1,207.3		1,200.3		1,215.5		1,231.3	

Source: Calculated from Central Statistical Office, National Accounts and Input-Output Tables 1973, Lusaka, 1980 (Table 6.3, page 111 for each year at 1965 prices and Table 5.1, page 53, for 1970 at current prices).

Table III.1.2 Sources of variation between alternative methods of deflation, 1965-70
(Million kwacha)

	1965		1966		1967		1968		1969		1970		
	(at 1965 prices)	(at 1970 prices)	(at 1965 prices)	(at 1970 prices)	(at 1965 prices)	(at 1970 prices)	(at 1965 prices)	(at 1970 prices)	(at 1965 prices)	(at 1970 prices)	(at 1965 prices)	(at 1970 prices)	Deflator (a)
1. Mining sector	303.0	659.9	241.0	524.9	241.2	525.3	219.1	477.2	240.3	523.3	210.3	458.0	2.178
2. Non-mining sector													
direct deflation (b)	427.4	573.8	448.7	602.4	503.1	675.4	534.5	717.6	510.0	684.7	576.0	773.3	1.343
column total (c)	427.4	577.2	448.7	608.9	503.1	682.0	534.5	723.1	510.0	692.2	576.0	773.3	--
Variation (d)	--	3.4	--	6.5	--	6.6	--	5.5	--	7.5	--	--	--
3. Total GDP													
direct deflation (b)	730.4	1,143.7	689.7	1,079.9	744.3	1,165.6	753.6	1,180.1	750.3	1,175.0	786.3	1,231.3	1.566
column total (c)	730.4	1,237.1	689.7	1,133.8	744.3	1,207.3	753.6	1,200.3	750.3	1,215.0	786.3	1,231.3	--
Variation (d)	--	93.4	--	53.9	--	41.7	--	20.2	--	40.5	--	--	--
4. Percentage of variation attributable to mining	--	96.4	--	87.9	--	84.2	--	72.8	--	81.5	--	--	--

(a) "Deflator " is the pertinent quantity in 1970 expressed in 1970 values divided by its value in 1965 prices.
(b) Calculated by applying the "deflator" directly to the value of the pertinent quantity (in 1965 prices) in each year.
(c) The sum of the directly "deflated" individual sectors.
(d) The difference between "direct deflation" and "column total" for each year's quantity expressed at 1970 prices.

Source: Calculated from Table III.1.1.

Table III.1.3 Indices of production and value added in the mineral sector at constant prices, 1965-79 (1970=100)

	Value added (1970 prices) (1)	Production (a) (2)	Ratio (2) ÷ (1)
1965	142.8	100.2	70.2
1966	113.5	85.5	75.6
1967	113.7	90.2	79.3
1968	103.2	97.3	94.3
1969	113.3	109.4	96.6
1970	100.0	100.0	100.0
1971	90.3	92.7	102.7
1972	103.9	102.1	98.3
1973	97.7	99.7	102.0
1974	103.0	102.7	99.7
1975	93.0	93.7	100.7
1976	109.3	104.3	95.4
1977	103.0	96.4	94.5
1978	109.7	95.9	82.4
1979	88.0	85.4	97.0

(a) Based on tonnage of copper produced. Lead and zinc have a relatively low level of value added while cobalt production has been negligible in volume terms.

Sources: Calculated from Appendix S. Tables S.1.2, S.4.5

output, but such rises has been steady in its progress and were more evident in the 1970's than the 1960's.

It is not proposed to develop alternative deflators to the Zambian Central Statistical Office's since the problem is not central to the thesis. However, it is noted that the unreliability of the mineral sector deflator gives rise to difficulties in areas such as the estimation of average growth rates, where the two estimates of 1965 GDP at 1970 prices yield average annual growth rates of 1.2 per cent and 0.7 per cent (geometric means). While this analysis relates to GDP by kind of economic activity, the effects will be transmitted also to GDP by type of expenditure.

In this thesis the practice is adopted of calculating growth rates from the directly deflated series when appropriate (ie as opposed to aggregates of deflated sectoral values). The mining sector requires some special consideration. For instance, in calculating the level of output for the mining industry with respect to Table 3.17 (output per worker) the value added in 1965 at 1970 prices obtained by simple rebasing was reduced by the difference between the total variation and the variation attributable to the non-mining sector.

APPENDIX III.2 GDP ADJUSTED FOR TERMS OF TRADE EFFECTS

The procedure used to obtain a continuous constant price series of GDP in constant prices adjusted for the terms of trade given for 1971 onwards is outlined in the following paragraphs, with reference to Table III.2.1. It follows the methodology used in the National Accounts, 1973. See also section 3.2 of the main text.

The problem was to rebase to 1970 prices figures given in 1965 prices for 1965-69. The basic procedure outlined in Appendix III.1 is followed. Unadjusted GDP data in 1970 prices (see Table III.2.1) were used (Column 1). Exports and imports available in 1965 prices and in current prices were similarly rebased to 1970 price levels (columns 2 to 7). Implicit deflators for exports and imports were then calculated (column 8 and 9) and applied to exports expressed in current prices (columns 2, 10 and 11). The deflator for exports' is the implicit deflator for the mining industry. The difference between columns (10) and (11), i.e. exports deflated in the two ways (column 12), is added to unadjusted GDP (column 1) to give the adjusted level of GDP (column 13).

The complete series, together with the level and growth rate per capita appears in Table III.2.2.

Table III.2.1 GDP adjusted for terms of trade at constant (1970) prices, 1965-70

(Million kwacha)

	GDP (unadjusted) 1970 prices (1)	Exports			Imports			Implicit deflator		Exports deflated by		Difference (e) (12)	GDP Adjusted for terms of trade (f) (13)
		Current prices (2)	1965 prices (3)	1970 prices (4)	Current prices (5)	1965 prices (6)	1970 prices (7)	Exports (a) (8)	Imports (b) (9)	Export deflator (c) (10)	Import deflator (d) (11)		
1965	1,186.9	373.3	373.3	641.7	262.7	262.7	313.1	58.2	83.9	641.7	444.9	-196.8	990.1
1966	1,120.7	455.7	318.7	547.9	335.4	327.0	289.8	83.2	86.0	547.9	529.9	-18.0	1,102.7
1967	1,209.6	475.2	368.4	633.3	416.3	391.5	466.7	75.0	89.2	633.3	532.7	-100.6	1,109.0
1968	1,224.7	544.5	344.4	592.0	470.4	420.0	500.7	92.0	93.9	592.0	579.9	-12.1	1,212.6
1969	1,219.4	862.7	415.0	713.4	425.9	390.0	464.9	120.9	91.6	713.4	941.8	228.4	1,447.8
1970	1,277.7	685.4	398.7	685.4	470.5	394.7	470.5	100.0	100.0	685.4	685.4	--	1,277.7

(a) Column (2) ÷ column (4).

(b) Column (5) ÷ column (7).

(c) Equal to column (4); or column (2) ÷ column (8).

(d) Column (2) ÷ column (9).

(e) Column (11) - column (10).

(f) Column (1) + column (12)

Sources: Calculated from Table S.1.2 and Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office

Table III.2.2 Derivation of per capita GDP adjusted for terms of trade

	GDP at 1970 prices (millions of kwacha)		Population (a) (millions)	Per capita GDP (adjusted) (kwacha)	Percentage change from previous year
	Unadjusted	Adjusted			
1965	1,186.9	990.1	3.67	269.8	--
1966	1,120.7	1,102.7	3.76	293.3	8.7
1967	1,209.6	1,109.0	3.85	288.0	-1.8
1968	1,224.7	1,212.6	3.96	306.2	6.3
1969	1,219.4	1,447.8	4.06	356.6	16.5
1970	1,277.7	1,277.7	4.17	306.4	-14.1
1971	1,269.9	1,100.7	4.29	256.6	-16.2
1972	1,386.5	1,183.0	4.42	267.6	4.3
1973	1,361.0	1,312.6	4.68	280.5	4.8
1974	1,473.9	1,369.2	4.83	283.5	1.1
1975	1,438.1	1,050.9	4.98	211.0	-25.6
1976	1,558.2	1,111.8	5.14	216.3	2.5
1977	1,488.8	992.5	5.30	187.3	-13.4
1978	1,496.4	989.5	5.47	180.9	-3.4
1979	1,361.5	908.0	5.65	160.7	-11.2

Gross domestic product: 1965-70: Table III.2.1

Sources: 1971-73, Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office; 1974-79, Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April/September 1980.

(a)Population: based on mid-year estimates of population in Central Statistical Office, Monthly Digest of Statistics, July/September 1979 Lusaka, with constant growth rates assumed for intermediate years.

APPENDIX III.3 THE CALCULATION OF AVERAGE GROWTH RATES

The unstable performance of the Zambian economy causes problems in the calculation of 'average' rates of growth which give a fair representation of the economy over the entire period. The most common method of calculating average rates of growth is the geometric mean growth rate, r

$$r = \left(\frac{X_t}{X_1} \right)^{1/t-1} - 1$$

This rate, however, relies on the initial and final observations, X_1 and X_2 respectively, so that it is possible for large variations to occur in intervening years without being reflected in the final measure of growth. This is illustrated in Figure III.3.1. The original time series is represented by the curve TT′, and follows a time path frequently encountered in economic variables - a rising trend with periodic cyclical variations. If a geometric average growth rate were calculated for the period between i and (t + i), it is evident that a very much higher rate will be obtained than if the period between j and (t + j) were to be considered, simply because of their positions relative to the phases of the business cycle during which they are taken. The resulting average rates are represented by the slope of the lines II′ and JJ′ respectively. The difference between the two rates is due solely to the positions of the initial and final points in the business cycle, line II′ running from the trough of one cycle to the peak of a subsequent one, while JJ′ joins intermediate points in the cycles.

Figure III.3.1. Unstable time series and geometric mean growth rate

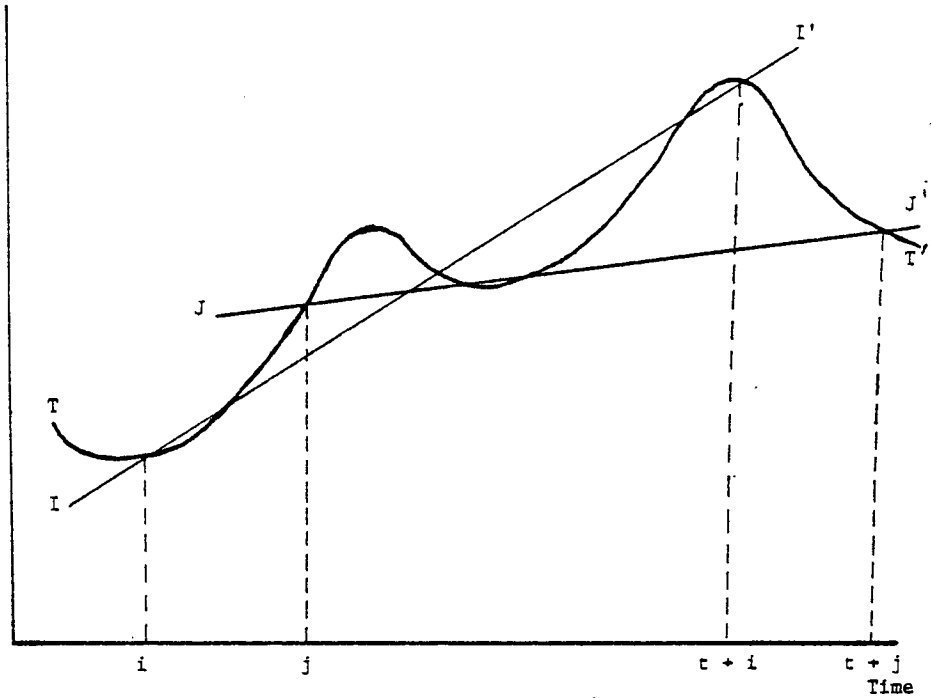
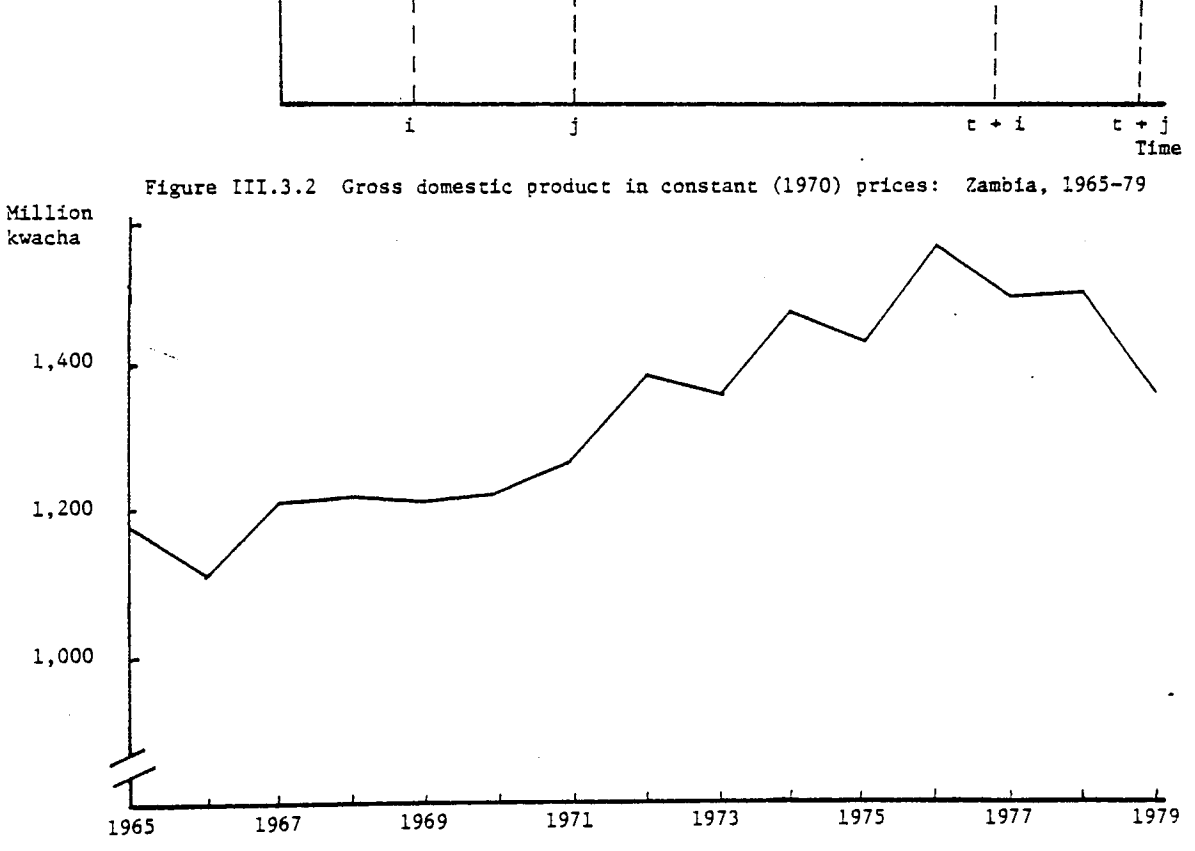


Figure III.3.2 Gross domestic product in constant (1970) prices: Zambia, 1965-79



Source: Appendix S, Table S.1.2.

It is desirable therefore to devise some measure of average growth which takes account of the possibility of variations due to economic cycles or other abnormal factors. This is particularly true of the Zambian economy where the post-1975 recession has caused many major economic variables not only to cease growing but to fall in real terms, in some cases quite sharply. This is illustrated by Figure III.3.2 which represents Gross Domestic Product in 1970 prices for the period under study. It should be apparent from this that a much higher growth rate would be yielded by a simple geometric mean for the period 1966-76 than for the period 1969-79. Neither would provide an acceptable summary measure for the growth performance over the entire period.

A fairly common method is to estimate a trend line, by least squares regression, and then to calculate a growth rate from this (usually exponential) trend line. In an attempt to improve upon this, Bell, Silver and Stray (1981) have suggested the following procedure:

1. Determine the mathematical function which best fits the data series using least squares regression.
2. Obtain estimates of the initial and final points from the line of best fit.
3. Use the observations so estimated to calculate a geometric average growth rate.

This procedure has been applied to various Zambian data series using the four mathematical curves applied in the study mentioned above. These were:

a) Linear $X_t = a + bt$

b) Exponential $X_t = ae^{bt}$

c) Power function $X_t = at^b$

d) Logarithmic parabola $X_t = ae^{(bt + ct^2)}$

The results are summarized in Table III.3.1.

It will be noted that in six of the seven cases the logarithmic parabola is the curve of best fit. This curve and the exponential yield virtually identical results, as did the empirical testing conducted in the Bell/Silver/Stray study on the growth of industrial output in eleven OECD countries. It is also evident that the use of these alternatives yield very substantial differences from the geometric mean growth rate calculated directly from the original data.

For these reasons it was decided to use the "exponential least squares" growth rate: firstly, because unlike the crude geometric mean it takes account of all observations; secondly, because the "best fit" method involves considerably more computation, and it appears unlikely that substantial variation would occur in the majority of cases; and thirdly because of the greater ease of interpretation involved with using a standard method. However, in cases where it appears necessary, or where growth rates are central to the discussion, the "best fit" methodology has been used.

The exponential least squares method involves fitting the data to the curve type:

$$X_t = ae^{bt}$$

Then the average rate of growth between X_1 and X_t is seen to be

$$r = \left(\frac{X_t}{X_1}\right)^{1/(t-1)} - 1$$

$$= e^{b} - 1$$

Table III.3.1 Growth rates estimated from alternative trend curves (a)

Growth rate:	Geometric mean (b)	Exponential (c)	Best fit	Best fit curve type
1. GDP-Total	0.98	2.03	2.03	Logarithmic parabola
Categories of expenditure				
2. Government final consumption	4.72	5.53	5.53	" "
3. Private final consumption	0.014	-0.81	-0.81	" "
4. Gross fixed capital formation	-2.93	-1.90	-1.9	" "
Kind of economic activity				
5. Manufacturing	5.12	4.39	4.39	" "
6. Mining	-3.46	-1.62	-2.23	Power function
7. Non-mining GDP	3.16	3.58	3.58	Logarithmic parabola

(a) Based on GDP data at 1970 prices.

(b) $r = \left(\frac{X_t}{X_1}\right)^{1/(t-1)} - 1$

(c) $r = e^{b} - 1$ where b is estimated from the relationship $X_t = ae^{bt}$ using least squares regression.

Source: Calculated from Appendix S, Table S.1.2 and S.1.4.

APPENDIX V.1 TECHNICAL FEATURES OF COPPER MINING AND PRODUCTION

The contents of this Appendix are largely based upon the extensive survey of the international copper industry by Whitney (1979).

Natural occurence: Copper occurs in three types of natural minerals: sulfides, carbonates and silicates, the former being the most significant in terms of known and viable deposits. The copper content of these ores typically ranges from 0.5 to 6.0 per cent, a considerably lower metal content than, say, iron (22 to 55 per cent) or aluminium (22 to 28 per cent). The ore is found in three main categories of deposits:

(i) Porphyry deposits: Found in rocks of igneous origin, and usually consisting of sulfide ores, these are located in North, Central and South America, the Philippines, Indonesia and Papua New Guinea. Ore grades in this category are generally fairly low, rarely exceeding 2.0 per cent.

(ii) Strata-bound deposits: Found in marine sedimentary rocks, containing all three of the main ore types. Ore grades are typically much higher than porphyry deposits, ranging from 2.0 to 6.0 percent. This type of deposit is found almost exclusively in the Central African "copperbelt" i.e. Zambia and Zaire. (Zambian deposits are predominantly sulfides with a copper content of between 2.0 and 4.0 per cent. The Zairois deposits are carbonates and silicates with a rather higher mineral content, ranging up to 6.0 per cent.)

(iii) "Massive" Sulphide deposits: this class covers a number of different geological types of ore deposit, but all containing sulfide ores. Found mainly in Canada, Australia, South Africa and Namibia, the metal content varies between 1.0 and 5.0 per cent. Copper frequently occurs in deposits of more than one economically valuable mineral; for instance large concentrations of nickel are found in the copper deposits of Canada and cobalt is found in Zaire and Zambia; the main supplies of this metal.

Reserves: Whitney defines reserves as "those portions of known copper mineral deposits that can be technologically and economically extracted at the time of determination". Thus estimates of reserves will vary with economic and technical conditions, and the variability of estimates is increased by the lack of any standardized methods or criteria for measurement, so that any attempt to estimate global reserves must depend on individual companies' estimates, with the inevitable lack of consistency which must occur. Table V.1.1 presents estimates of reserves made of Schroeder and used by Mikesell (1979). This would suggest that at the 1979 rate of consumption proven reserves have a life of about 46 years or about 220 years if "undiscovered" reserves are taken into account.

Table V.1.1 Global Reserves of copper

(Million tonnes of copper content)

	Reserves (a)	Other (b)	Total
North America	146	427	574
South America	137	218	355
Europe	6	36	43
Asia	27	64	91
Oceania	18	55	73
Africa	63	109	173
(Zambia)	(29)	(64)	(93)
Centrally Planned Economies	60	173	233
Ocean Floor (c)	-	692	692
Totals	457	1774	2,234

Notes (a) Proven resources

(b) Includes "undiscovered" deposits (hypothetical)

(c) Sea nodules; as yet not commercially exploited.

Source: H. J. Schroeder, Copper, Bureau of Mines (Washington, D.C., US Department of the Interior, June 1977) presented in Mikesell (1979, p12)

In the case of Zambia the corresponding figures are 41 years and 130 years, assuming an annual rate of extraction of 700,000 tonnes. This would suggest that the economic life of copper production in Zambia is rather shorter than the global figure, and that therefore Zambia cannot realistically expect to benefit from real price increases as reserves are depleted.

Copper Extraction: Three main stages may be identified in the process of extraction and the preparation of the refined metal:

(1) Mining: Two main types of mining may be distinguished: open-cast and underground, and the type adopted will depend on cost and local geological conditions, the depth of ore, concentration and so on. Both types are employed in Zambia, often in close proximity, as for instance in the Chingola Division of Nchanga Consolidated Copper Mines, which has one of the largest open pit mines in the world together with significant underground mines. However since the main ore body runs at an oblique angle to the surface a point in time will be reached when it is no longer economically viable to extract by open cast methods and a decision must then be made whether to continue exploiting the ore body by underground mining.

(2) Concentration and smelting: Several different processes exist for concentrating ore after it has been mined, and the choice largely depends on the type of ore involved. Sulfide ores can be concentrated by a process of flot-

ation, which separates from finely crushed ore particles of copper bearing minerals which are then skimmed off. This process produces concentrates bearing 25 to 30 percent copper by weight. Oxide ores (i.e. the silicates and carbonates) are more appropriately treated by a leaching process, in which copper is separated from the copper-bearing mineral by chemical reaction with a dilute acid solution. Several variations of this method are employed. Since it is a relatively new technology in certain of its forms, it has become possible to treat dumps of waste containing considerable amounts (often over 1.0 per cent) of copper in oxide form which could not previously be treated. This is a process in which the Zambian mining companies are considering investment because of the relatively low unit cost of production. The final stage of the leaching process is to extract purer copper by precipitating it on scrap iron or by an electolytic process. Some variants of this process produce copper sufficiently pure to eliminate the need for further refining before use in certain end-products (e.g. in copper wire).

The main alternative process of concentration is smelting, used mainly in the extraction of copper from sulphides. The processes usually roast the ore to reduce the sulphur content, then smelt the product to produce a

copper matte from which copper blister is prepared. These processes produce blister which contains 95 percent or more copper.

Certain processes result in the production of substantial quantities of sulphuric acid as a by-product of smelting, for which markets are sometimes available; if not then the disposal of the acid can become an environmental problem.

(3) Refining: There are two main types of refining process used to obtain copper that meets the required standards of purity: usually at least 99.9 per cent pure. Fire refining is no longer extensively used; it uses reverbatory furnaces where the metal is refined in its molten state. The more common technique is electrolytic refining in which unrefined copper in the form of anodes is treated by an electro-chemical process to yield pure copper in the form of copper cathodes (copper is 'dissolved' from the anode and deposited on the cathode).

Scrap recovery: This forms an important alternative source from mine production. Waite (1975) notes that copper is almost indestructible and estimates suggest that 99 per cent of copper extracted is still available in circulation or could be recycled. There is no doubt that a substantial volume of annual output comes from scrap; indeed Appendix S Table S.3.1 shows that in 1979 about 33 per cent of total world demand was met by scrap recovery (excluding the centrally planned economies for which information is not available).

It is useful to distinguish "old" from "new" scrap, the former being that which is being recycled after being fabricated and disposed

of, while the latter is created during the process of fabrication, and is thus easily returned to the refineries. Large amounts of scrap typically are generated by foundries, and wire and brass mills in the process of manufacturing semi-fabricates. New scrap is easy and cheap to refine, while the variety of forms of old scrap render it rather more difficult to reclaim. The attractiveness of scrap recovery therefore depends, at least in part, on the world market price - high prices will encourage greater scrap recovery because of its cost-competitiveness. But limits exist to the amount or old scrap which be recovered with existing technology, and prices in the late 1970's and early 1980's were too low to encourage new investment either in new mines or scrap recovery smelters.

Copper products: Until recently refined copper entered the market in two main forms: cathodes and wirebars. Both of these could easily be transported and so producers distant from the main markets for copper could ship refined products to world markets competitively. However in recent years technological changes have lead to the development of processes producing continuous cast rod (CCR). This consists of rod measuring about 5/16 of an inch, and is produced in coils weighing between 2 and 6 tonnes, with up to 15 miles in one strand. This rod can then be drawn out into wire of desired diameter. CCR is not easily transported and so it must be produced close to the point of consumption, thus placing remote producers, such as Zambia, Zaire, etc. at a considerable disadvantage. A Zambian company

recently entered a joint project with a French refiner to produce CCR in France, thus removing from Zambia the chance of creating domestic value added on the final stage of production.

Fabrication and Consumption: Refined copper is mainly used by the "semi-fabricators", that is industries producing intermediate copper goods. Principal among these are wire mills, brass mills and foundries. The final demand for copper comes from a wide range of economic activity, including: electrical and electronic products, engineering, consumer durable goods, motor vehicle manufacture, military equipment and coinage.

Copper has been so widely used because of its high electrical and thermal conductivity, but its bulk relative to certain other substitutable products has become one of its major disadvantages. Aluminium has been the largest single competitor because of its superior all-round attractiveness for long-distance high voltage power transmission lines. Aluminium had become somewhat cheaper in production before the oil price revolution in 1973. Further real increases in energy costs may render copper more attractive in marginal cases, because of the energy-intensity of aluminium production. A more recent threat has come in the telecommunications industry with the development of fibre optics, which if fully developed would replace a large part of the demand for copper from that industry. However, new applications are occasionally forthcoming: for instance, panels used in the production of solar energy use large amounts of copper, although this is unlikely to constitute a major source of demand in the near future.

Demand for copper has also been reduced by advances leading to the more efficient use of copper, such as the ability to produce tubes with thinner walls.

Substitution and increased efficiency in utilization mean that although demand for copper may be expected to grow in line with world production, the rate of increase of the former will tend to be somewhat slower.

A final reason for a reduction in demand for primary copper is that techniques for recovering scrap copper are steadily being improved, so that at least part of any increase in demand can be met from this source.

APPENDIX V.2 GLOSSARY OF TERMS RELATING TO FUTURES TRADING

Arbitrage The purchase (usually simultaneous) of futures contracts in one commodity market and the sale of a contract of the same amount in another market(often in another country) in order to profit from a differential in price between the markets.

Backwardation Differential in price between spot or near dated contracts and longer dated contracts in which the price of the former exceed the latter.

Clearing house An organisation associated with a futures market which arranges the settlement or closing out of all futures contracts made during a certain period. A leading example in the UK is the International Commodities Clearing House (ICCH), which handles contracts on many of the "soft" commodity markets. In most cases the clearing house acts as principal in settling contracts between traders on the futures market.

Comex The New York Commodity Exchanges in general, but the term is frequently used to describe the "free market" price in New York for copper.

Contango (forwardation) The more normal situation in which forward prices exceed spot or near dated contract prices. The reverse of backwardation.

Forward contract A contract between two traders for delivery of a specified amount of a given quality of a commodity on an agreed date. The contracting parties must conclude the contract themselves, that is there is no possibility of closing out as in the case of futures trading.

Futures contract Similar to a forward contract except that a trader who initiates a contract need have no intention of ultimately taking delivery or supplying the commodity, that is it is possible to close out by buying or selling an equal amount to that originally contracted.

Hedging Establishing a position in the futures market oppostie to that held in the physical market. That is, the risk of price variations on a physical position is eliminated.

London Metal Exchange (LME) The commodity market on which trading is conducted for copper, lead, zinc, tin, nickel, aluminium and silver. Differs from most established exchanges in that a large volume of the trading which takes place is in physical contracts, and futures trading is limited to three months forward. Thus it effectively combines the functions of spot, forward and futures trading.

Options An option allows the holder the right to buy from or sell to the grantor a specified quantity of a commodity at an agreed price

known as the basis price. A call option permits the holder to buy from the grantor, while a put option gives the right to sell to the grantor. A double option gives the holder either to buy or to sell during its validity. A premium is paid to the grantor in each case regardless of whether the option is exercised. In the case of the double option the premium is twice that on the put or call option.

Physical trading The actual trading in commodities, the large majority of which is undertaken outside commodity exchanges, but which can also be conducted on the exchanges often as part of a speculative strategy.

Spot prices Prices prevailing in respect of commodities on the physical markets, i.e. for immediate settlement.

Straddle The simultaneous purchase of a futures contract for a particular forward month, and the sale of an equivalent amount in a different month and a different commodity or exchange. A generic term which includes the more limited operation of arbitraging.

For more details and other market expressions refer to Granger (1979) and Wolff (1980).

Appendix IX.1 The Measurement of Indebtedness

The following variables are used:

DS - debt service in a year which is equal to amortization (A) plus interest and other service charges (I).

DOD - debt outstanding and disbursed - i.e., the balance at year end.

DSR - debt service ratio, equal to debt service (DS) divided by exports (X) of goods and service.

DB - disbursements during a given year.

NT - Net transfer, equal to disbursements less total debt service (DB - DS).

NF - net flow, equal to disbursements less amortization (DB - A).

A - amortization (payments of principal) during the year.

I - payments of interest and other service charges.

GNP (GDP) - Gross national (domestic) product.

X - Exports of goods and services (generally taken here to be all current account receipts).

M - imports of goods and services (taken to be all current account payments).

R - gross international reserves.

ND - net external debt (see 3(ii) below).

All the above except DOD and R are flow variables representing inward, outward or net transfers.

Dhonte (1975, and 1979 pp. 31-33) presents a useful two-way classification among various ratios based on a principal components analysis of these variables in 69 developing countries which did not experience severe debt servicing problems during the period 1969-75. He distinguishes:

a) indicators of exposure to debt subdivided among past and current exposure, and

b) roll-over conditions.

There is also a presentation in IMF (1981 pp. 47-50) of some other measures which provides fuller discussion of each than is undertaken here. The following classification is based largely on these two.

1. Indicators of exposure:

a) Past reliance: (i) DOD/X - relates the balance of debt outstanding to the country's foreign currency earnings.

(ii) DOD/GDP -relating the debt outstanding to the country's total production. Since there is wide variation in the degree of openness among developing countries, the use of DOD/X may suggest a degree of exposure in a relatively closed economy which would be unacceptable in a more open economy. Thus it is necessary to look not only at the foreign currency implications of debt but also at the total productive capacity of the economy. It should also be noted that a high external debt ratio (whether DOD/X or DOD/GDP) does not necessarily imply a high debt service ratio: the latter will also be determined by the average terms of borrowing.

(iii) Debt service ratio: DSR=DS/X. The most commonly used of the indicators of indebtedness, it measures the total outflow on account of past borrowing relative to current export earnings. In many LDCs the DSR is sensitive to export earning instability - a rising DRS can result from a decline in the price of a commodity. Associated measures would be A/X and I/X. It is suggested that the distinction between interest and amortization is of little interest to countries whose creditors are official agencies which lend for specific projects. Principal cannot easily be rolled over. Countries whose main creditors are banks making non-specific loans are far more likely to be able to "roll over." The distinction between A and I then becom

b) Current reliance: (iv) DB/M - measures the proportion of a country's imports financed by total inward transfers from external loans. However, because the total outflow for debt service can vary between countries, a somwhat better comparative figure may be given by one of the following two indicators.

(v) NF/M - since this excludes interest payments it excludes an important cost of foreign borrowing and is therefore less satisfactory than the following.

(vi) NT/M - the net transfer measures the additional resources available to a country on account of foreign loans and the ratio NT/M shows the reliance on such inflows for financing imports.

(vii) NT/GDP - This indicates the contribution of net foreign savings to GDP; it is directly comparable with savings and investment ratios (but only if the debt data is really comprehensive)

2. Roll-over conditions

(viii) DS/DB - the proportion of annual disbursements which are paid out in debt servicing. A high ratio might indicate that a country was in difficulty over its debt management polices, i.e. that it was unable to raise additional loans. It might also reflect a sudden rise in interest rates, for instance where a high proportion of a country's debt carries variable rates. Finally it would also occur in a country late in the "debt cycle" which was decumulating its debt outstanding. Thus international comparisons must be treated with some caution. An associated measure (which would eliminate the interest rate problem) would be A/DB, using amortization only.

(ix) DS/DOD - The former measure is a marginal concept: the amount of new loans taken up by debt service. DS/DOD is an average concept and a rise in this

ratio might indicate a country having problems in debt sevicing: e.g. those associated with "bunching" or a significant deterioration in the terms of borrowing (rising interest rates or shortening maturities.)

3. Other indicators

(i) Growth rates of X and GDP - Dhonte finds these to be closely correlated in the non-problem countries; that is, a successful country not only has an acceptable level of exposure and good "roll-over conditions but also maintains a balance between the growth of total output and exports. If exports grew more slowly, then growth financed by foreign savings would, as debt accumulated, lead to problems of servicing.

(ii) ND/X and ND/GDP - ND is defined as

$$ND = DOD - R + \frac{p}{12} M$$

where p is the number of months imports which represent a minimum working balance for international reserve. This indicator, net external debt, used by the IMF (1981, p.50), allows a formal assessmnet to be made of the trade-off between increased in-debtedness and the decumulation of reserves which in reality confronts many countries.

Grant element (grant equivalant) The definition used by the World Bank (World Debt Tables and Annual Reports) is used here. The grant equivalent is "The face value of the commitment minus the discounted present value of the future flow of repayments of principal and payments of interest. The grant element is the grant equivalent expressed as a percentage of the face value of the commitment. The discount rate used is 10%, the conventional rate used by the Development Assistance Committee of the OECD in assessing terms" (World Bank World Debt Tables 1980 Vol I, p. xxx)

Appendix IX.2 Mathematical Notes on Debt Accumulation (1)

The domestic resource gap

From Chapter 9, section 9.2, the following equations are taken.

(9.1a) $Y_t = Y_0 e^{gt}$ (1)

(9.3) $S_t = sY_0 e^{gt}$ (2)

(9.4) $I_t = kgY_0 e^{gt}$ (3)

(9.8) $\Delta D = I_t - S_t + i\, D_{t-1}$ (4)

Adopting continuous time fomulation, and substituting (2) and (3), (4) becomes

$$\frac{dD}{dt} = (kg - s)\, Y_0 e^{gt} + iD$$

(assuming that $D_t \simeq D_{t-1}$)

Equation (5) is a linear differential equation of the first order of the form

$$\frac{dD}{dt} + PD = Q \quad (6) \text{ where } P = -i \text{ and } Q = (kg - s) Y_0 e^{gt}$$

The particular solution to this is given by the general form (e.g. see Yamane (1968, p 308))

$$D = e^{-\int P\, dt} \int_0^t e^{P\int dt} Q dt + ce^{-\int P\, dt} \qquad (7)$$

integrating in each case over the period o to t. Apply the form (7) to equation (5)

$$D_t = e^{it}\int_0^t \left(e^{-it} \cdot (kg - s)\, Y_0\, e^{gt}\right) dt + ce^{it}$$

$$\left(\text{since } \int_0^t P\, dt = \int_0^t -i\, dt = -it\right)$$

$$= (kg - s)\, Y_0\, e^{it}\int_0^t e^{(g-i)t}\, dt + ce^{it}$$

$$= \frac{kg-s}{g-i} Y_0 e^{it} \left[e^{(g-i)t}\right]_0^t + ce^{it}$$

$$\therefore \quad D_t = \frac{kg-s}{g-i} Y_0 e^{it} \left[e^{(g-i)t}\right]_{-1} + ce^{it} \qquad (8)$$

By substitution, it may be seen that

$$D_0 = c$$

It is assumed that $D_0 = 0$, that is in the initial year there is no accumulated debt and hence from (8) we have the result in (9.10) in chapter 9.

$$D_t = \frac{kg-s}{g-i} Y_0 \left(e^{gt} - e^{it} \right) \qquad (9)$$

The foreign resource gap

Consider equations (9.4), (9.7) and (9.12) in chapter 9, that is

$$\Delta Dt = M_t - X_t + i D_{t-1} \qquad (10)$$

$$X_t = X_0 e^{xt} \qquad (11)$$

$$M_t = a X_t^b \qquad (12)$$

As before adopting continuous time notation and substituting

$$\frac{dD}{dt} = a X^b - X_0 e^{xt} + iD$$

$$= a X_0^b e^{bxt} - X_0 e^{xt} + iD \qquad (13)$$

This is a linear differential equation of the first order of the form

$$\frac{dD}{dt} + PD = Q \qquad \text{where } P = i \quad Q = a X_0^b e^{bxt} - X_0 e^{xt}$$

the solution of which is given by equation (7), and the particular solution to (13) is given by

$$D_t = e^{it} \int e^{-it} \left(aX_0^{\,b} e^{bxt} - X_0 e^{xt} \right) dt + ce^{it}$$

since $\int_0^t P\,dt = \int_0^t -i\,dt = -it$

$$\therefore D_t = \frac{aX_0^{\,b}}{bx-i} (e^{bxt}-e^{it}) - \frac{X_0}{x-i} (e^{xt}-e^{it}) + ce^{it} \quad (14)$$

When $t = o$, $D_0 = c$

Assume that debt outstanding in initial year is zero, i.e. $c = o$.

Thus, from (14) the equation (9.14) in chapter 9 is

$$D_t = \frac{aX_0^{\,b}}{bx-i} (e^{bxt} - e^{it}) - \frac{X_0}{x-i} (e^{xt} - e^{it})$$

Note

(1) Notation used is the same as chapter 9, section 9.2

APPENDIX IX.3 STATISTICAL SOURCES FOR EXTERNAL INDEBTEDNESS

Comprehensive data on international indebtedness and related financial flows is far from satisfactory. Large numbers of developing countries do not collect data on foreign borrowing by all national institutions. Among these is Zambia. As long as a country is not heavily indebted it will not perceive this as an area warranting a significant concentration of scarce skilled manpower resources, and in Zambia's case it is probably not an exaggeration to say that its indebtedness became problematic so quickly that its available personnel were used to resolve the difficulties rather than tabulating the causes.

The only Zambian source in which some data is presented systematically is the Government of Zambia, Financial Report (annual). However this provides satisfactory coverage on both stocks (or balances) and flows for the central government only (local authorities are not empowered to borrow abroad). Some information is available for debt guaranteed by the government, but this is presented only in the form of contingent liabilities compatible with a balance sheet concept. That is, the data given show a single figure measuring the government's total liability at the end of each year with respect to both the principal outstanding and the total interest payable from the current date to final maturity. Since interest rates are not always stated in the

available details there is no way of even estimating information on this publicly guaranteed debt.

There are no other published national sources of Zambian indebtedness since the Central Statistical Office's data on the balance of payments (published in the Monthly Digest of Statistics) is highly aggregated, particularly on capital account and, is typically several years out of date.

However, there exists on the files of the Bank of Zambia most of the information necessary to commence a fairly comprehensive survey of the country's debt. This data was collected for the purposes of exchange control and would be available for most large companies (which would be the major external borrowers) from at least the mid-1970's when increasingly tight exchange controls were imposed and would cover both guaranteed and non-guaranteed debt. The only obstacle to preparing a compilation is the administrative one of extracting information from company files (for past information) and of ensuring that future returns from companies are gathered in a fashion compatible with the needs of the Bank's Research Department. The volume of information is fairly small, and should be within the capacity of the current generation of microcomputers, even if no other facilities are available. The government and Bank of Zambia are urged to complete this exercise which was proposed at least as far back as 1976.

Since national data sources are so inadequate resort has been made to the various international sources. The problem then

is that most such collections tend to be biased towards the perspective of the creditors-disaggregation by debtor country is rare (except among World Bank publications) and further levels of disaggregation (e.g. by type of borrowing institution or sector) within individual countries are not available systematically.

Several international data sources are available:

1. The Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development (OECD) publishes data in its Annual Reports and in "Development Co-operation: Efforts and policies of members of the Development Assistance Committee", a periodic review. The data is not made available on an individual country basis.
2. The Bank for International Settlements (BIS) publishes some information in its Annual Reports, but this only shows flows from donor countries which are also members of the BIS.
3. International capital markets provide some statistics on new and publicized medium and long term international loans and bond issues. A good example is Morgan Guaranty's World Financial Markets which also demonstrates the shortcomings of this source: systematic historic analysis is difficult; unpublicized debt is excluded; much official non-market lending is not included;

disbursement, amortization and interest flows are not documented. The publication is good (and prompt) for assessing the current state of the international capital markets.

4. The World Bank's debtor reporting system (DRS) provides good historic coverage of debt from the perspectives of both creditor and debtor nations. In the past it was released annually as a mimeographed collection in the World Bank's World Debt Tables; from 1982 it is published on a more formal basis.

Since the World Bank's World Debt Tables provide data on an individual country basis, the data form an acceptable substitute for national sources, where, as in Zambia, there are not available, and the data used in this volume is almost exclusively drawn from this source. Although the Debtor Reporting System provides good cover a number of qualifications and shortcomings in the system must be noted in interpreting the data:

a) the DRS, because it relies on debtors (usually governments) for its information, shows only public and publicly guaranteed debt. It does not show private non-guaranteed debt for individual countries although some estimates of aggregates for groups of LDCs were shown in the 1980 edition of the World Debt Tables;

b) it excludes short term debt, i.e, that with an original maturity of less than twelve months;

c) it excludes IMF facilities other than Trust Fund loans, which in some cases (especially Zambia) can constitute a very substantial proportion of total external borrowing and debt service;

d) the individual country data is not disaggregated by type of borrower (e.g. by sector or by type of institutional - parastatal, private or government). It is believed that unpublished DRS data would permit such analysis: the author was not able to gain official access to such information;

e) the construction of long time series from overlapping shorter series proved almost impossible. This is because of unrecorded adjustments and cancellations and changes in classification to amounts outstanding and unspecified improvements in reporting and coverage. The practice adopted was simply to use the most recent information available - but this means that absolute amounts and growth rates may not be strictly accurate;

f) finally the DRS takes no account of the arrears on external payments or of the interest paid to these "involuntary creditors."

Some idea of the accuracy of the information available from different sources is provided by Table IX.3.1. Columns (1) and (2) compare an aggregate which should be the same in both cases, while column (3) shows the precentage variation between the two. Although the deviation has been as high as 12 per cent, it is seen that the level of indebtedness is of the same order of magnitude, and that the year-to-year variations are roughly the same in each case. This cannot be said for the series in columns (4) and (5) of Table IX.3.1. "Other investment income" (column 4) would include interest on short terms loan, arrears, IMF facilities and non-guaranteed private debt not included in the DRS concept of interest (column 5). The large variation particularly in the 1970's gives a good indication of the amount of external indebtedness which is omitted by the DRS definitions.

Table IX.3.1 Zambian external debt aggregates: comparison of statistical sources

	Amounts outstanding			Service	
	Ministry of Finance (1)	World Bank (DRS) (2)	Percentage deviation ((2)-(1) / (1) x 100%)	Other investment income (IMF) (4)	Interest (a) (DRS) (5)
1967	135	149	10.4	17	5
1968	167	163	-2.4	9	4
1969	203	200	-1.5	17	9
1970	473	417	-11.8	27	14
1971	434	421	-3.0	34	20
1972	458	454	-0.9	82	22
1973	400	420	5.0	81	53
1974	454	490	7.9	85	24
1975	704	708	0.6	60	25
1976	989	985	-0.4	96	39
1977	979	1067	9.0	103	43
1978	1084	1144	5.5	82	33
1979	1253	1246	-0.6	98	36
1980	...	1320	...	181	58

(a) Interest used because consistent time series of loan repayments not available is balance of payments presentation.

Source: Calculated from (1) Republic of Zambia Financial Reports (annual issues) Lusaka: Ministry of Finance; (2) Appendix S Table S.9.1; (3) International Monetary Fund, Balance of Payments Yearbook (various issues)

Appendix IX.4. GLOSSARY OF TERMS USED IN CONNECTION WITH INTERNATIONAL MONETARY FUND.

I. General terms

Charges - levied at various rates on outstanding balances under all facilities except Reserve tranche. Equivalent to interest rate on loans. See IMF Annual Report 1981 (Table I-II pg.129) for current charges.

Conditionality - the system of economic conditions (balance of payments, fiscal, monetary, etc.) attached to members use of resources. Degree of severity varies with facility.

Facility - name applied to the different types and purposes of IMF resources made available to members.

Purchases - refers to system under which member "purchases" foreign currency from the Fund using its own currency. Since no change in IMF assets/ liabilities occurs the normal terminology of lending operations is not used. For developing countries using non-convertible currencies the transaction is analytically the same as borrowing.

Quota - a member's contribution to the IMF's resources. Based on an assessment of the country's share in international trade, payments and reserves. Used as the basis for calculating member's eligibility for and access to individual facilities. They are reviewed periodically The Eighth review was under way in 1981.

Remuneration - Payments by the Fund on countries' holdings of SDRs.

Repurchases - the repurchase of a member's own currency from the Fund. The opposite of purchase (see above), it is analytically equivalent to amortization.

Special Drawing Rights (SDR) - effectively the currency unit of the IMF. Initially defined as one ounce of gold (pre-1971), its calculation system has changed several times and is based on a basket of currencies. From 1 January 1981 the basket of currencies was reduced from 16 to 5 (US dollar, deutsche mark, French franc, Japanese yen and pound sterling - initial weights 42,19,13,13,13). A slight variation was introduced subsequently which allocated specific numbers of units of each currency to one SDR.

Stand-by arrangement - where Fund resources are put at the disposal of a member for draw down if necessary.

II. Facilities (figures given apply to 1981)
Except where stated all facilities financed by members' subscriptions.

Reserve tranche - (formerly the gold tranche) 25 per cent of the quota which members are required to contribute in reserve currencies. Available to any member requiring balance of payments support; no conditionality.

Credit tranche -The main source of access to Fund resources usually under a stand-by arrangement for members requiring general balance of payments support. Four tranches available each of 25 per cent of quota; conditionality increases as higher tranches used.
Charges - 6.25 per cent; Repurchase - 3 to 5 years.

Compensatory Financing Facility (CFF) - available to members to stabilize export earnings where deviations occur away from trend values. Up to 100 percent of quota. Limited conditionality.
Charges - 6.25 per cent; Repurchase - within 5 years.

Buffer Stock Financing Facility (BSFF) - available to members with balance of payments problems to finance contributions to international commodity buffer stock arrangements, up to 50 percent of quota (little used because of rarity of suitable buffer stocks).
Charges - 6.25 per cent; Repurchase - within 5 years.

Oil facility - introduced for 1974 and 1975 only, to assist members overcome balance of payments caused by the 1973/4 oil price revolution. Financed by borrowing from surplus countries. No longer available.
Charges - ranging between 6.9 and 7.9 per cent;
Repurchase - 1 to 7 years.

Extended Fund Facility (EFF) - available for countries with serious balance of payments problems or poor growth performance caused by structural imbalances. Amounts available up to 140 per cent of quota for a total of 165 per cent combined with credit tranches).
Conditionality intense.
Charges - 6.25 per cent; Repurchase - 4 to 10 years.

Supplementary Financing Facility (SFF) - nicknamed the Witteveen Facility after the former Managing Director of

the Fund who introduced it. Available to countries requiring more resources than available under credit tranches or EFF under stand-by arrangements. Amounts available up to 102.5 per cent of quota, through can be exceeded under some circumstances. Financed by special loans from 14 member countries; operational from 1979. Charges - cost of borrowing plus spread of 0.2 to 0.325 per cent; Repurchase - 3 1/2 to 7 years.

Enlarged Access Policy - Temporary facility introduced to allow members enlarged access pending agreement of the Eighth Review (i.e. revision and increase) of quotas. Financed by special loans. The main source of the 1981 programme for Zambia.
Charges - cost of borrowing plus spread of 0.2 per cent
Repurchase - 3 1/2 to 7 years.

Trust Fund - Not a facility in the normal sense. Established from the proceeds of sales of one-sixth of IMF gold holdings in 1976. Conventional (but concessional) loans are made from this to countries (mainly low income countries). Conditionality as for first credit tranche.
Interest rate - 1/2 per cent.
Repayment - 6 to 10 years.

III. Other information:

Total outstanding balances under IMF facilities is currently restricted to 600 per cent of a country's quota (excluding Trust Fund BSFF and CFF and oil facility balances). Other restrictions apply to drawing during given periods. Zambia's quota after the Seventh General Review was SDR 211.5 million

Sources: IMF Annual Report 1981, pp. 83-88 and Table I.11 p.129.

IMF International Financial Statistics March 1982, pp.5-6.

APPENDIX XI.1 A RUDIMENTARY MACRO-ECONOMIC MODEL FOR ZAMBIA

1. Introduction

In embarking on a modelling exercise for the Zambian economy, three objectives were perceived: firstly, to examine whether such an exercise was feasible in terms of economic theory and available econometric techniques; secondly, to vary policy or other exogenous variables within the model to examine the extent to which Zambia's economic performance might have been different in other circumstances; and thirdly, to prepare a framework within which projections of short to medium term developments in the economy might be forecast given certain assumptions about exogenous variables. The satisfactory realization of the second and third objectives was clearly subject to the outcome of the first.

There have been at least three recent attempts to model the Zambian economy (Blitzer (1978), Nziramasanga and Obidegwu (1981), and McPherson (1978)), and undoubtedly such organisations as the World Bank and the International Monetary Fund will have constructed their own models for internal policy purposes. However the formulations available had rather different policy objectives to that envisaged here: Blitzer concentrated on the role of the rural sector and is conceived as a long term model, McPherson's emphiasis was employment, while Nziramasanga and

Obidegwu focused on the copper industry with particularly detailed examination of certain of the micro-economic relationships in the mining industry. Moreover, none of these three used data for years later than 1976, and thus the effects of the economic difficulties in the late 1970s would not have been captured by normal regression techniques. Indeed it is noted that the use of data for the period 1975-80 undoubtedly caused severe problems in the estimation of parameters in the structural equations, as might be expected in an economy characterized by rapid growth in the early years of the sample period, followed by some years of slower progress and tighter financial constraints, and then by stagnation or decline and severe constraints, particularly with respect to the balance of payments. This general economic pattern (observed repeatedly in the main text) can be expected to give rise to the problem of multicollinearity with serious consequences for the robustness of the results. (see Johnston (1972, pg. 160).

As a result of the estimation problems and resource constraints no attempt was made to realize the third objective outlined above. Proceeding to this stage would have produced spurious predictions based, in some cases, on parameters for which no a priori justification can be made. Thus the process described here relates only to the specification of the model, testing its predictive capacity by static and dynamic simulations using actual data, and preparing simulations based on variations in certain of

the exogenous or policy variables during the sample period (1968-80).

As the title of this appendix implies the model is rudimentary, but it is felt to represent a workable framework for the type of model which might be used by a finance ministry or other agency of government to test the medium term effects of variations in policy or changes in external circumstances. Before that could happen considerably more work would have to be done to improve the specification of the equations and the realism of the assumptions made.

2. A description of the model

The model as presented in this appendix consists of 76 basic equations and identities though some equations omitted from the presentation (consisting largely of the transformation from constant to current price forms - or vice versa) are implicit. There are 20 wholly exogenous variables some of which are beyond the control of the authorities (e.g. the price of copper) while others (such as the exchange rate, and the extension of credit to the private sector by the banking system) are taken to be subject to governmental action. While simultaneous equation estimation would be preferable for this type of model, with a large number of variables and equations many of which are clearly interdependent, there is still insufficient data for this to be attempted. It

will be at least another decade before there is sufficient data to justify a full simultaneous equation approach.

The model presented here is recursive or triangular in structure: that is, for any year each equation in the system may be solved using exogenous variables, lagged variables or values of variables obtained from equations higher in the structure. It is the last category which is particularly characteristic of a recursive system. This method is appropriate because consistent and unbiased estimators may be obtained from the application of ordinary least squares (OLS), and it can be shown that OLS yields maximum likelihood estimates of the parameters (see Johnston (1972), pp. 376-380, or Pindyck and Rubinfeld (1976, pp. 268-270).

One particular feature the model attempts to capture is the need for both constant and current price versions of all variables, to overcome the difficulties posed by the mineral sector whose real (constant price) value added has remained fairly stable, but in which the current price valuation is subject to large annual variation. Thus although value added measured in constant prices shows little change over the sample period, there was a large deterioration in important financial aggregates such as the current account of the balance of payments, the government budget deficit and mining company profitability, all of which must be measured in terms of current prices to reflect financial flows in the economy. This requirement for parallel current and constant price

formulations creates the need for a high degree of precision and accuracy in the estimation of the price or inflation equations in the model. However, the price equations in practice were perhaps the weakest link in the whole exercise, and as is noted further in section 3 the problem of prices remained intractable.

This question of deflation procedures complicated the estimation of several equations, particularly those relating to the real level of output. Nevertheless in many cases, such as government revenue aggregates, the variables used in the regression analysis were the current price forms, and the results must be interpreted with some care because of the risk of establishing spurious relationships, and the estimation problems caused by the existence of collinearity among the variables.

The central price variable used was the implicit deflator of total domestic expenditure on gross domestic product, this being preferred to the consumer price indices (which cover only a relatively small basket of goods) and the deflator of total GDP which is distorted by fluctuating copper prices, and which have little relevance for the determination of domestic prices.

The model is based around the concept of a dual economy. Four production sectors are identified: subsistence agriculture, commercial agriculture, mining and the non-mining urban sector, which consists of all other sectors (such as manufacturing, electricity and water, construction and private and public services). An attempt was made to disaggregate the non-mining urban sector

but preliminary trials yielded no satisfactory relationships. Following Blitzer (1978) an attempt was made to fit Cobb-Douglas production functions to these sectors' output (Blitzer also identified an "emergent farming" sector), but, as is described in Appendix XI.2, without success. In the final structure, output by the subsistence sector was determined by the size of the rural population (that is essentially a labour based approach) while the output in the other sectors was significantly determined by the measure of output capacity developed (which is based on capital stock). A further distinction is drawn in which the "modern sector" is defined as commercial agriculture, mining and non-mining urban production.

Migration between the rural and urban sectors is a critical problem in Zambia as in other less developed countries. An explanation based on crude differences between average estimated earnings in the two sectors proved unsuccessful, but a weak relationship was discovered between the proxy variable for migration and the rate of growth of urban employment. The labour forces in the rural and urban sectors is taken to be a function of the pertinent population. Employment in the modern sector is entirely independent of the labour force, being largely determined by the level of output (a proxy for the demand for labour) and the real price of labour (earnings deflated by the price index of total domestic expenditure). However, in mining the level of employment is directly related to the size of the capital stock; output failed to provide a satisfactory prediction of employment, possibly due to

the deflation problems discussed previously. Since employment and the labour force are determined independently, it is possible to derive immediately a measure of the level of urban unemployment, which is expressed as a percentage of the urban labour force.

The balance of payments is one of the principal components of this model, and a number of different factors come into play. Export earnings when measured in foreign currency (here taken to be US dollars) are largely exogenous: prices are determined on world markets, while the volume of output and sales by the mining industry is assumed to be determined by external (mainly technical) factors. This is an oversimplification, but without very substantial new investment there is little that Zambia can do to increase the volume of output of its mines. The authorities can vary the domestic currency value of exports by variations in the exchange rate which is taken to be an exogenous (but policy determined) variable. Exports are determined initially in current prices.

The constant price level of imports is a function of the real price of imports (that is relative to domestic prices) and aggregate output of the modern sector used as a proxy measure for its demand. Interest payments on external debt, and payments for freight and insurance on imports are both endogenously determined, and combine with other invisibles to yield the current account balance. With regard to the capital account only flows on account of external borrowing are distinguished, all other capital movements being regarded as wholly exogenous and beyond the control of the authorities. The combined effects of current and capital account

result in changes to net foreign assets which constitutes the linkage between the balance of payments and the money supply. A simplifying assumption is that "net foreign assets" includes the arrears on external payments so that no distinction can be made between policies designed to improve the two aggregates.

Equations to account for the growth of external indebtedness and the associated burden of debt servicing are included, but in the simulations described in this appendix this aspect was largely regarded as passive.

Final consumption expenditure was explained by reference to the output of the modern sector, with government final consumption being determined by the level of government expenditure, and private final consumption consequently being derived as a residual. Capital accumulation is central to the determination of the measure of output capacity used in explaining production in the modern sector. Gross fixed capital formation is explained adequately by a simple accelerator model, described in the next section. Net additions to the capital stock are estimated by net fixed capital formation, derived from GFCF after an adjustment for capital consumption (used as a proxy for retirements form the capital stock).

Government revenue is explained in a number of ways: mineral revenue by output in the mining industry and the price of copper relative to other domestic prices; income taxes by the output of the modern sector; taxes on domestic expenditure (sales tax and excise duties) by the value of total domestic expenditure on GDP; and taxes

on imports by the value of imports of merchandise. All are measured in current values. Government expenditure is regarded as an exogenous variable, but one which is subject to limited variation by the authorities. The sole exception is government interest on its domestic and external indebtedness: this is enogenously determined by debt outstanding and interest rates. The brief outline given in this section is elaborated in the following section which presents an algebraic form of the model together with the estimated parameters of the stochastic equations.

The data used in estimating the equations were those contained in Appendix S of statistical tables. The only significant new series is the index of capacity utitization described in Appendix XI.2

3. Algebraic formulation of the model.

In this section the model is outlines with a minimum of discussion or comment. The recursive structive is followed in the presentation so that equations appear in the sequence required to solve the model for any given year. Table XI.1.2 contains a list of the variables included.

3.1 Population labour force and employment.

The excess (PDIF) of urban population growth (DPOPU) over the exogenously given growth rate of total population (DPOP) is used as a measure of mirgration from rural to urban areas. Neither the excess of urban over rural earnings nor the rate of change of this differential was found to provide a satisfactory explanatory variable. A somewhat better though still weak relationship was established using the lagged rate of growth of urban employment (DLURB) as the

Table XI. 1.1 List of variables used in model

Variable Name (a)	Description
Exogenous variables (20)	
POP	Total population
PCUS	Copper price per tonne (wirebars on LME) expressed as an annual average in U.S. dollars
EXRATE	U.S. dollars per kwacha (annual average)
QCU	Exports of copper (tonnes)
VCU	Production of copper (tonnes)
EXPOWP	Other non-copper exports expressed in US dollars
URTRP	Unrequited transfers (net) expressed in kwacha
IVOP	Other invisibles (net) expressed in kwacha
CAPOWP	Other (non-debt) capital account transactions (net) expressed in US dollars
FDBWP	Disbursements (gross) from foreign loans (expressed in US dollars)
WPIMP	International price of imports: index of world export prices expressed in US dollars
NCWP	New commitments of foreign loans during a given year
COPSP	Banking system claims on the private sector
OTH	Other banking system liabilities
GCE	Government current expenditure other than debt interest
GKE	Government capital expenditure
GNL	Net lending by government
GRFG	"Other" government revenue - includes grants, administrative fees, etc.

TGFDP	Net change in government external indebtedness
TGLDP	Net change in government long-term internal indebtedness

Endogenous variables (79)

X	Total gross domestic product
X1	Value added - subsistence sector
X2	Value added - commercial agriculture
X3	Value added - mining
X4	Value added - non-mining urban sector
XMOD	Value added - "modern" sector
E	Total expenditure on gross domestic product
EDOM	Total domestic expenditure on gross domestic product
CON	Total consumption expenditure
CONMP	Consumption expenditure of the modern sector
CGVT	Government consumption expenditure
CPRV	Private consumption expenditure
GFCF	Gross fixed capital formation
NTX	Net exports of goods and services
NDIP	National disposable income (current prices)
SAVP	Savings (current prices)
DEPR	Capital consumption (current prices)
NFCF	Net fixed capital formation
K	Capital stock
XC	Capacity output
POPU	Urban population
POPR	Rural population
LF	Total labour force

LFURB	Urban labour force
LFRUR	Rural labour force
L	Total employment
Li	Employment in the ith sector (i = 1,...,4)
LURB	Employment in urban sector (sectors 3 and 4) Employment in rural sector (sectors 1 and 2)
UU	Urban employment
UU%	Urban employment expressed as a percentage of the urban labour force
PIMP	Domestic currency price of imports
PEDOM	Deflator of domestic expenditure on gross domestic product
PEXP	Index of export prices (in domestic prices)
Pi	Deflator of output for sector i
EXP	Exports of goods
IMP	Imports of goods
FI	Interest on external debt
IMIF	Insurance and freight on imports
IV	Total payments on current account for services (net)
CBAL	Current account balance
FA	Amortization payments on external debt
FNF	Net flow on external debt (disbursements less amortization)
FNT	Net transfer on external debt (disbursements less debt service)
CAP	Balance on capital account transactions
NFAP	Net foreign assets (in current prices)
FDCU	External debt committed but undisbursed

FDS	External debt service
FDOD	External debt outstanding and disbursement
IMCAPP	Capacity to import (in current prices)
GRMI	Mineral revenue
GRYT	Revenue from income taxes (other than mining companies)
GRDE	Revenue from taxes on domestic expenditure
GRMT	Revenue from import taxes
GREV	Total government revenue
GINT	Interest payments on government debt
GCE	Total current expenditure
GEXP	Total government expenditure
GDEFP	Government deficit
TSTBP	Net change in short term borrowing by the government
M3P	Money supply (broad definition) in current values
DCP	Domestic credit in current prices
COGP	Banking system claims on government in current values
V_3	Velocity of circulation of money (broadly defined)
Wi	Average earnings in sector i
WAVG	Average earnings - economy wide
WURB	Average earnings in the urban sector
WRUR	Average earnings in the rural sector
W (i) DEF	Average earnings in sector i deflated by domestic price index

Notes to Table XI.1.1

(a) The following conventions are used to vary the interpretation of variables

Prefixes: T - first difference of variable concerned (e.g. TCOGP, TM3P)

D - proportionate rate of change (e.g. DM3P, DX3)

Suffices: P - indicates current price value (e.g. GFCFP, EXPP)

WP - indicates value expressed in world prices (current values); in this formulation current US dollars are used as the numeraire.

Lags and time subscripts: Lags are indicated by a subscript such as "-1" indicating a lag of one time period. All variables represent time series but time subscripts are not used being implicitly understood.

(b) All indices are expressed with 1970 = 100

(c) All constant value series are expressed in 1970 prices

independent variable suggesting that the prospect of employment rather than the size of the income differential acts as the incentive to internal migration. Indeed in Zambia, there was a negative relationship between the size urban/rural differential (which increased) and the excess of urban over total population (which decreased).

Finally the relationship establised was

$$PDIF = 2.2300 + \underset{(2.7313)}{7.7024}\ DLURB_{-1} \qquad (1) \qquad (1967\text{-}80)$$

$$R^2 = 0.3834 \quad F = 7.460 \quad SEE = 0.4803 \quad DW = 1.1002$$

$$\text{where } PDIF = \frac{DPOPU}{DPOP} \qquad (1a)$$

Since DPOP is given exogenously, the rate of growth of the urban population may be inferred from (1a), and hence the actual size in any given year of the urban population may be estimated. Rural population is estimated as

$$POPR = POP - POPU \qquad (2)$$

The urban and rural labour forces are assumed to be linearly related to the appropriate population:

$$LFURB = 44.624 + \underset{(146.531)}{0.2755}\ POPU \qquad (3) \qquad (1965\text{-}80)$$

$$R^2 = 0.9997 \quad F = 21549.2 \quad SEE = 3.622 \quad DW = 0.4054$$

$$LFRUR = 703.51 + \underset{(37.362)}{0.5388}\ POPR \qquad (4) \qquad (1965\text{-}80)$$

$$R^2 = 0.9901 \quad F = 1395.2 \quad SEE = 7.8699 \quad DW = 0.5614$$

The total labour force is given by

$$LF = LFURB + LFRUR \qquad (5)$$

Employment in commercial agriculture (L2) and the non-mining urban sector (L4) is determined by the sectoral level of output in the previous period and the lagged "real" wage in the sector. Thus it is assumed that hiring decisions are based on factors in the previous time period. A similar formulation for the mining sector produced coefficients which bore the wrong sign or which were not statistically significant. Mining employment proved to be best explained by the level of capital stock in the industry. Thus:

$$L2 = \underset{}{36.734} - \underset{(2.6849)}{0.1443}\ X2_{-1} + \underset{(0.9145)}{0.00972}\ W2DEF_{-1} \qquad (6) \quad (1966\text{-}79)$$

$R^2 = 0.3972$ F = 3.6246 SEE = 105.74 DW = 2.589

(DW lies in the inconclusive region for negative auto-correlations; the t - statistic for the coefficient of W2DEF is very low)

$$L3 = \underset{}{45.612} + \underset{(4.2217)}{0.0237}\ K3_{-1} \qquad (7) \quad (1966\text{-}79)$$

$R^2 = 0.5975$ F = 17.813 SEE = 2.6641 DW = 0.4142

(There is a serious problem of auto-correlation)

$$L4 = \underset{}{109.99} + \underset{(9.1123)}{0.1576}\ X4_{-1} + \underset{(2.0141)}{0.0424}\ W4DEF_{-1} \qquad (8) \quad (1966\text{-}79)$$

$R^2 = 0.9505$ F = 51.41 SEE = 8.7818 DW = 1.6287

It is assumed that all workers in the rural labour force not employed in commercial agriculture are engaged in subsistence activity; that is

$$L1 = LFRUR - L2 \qquad (9)$$

thus implicitly assuming that the whole rural labour force is employed.

Total employment is given by

$$L = L1 + L2 + L3 + L4 \qquad (10)$$

Urban employment (the lagged variable in equation 1) is given by

$$LURB = L3 + L4 \qquad (11)$$

An indicator of the economy's capacity to generate employment is given by the level of urban unemployment

$$UU = LFURB - LURB \qquad (12)$$

and the rate of unemployment is given by

$$UU\% = \frac{UU}{LFURB} \qquad (13)$$

3.2 Prices

The prices of Zambia's imports proved to be central in the estimation of domestic prices. The import price equation represents one means by which exchange rate variations affect economic activity in this model. A distinction is drawn between the world price of imports (WPIMP) and their domestic price (PIMP). The domestic price of imports is given by

$$PIMP = \frac{1 + TF_{-1}}{1 + TF_{70}} * \frac{WPIMP}{EXRATE} \qquad (14)$$

$$\text{where } TF = \frac{GRMTP}{IMPP} \qquad (14a)$$

The factor TF is used to capture the effect of variations in the import tax regime, and is estimated for each year by the value in the previous year in order to retain the triangular structure.

The estimation of domestic inflation proved to be an intractable problem. A large variety of single equation models was tested including formulations with rates of change and absolute levels of the variables. The index used to estimate inflation was the implicit deflator of domestic expenditures on GDP. Although this was used in preference to the indices of consumer prices it was found to correlate very closely with the index of consumer prices for low income households ($R = 0.9937$) and it was therefore felt to be a satisfactory measure of domestic inflation, as well as representing the price of all domestically traded goods (including capital goods and raw materials) and not simply those goods in the fairly restricted basket of consumer goods.

Among problems encountered in estimating the rate of inflation or the absolute price level were:

(i) monetary variables tended to show very low correlation coefficients with individual variables, low coefficients of determination or coefficients whose signs conflicted with *a priori* theory, or which were not significantly different from zero, results confirming the evidence of Chapter 7 section 7.7; the introduction of the velocity of circulation to basic monetary formulations did not appear to improve the strength of monetary explanations of inflation.

(ii) more eclectic models were used with such variables as average wages (level and rate of change), the level of

capacity utilization (see Appendix XI.2), rates of growth of output, in various combinations, but no conclusive results emerged consistent with accepted economic theory;

(iii) a particular problem was posed by the specification of the model and the attempt to achieve a recursive or triangular structure which required a price equation early in the solution and hence the use of lagged or exogenous variables. High priority needs to be given to a specification of inflation in any further development.

In all formulations domestic prices were found to be closely correlated with the "domestic" price of imports (that is the domestic currency tax inclusive price of imported goods). In view of the inability to produce alternative satisfactory single equations it was decided to use the simple bivariate relationship between domestic and import prices to provide a prediction of price levels, a procedure felt to be adequate for certain limited simulation purposes but an aspect of Zambia's economic performance and structure requiring much closer study than could be done in this study.

$$PEDOM = \underset{(32.326)}{0.3291 + 0.6339\ PIMP} \qquad (15)$$

$R^2 = 0.9867$ $\quad F = 1044.6$ $\quad SEE = 0.0816$ $\quad DW = 1.5092$

The implicit deflators of subsistence and commercial agriculture and of non-mining urban output were estimated using domestic prices as the explanatory variable.

$$P1 = 0.1597 + 0.8885\ PEDOM \qquad (16) \qquad (1965\text{-}80)$$

$$(30.098)$$

$$R^2 = 0.9848 \qquad F = 905.70 \qquad SEE = 0.0784 \qquad DW = 1.0612$$

$$P2 = 0.1750 + 0.7698\ PEDOM \qquad (17) \qquad (1965\text{-}80)$$

$$R^2 = 0.9316 \qquad F = 190.61 \qquad SEE = 0.1481 \qquad DW = 0.7482$$

$$P4 = 0.1941 + 0.7938\ PEDOM \qquad (18) \qquad (1965\text{-}80)$$

$$(47.333)$$

$$R^2 = 0.9938 \qquad F = 2241.6 \qquad SEE = 0.0445 \qquad DW = 2.7037$$

The estimation of an implicit deflator for mining output is complicated by the variability of mineral prices. In the Zambian National Accounts a double deflation procedure is used and this was reflected in the procedure adopted here, in that an index of copper prices expressed in domestic currency (kwacha) was adjusted by a cost factor which assumed that costs of production grow at a constant rate. Thus

$$P3 = \frac{1}{(1+c)^t} * PCUIND \qquad (19)$$

where c is the annual growth rate of costs of production,

t is measured with the base year (1970) as 0

PCUIND is PCU expressed as an index with 1970 = 100.

Finally it was necessary to provide an estimator of the implicit deflator of export earnings for the deflation of current aggregates in the national accounts. This was provided by an estimate based on the index of copper prices used in (15) again reflecting the dominance of copper in the country's exports:

$$PEXP = -2.745 + \underset{(27.949)}{113.466}\ PCUIND \qquad (20) \qquad (1965\text{-}80)$$

$R^2 = 0.9824 \qquad F = 781.1 \qquad SEE = 4.1338 \qquad DW = 2.074$

3.3 Output

Following Blitzer (1978) an attempt was made to estimate Cobb Douglas production functions for the four sectors in the model and at an economy - wide level. The results were most disappointing (see Appendix XI.2) with the explanatory variable, employment, yielding coefficients inconsistent with a priori expectations, which in many cases were negative. A production function procedure was not used. However, the measure of output capacity (described in Appendix XI.2), a capital based concept, was used in estimating output in commercial agriculture and the non-mining urban sector. Output capacity, XC, for the whole economy is estimated from

$$\ln XC = \ln\ \underset{(6.4901)}{(196.5)} + 0.2524 * \ln K \qquad (21)$$

$R^2 = 0.8404 \qquad F = 42.12 \qquad SEE = 0.0347 \qquad DW = 2.2612$

Thus the level of employment plays no part (in this model) in determining output, a result of the severe constraints on output imposed by the deteriorating financial position of the 1970's. In each sector an attempt was made to incorporate the "capacity to import" as an explanatory variable but with inconclusive results, probably due to the short period (relative to the whole period for estimation) during which the import constraint was so significant. The use of producer prices as an independent variable in agriculture did not produce statistically significant results, and there

was some evidence of a negative relationship between prices and output. Thus no support was found for Nziramasanga and Obidegwu's (1980) method which used producer prices.

Subsistence agricultural output was estimated as a function of the rural population. Thus it is assumed that pure subsistence output is just sufficient to maintain existing living standards, an approach similar to that adopted by the Zambian National Accounts (see National Accounts 1973, page 5). Any surplus produced by subsistence activity is thus implicitly assumed to be traded for cash, thus entering "Commercial agriculture" which might more accurately be termed "marketed agricultural production."

$$X1 = -28.246 + \underset{(21.814)}{0.0423}\ POPR \qquad (22) \qquad 1965\text{-}80$$

$$R^2 = 0.9713 \qquad F = 473.96 \qquad SEE = 1.0606 \qquad DW = 1.6096$$

In current prices subsistence output is

$$XP1 = P1 * X1 \qquad (22a)$$

Commercial agricultural output was estimated as a function of output capacity and the size of the urban population:

$$X2 = 200.89 + \underset{(3.3191)}{0.1611}\ XC - \underset{(1.631)}{0.0197}\ POPU \qquad (23) \qquad (1967\text{-}80)$$

$$R^2 = 0.8468 \qquad F = 30.406 \qquad SEE = 4.3636 \qquad SW = 1.9109$$

Expressed in current prices:

$$XP2 = P2 * X2 \qquad (23a)$$

The coefficient of POPU presents some problems in interpretation. The a priori expectation was that it would be positive reflecting a rising demand for food from a growing urban population. A negative coefficient would be interpreted in terms of a growing

urban population representing a drain on scarce skilled agricultural labour. More probably it reflects the inability of agricultural output to keep pace with urban growth. In view of the lack of clear a priori expectations it was decided to retain POPU despite the low t-ratio of its coefficient.

In order to reduce stong autocorrelation in the "level" variable for mining output, X3 is derived from a growth rate formulation. Thus:

$$DX3 = -0.0206 + \underset{(5.2655)}{1.1832}\ DVCU - \underset{(0.5175)}{0.0459}\ DPCUDF \qquad (24) \quad (1965\text{-}80)$$

where $PCUDF = \frac{PCU}{PEDOM}$

$R^2 = 0.7012$ $\quad F = 14.081$ $\quad SEE = 0.0701$ $\quad DW = 1.6767$

and for current values

$$XP3 = P3 * X3 \qquad (24a)$$

Although autocorrelation in the formulation with absolute levels may have been reduced, the effect was to render the coefficient on the deflated copper price statistically insignificant.

Value added in the non-mining urban sector, X4, was estimated using output capacity and the exogenously determined supply of credit (as measured by net claims on the private sector) as explanatory variables.

$$X4 = -315.12 + \underset{(4.6329)}{0.6881}\ XC + \underset{(1.7341)}{0.3816}\ COPSP \qquad (25) \quad (1967\text{-}80)$$

$R^2 = 0.7760$ $\quad F = 19.055$ $\quad SEE = 50.994$ $\quad DW = 0.5861$

and current price values given by

$$X4 = P4 * X4 \qquad (25a)$$

Despite strong autocorrelation, a growth rate formulation could not be applied since the variable COPSP started from a near zero base with some negative values.

Other output related identities include:

"Modern sector" output

$$XMOD = X2 + X3\ X4 \qquad (26)$$

$$XPMOD = XP2 + XP3 + XP4 \qquad (26a)$$

Total output (GDP estimate)

$$X = X1 + X2 + X3 + X4 \qquad (27)$$

$$XP = XP1 + XP2 + XP3 + XP4 \qquad (27a)$$

3.4 The balance of payments and external indebtedness Export earnings are taken as the sum of proceeds (in US dollars) from sales of copper and all other exports. Exports are thus entirely exogenous to the model, though in practice Zambia could influence earnings by varying production and sales of copper.

At world prices: $EXPWP = (QCU * PCUS) + EXPOWP \qquad (28)$

At domestic prices: $EXPP = \frac{EXPWP}{EXRATE} \qquad (28a)$

At domestic prices at constant values: $EXP = \frac{EXPP}{PEXP} \qquad (28b)$

Imports of merchandise at constant values are determined by their price relative to domestic prices and the level of demand as measured by the output of the modern sector.

At domestic (constant) values:

$$IMP = 635.96 - 451.4\ PIMPDF + 0.1403\ XMOD \quad (29) \quad (1965\text{-}80)$$

$$(5.7817) \qquad (1.1776)$$

$$R^2 = 0.7743 \quad F = 22.295 \quad SEE = 39.28 \quad DW = 1.9602$$

At domestic prices: $IMPP = PIMP * IMP$ (29a)

At world prices: $IMPWP = IMPP * EXRATE$ (29b)

The formulation of equations for merchandise trade reflects the position in which demand for imports is internally determined (in domestic currency) while export earnings are largely externally determined.

Net "invisibles" in the current account are from four sources:

a) Freight and insurance: $IMIFWP = f.IMPWP$ (30)

where f is the proportion of the import bill devoted to freight and insurance (assumed to be 0.21 for all simulations).

b) Interest on external debt: $FIWP = \Pi_o\ FDODWP_{-1}$ (31)

$$FIP = \frac{FIWP}{EXRATE} \quad (31a)$$

c) and d) Unrequited transfers (URTRWP) and other invisibles (IVOWP) are both exogenous and are expressed in net terms (negative sign representing a net outflow)

Thus net invisibles are given by:

$$IVWP = URTRWP + IVOWP - FIWP - IMIFWP \quad (32)$$

$$IVP = \frac{IVWP}{EXRATE} \quad (32a)$$

The current account balance is given by the following:

At world prices: $CBALWP = EXPWP - IMPWP + IVWP$ (33)

At domestic prices: $CBALP = EXPP - IMPP + IVP$ (33a)

The capital account involves several variables, most relating to external debt:

a) Disbursements (FDBWP) are taken to be exogenous

b) Amortization was assumed to be a constant proportion (α) debt outstanding at the end of the previous period:

$$FAWP = \alpha \ FDODWP_{-1} \qquad (34)$$

c) The net flow of receipt from foreign borrowing is thus

$$FNFWP = FDBWP - FAWP \qquad (35)$$

d) The balance on capital account is thus:

At world prices: $CAPWP = FNFWP + CAPOWP$ (36)

At domestic prices: $CAPP = \frac{CAPWP}{EXRATE}$ (36a)

The change in net foreign assets in any year (defined to include external payments arrears and other monetary movements) is given by:

At world prices: $TNFAWP = CBALWP + CAPWP$ (37)

At domestic prices: $TNFAP = \frac{TNFAWP}{EXRATE}$ (37a)

Equation (37a) represents the link between the balance of payments and the money supply.

Other identities which could be used in a fuller specification of an "indebtedness" model but were not introduced in the simulations are:

$$FDCUWP = FDCUWP_{-1} - FDBWP + NCWP \qquad (38)$$

$$FDSWP = FIWP + FAWP \qquad (39)$$

$$FNIWP = FDBWP - FDSWP \qquad (40)$$

$$FDODWP = FDODWP_{-1} + FNFWP \qquad (41)$$

The capacity to import was estimated in simulations but did not enter the final version of the model as an endogenous variable. It is defined as:

$$IMCAPP = EXPP - FIP - URTRP - IVOP + CAPP + 0.2\ NFAP \quad (42)$$

thus following the definition proposed in Chapter 7, section 7.7, and yielding a figure expressed in terms of a c.i.f. valuation of imports.

3.5 Domestic expenditure on gross domestic product and total consumption

It is assumed that GDP measured by type of expenditure and by kind of economic activity are equal, that is

$$E = X \quad (43)$$

Hence no independent measure of GDP (expenditure based) is derived and it follows that total domestic expenditure on GDP is given by:

$$EDOMP = XP - NTX \quad (44)$$

where

$$NTX = EXPP - IMPP + IVP - FIP - URTRP \quad (45)$$

NTX is a measure of net exports of goods and services.

From (44) it follows that

$$EDOM = \frac{EDOMP}{PEDOM} \quad (44a)$$

Total consumption determined from a linear equation with total domestic expenditure as the explanatory variable resulted in serious problems of autocorrelation. However, when consumption in the modern sector is regressed on the output of that sector the problem is overcome.

$$CONMP = 335.6 + 0.8593\ XPMOD \quad (46)$$

$$(12.197)$$

$$R^2 = 0.9140 \quad F = 148.76 \quad SEE = 156.59 \quad DW = 1.7030$$

Thus total consumption is given by:

$$CONP = CONMP + XP1 \qquad (47)$$

and the constant price equivalent by:

$$CON = \frac{CONP}{PEDOM} \qquad (47a)$$

3.6 The Government Budget

Mineral revenue was projected from a regression equation rather than an identity involving profits, costs and levels of output because of data limitations with the latter approach. Dummy variables were introduced to capture the change in ownership and tax regime in 1973 and the large shift which occurred in 1975 when copper prices collapsed.

$$GRMIP = -204.84 + \underset{(3.6627)}{0.4875}\ PCUDEF - \underset{(1.3485)}{0.1776}\ XP3 + \underset{(3.574)}{153.6}\ DUM2 - \underset{(2.549)}{140.0}\ DUM3 \qquad (48) \quad (1968\text{-}70)$$

$R^2 = 0.9243 \quad F = 24.410 \quad SEE = 36.419 \quad DW = 1.6183$

(DUM2 = 0 until 1973, 1 thereafter; DUM3 = 0 until 1974, 1 thereafter)

Taxes on all other (non-mineral) income are estimated from an equation with modern sector output.

$$GRYTP = -72.863 + \underset{(14.334)}{0.1322}\ XPMOD \qquad (49) \quad (1965\text{-}80)$$

$R^2 = 0.9362 \quad F = 205.30 \quad SEE = 20.501 \quad DW = 1.3163$

Taxes on domestic expenditure are estimated from total expenditure and a dummy variable (DUM2 as above) is introduced to capture the introduction of sales tax in 1974.

$$GRDEP = -64.219 + 0.0964\ EDOMP + 40.745\ DUM2 \quad (50) \quad (1965\text{-}80)$$
$$(14.686) \qquad (2.1875)$$
$$R^2 = 0.9554 \qquad F = 139.24 \qquad SEE = 20.069 \qquad DW = 1.5607$$

Taxes on international trade (customs duty and sales tax (imports)) are estimated from the level (in current prices) of merchandise imports.

$$GRMTP = -13.450 + 0.1259\ IMPP \qquad (51) \quad (1965\text{-}80)$$
$$(11.784)$$
$$R^2 = 0.9085 \qquad F = 138.97 \qquad SEE = 6.984 \qquad DW = 1.5580$$

Total government revenue is the following identity including grants and other revenue items in GRFGP.

$$GREVP = GRMIP + GRYTP + GRDEP + GRMTP + GRFGP \qquad (52)$$

Current expenditure (other than interest), capital expenditure and net lending are regarded as wholly exogenous. A formulation using a trend growth rate for capital and current expenditure resulted in unstable simulations. Government interest payments are estimated by:

$$GINTP = \Pi_0\ GFDP_{-1} + \Pi_1\ GLDP_{-1} + \Pi_2\ COGP_{-1} \qquad (53)$$

(In this exercise fixed interest rates were assumed - $\Pi_0 = 0.075$, $\Pi_1 = 0.085$, $\Pi_2 = 0.045$. A simple revision would allow the introduction of variable interest rates).

Current expenditure is thus defined as:

$$GCEP = GCEOP + GINTP \qquad (54)$$

and total government expenditure is

$$GEXPP = GCEP + GKEP + GNLP \qquad (55)$$

The government budget deficit, given by

$$GDEFP = GREVP - GEXPP \qquad (56)$$

is financed by external and internal borrowing with differentiation between short and long term borrowing. The net flows from long-term internal and external borrowing (TGLDP and TGFDP respectively) are assumed to be exogenous. Thus the levels of long term indebtedness are given by:

$$GFDP = GFDP_{-1} + TGFDP$$

$$GLDP = GLDP_{-1} + TGLDP$$

Short term borrowing by the government is treated as a residual, thus:

$$TSTBP = GDEFP - TGFDP - TGLDP \qquad (57)$$

In more recent years it would be a safe assumption that almost all short term borrowing was financed by the banking system. Nevertheless a regression was run between short term borrowing requirements and banking sector claims on the government to establish a satisfactory link to the money supply equation.

$$TCOGP = \underset{(9.9171)}{16.251 + 0.8903\ TSTBP} \qquad (58) \qquad (1966\text{-}80)$$

$R^2 = 0.8833$ $\quad F = 98.35$ $\quad SEE = 44.565$ $\quad DW = 1.7339$

3.7 The money supply

Money is treated largely as a passive variable, changes in the stock of money corresponding to variations in net foreign assets and the government's short term borrowing requirement, both of which are largely governed by factors beyond the control of the authorities. The only variable over which the authorities can exercise some degree of control is "claims on the private sector" and this is an exogenous policy variable. Using the basic banking sector balance

sheet identity, then changes in the stock of money (broadly defined) are given by

$$TM3P = TNFAP + TCOGP + TCOPSP + TOTH \qquad (59)$$

and hence for any given year

$$M3P = M3P_{-1} + TM3P \qquad (59a)$$

The total expansion of domestic credit is given by

$$TDCP = TCOGP + TCOPSP \qquad (60)$$

so that the total supply of domestic credit is

$$DCP = DCP_{-1} + TDCP \qquad (60a)$$

The income velocity of circulation of broad money is defined as

$$V3 = \frac{XP}{M3P} \qquad (61)$$

and real money balances (M3) could be defined as

$$M3 = \frac{M3P}{PEDOM} \qquad (59b)$$

3.8 Other national accounts aggregates

Equation (48) gave total consumption without disaggregating between private and government sectors. Private consumption expenditure is derived as a residual after the estimation of government final consumption expenditure which is estimated from total government expenditure:

$$CGVTP = -79.69 + 0.7051\ GEXPP \qquad (62)$$

$$(12.033)$$

$$R^2 = 0.9118 \quad F = 144.80 \quad SEE = 70.779 \quad DW = 2.1618$$

with the constant price value given by

$$CGVT = \frac{GGVTP}{PEDOM} \qquad (62a)$$

Private consumption expenditure is then estimated as

$$CPRVP = CONP - CGVTP \qquad (63)$$

$$CPRV = \frac{CPRVP}{PEDOM} \qquad (63a)$$

Investment figures as an explanatory variable in this specification only to the extent that it provides an estimate of the net addition to the capital stock. It is estimated from a simple accelerator model (see Appendix XI.2) giving the equation (expressed in constant values):

$$GFCF = -521.26 + 0.8997 \text{ X MOD} - 0.1169 \text{ KLAG} \qquad (64) \quad (1966\text{-}80)$$

$$(4.982) \qquad (5.177)$$

$$R^2 = 0.7079 \qquad F = 14.541 \qquad SEE = 46.170 \qquad DW = 1.8565$$

and the current price equivalent

$$GFCFP = GFCF * PEDOM \qquad (64a)$$

Capital consumption was found to be better estimated by an equation using the value added of the modern sector rather than lagged capital stock:

$$DEPRP = -80.176 + 0.1975 \text{ XPMOD} \qquad (65) \quad (1965\text{-}80)$$

$$(14.209)$$

$$R^2 = 0.9352 \qquad F = 201.95 \qquad SEE = 30.892 \qquad DW = 1.4318$$

and $$DEPR = \frac{DEPRP}{PEDOM} \qquad (65a)$$

It is assumed that capital consumption is equal to the value of retirements from the capital stock, there being no measure of the latter. Thus net additions to the capital stock are estimated by net fixed capital formation, giving the following equations:

$$NFCF = GFCF - DEPR \quad (66)$$

$$NFCFP = GFCFP - DEPRP \quad (66a)$$

$$K = K_{-1} + NFCF \quad (67)$$

Finally national disposable income and savings may be estimated (current price series only) from basic identities:

$$NDIP = XP - DEPRP + FIP + URTRP \quad (68)$$

$$SAVP = NDIP - CONP \quad (69)$$

3.9 Wages and earnings

"Earnings" or income in subsistence agriculture are taken to be equal to the average product of subsistence workers, i.e.

$$W1 = \frac{XP1}{LI} \quad (70)$$

Various formulations of earnings equations were tested and the following proved least unsatisfactory. Earnings in the mining industry were regressed on the domestic price index and value added per worker (a measure of productivity):

$$W3 = 1320.3 + 969.8\ PEDOM - 0.0289\ PRODY3 \quad (71) \quad (1965\text{-}79)$$

$$(5.2809) \qquad (0.6342)$$

$$R^2 = 0.7258 \qquad F = 18.878 \qquad SEE = 374.69$$

In each of the commercial agriculture and non-mining urban sectors prices, value added per worker and earnings in the mining industry were used as explanatory variables, the last reflecting the hypothesis that the mining sector acts as a "trend-setter" for the rest of the economy. (Testing of bivarate relationships showed that the current year value gave a higher correlation than lagged earnings in the mining industry). Collinearity between prices and the current price measure of value added per worker led to the

retention of the one which was introduced first in a stepwise regression.

$$W2 = -67.916 + 333.23\ PEDOM - 0.0588\ W3 \quad (72) \quad (1965\text{-}79)$$

$$(6.9761) \qquad (1.4525)$$

$$R^2 = 0.9523 \qquad F = 119.83 \qquad SEE = 53.468$$

$$W4 = 305.64 + 0.3622\ PRODY4 - 0.0999\ W3 \quad (73) \quad (1965\text{-}79)$$

$$(8.2307) \qquad (1.066)$$

$$R^2 = 0.9553 \qquad F = 128.51 \qquad SEE = 105.74 \qquad DW = 0.9963$$

The unsatisfactory results obtained in this section and the employment equations meant that very limited attention was paid to reporting estimated values in the simulation results. It is also noted that wages and earnings were introduced initially in the expectation that they would act as explanatory variables, but estimation results were disappointing.

Other aggregates calculated were average modern sector earnings, urban earnings and rural earnings.

$$WAVG = \sum_{i=1}^{3} \left(\frac{LiWi}{Li}\right) \quad (74)$$

$$WURB = \sum_{i=3}^{4} \left(\frac{LiWi}{Li}\right) \quad (75)$$

$$WRUR = \sum_{i=1}^{2} \left(\frac{LiWi}{Li}\right) \quad (76)$$

4. Some limitations

The model as it stands suffers from several limitations which would require correction or further investigation before it would be of use for testing policy measures or preparing short or medium term forecasts.

Specification of the model was restricted by the imposition of a recursive structure. This was particularly true of the inflation equation which might be strengthened by the inclusion of other unlagged variables. Almost all relationships were cast in linear equations; a number of equations might be improved by the adoption of non-linear formulations. Moreover specification of several equations reflects a rather eclectic approach, and a more systematic theoretical framework is desirable, though this may well be unattainable.

A principal reason for adopting a recursive structure was the insufficiency of the available data to warrant a full simultaneous equation estimation procedure. Also as stated in section 2 the data used were those contained in Statistical Appendix S, and it will be noted from the qualifications stated in the footnotes to the tables that many of the series suffer from a variety of limitations: non-availability for certain years, inconsistency or discontinuity, and the fact that very few series (other than monetary aggregates) can be obtained for periods shorter than one year. Some of the problems of estimation might be partially overcome if shorter periods were to be investigated.

Specific econometric problems arise with a number of equations. The Durbin-Watson statistics reported show that for a number of the

equations autocorrelation was present, and although in some cases this was overcome by changing the specification (e.g. from the "level" form of the variable to a growth rate form) a more systematic correction is necessary. The first step would be to apply the Cochrane-Orcutt iterative procedure of estimation to the affected equations and to estimate the necessary additional parameters. The presence of autocorrelation is another reason why the use of the model as it now stands for prediction purposes would be inappropriate. (See Johnston (1972) pp 243-266 for further discussion of the nature, consequences and solutions for the problem of autocorrelation.)

Finally as noted previously there are at least two reasons why multicollinearity among the variables might affect the estimated parameters. Firstly, several of the equations were estimated from the current price form of their variables; and secondly, the progress of the economy through three distinct phases during the sample period (rapid growth, slower growth, stagnation and decline) means that all the variables tend to move in parallel, with the result that it becomes more difficult to distinguish the underlying relationships. One means of overcoming this would be to estimate the parameters for shorter periods, but again there would be limitations imposed by the availability of data, and the possible sacrifice of too many degrees of freedom, for tests of statistical significance.

5. Error analysis

In section 3 the parameters were presented together with associated tests of statistical significance and goodness of fit. Except where stated for very specific reasons, no parameter or equation was retained where tests yielded results with significance levels of greater than 5 per cent. In addition to these tests for individual equations, a further analysis was applied to simulations using historical data.

Two historical simulations were undertaken: static and dynamic. The static simulation used actual or historical data as the input to the solution of the model for each year; that is in solving the model for any given year 't', the values of pertinent variables are set equal to their actual levels in the previous years. The dynamic simulation differs in that lagged variables take on the value yielded by the model; only the initial year values (in this case 1968) are set equal to historic levels. As a test of the model's predictive ability the dynamic simulation is clearly the more realistic, but the use of both simulations allows a judgement to be made about the extent of the deterioration caused by using "model-generated" data.

A variety of test statistics have been used for this purpose (e.g. mean simulation error, mean percent error - see Pindyck and Rubinfeld (1976, pp 316-8) for further discussion). The measure adopted here is the root mean square error (RMS), expressed in percentage terms defined for variable X as:

$$RMS = \sqrt{\frac{1}{t}\sum\left(\frac{X_i - \hat{X}_i}{X_i}\right)^2}$$

where $\hat{X}_i$ is the predicted or simulated value of X.

and thus measures the average squared deviation of predicted values from the actual time series. Table XI.1.2 presents the root mean square error (RMS) calculated for selected significant macro-economic variables, for both static and dynamic simulations. Judgements about acceptable levels of error (as measured by the RMS) must inevitably be subjective, but it is suggested that any variable with an error greater than 10 percent should be the subject of further investigation and possible re-specification; wherever possible the error should be brought below 5 per cent.

On this criterion several variables give cause for concern: commercial agriculture (especially in current prices) is poorly predicted, not unexpectedly in view of the comments in section 3 on its parameters. Mining output predictions are particularly weak, further evidence of the problems of specifying a satisfactory equation (or equations) for this sector.

The variables classified under GDP by type of final expenditure (consumption, investment, etc) and capital consumption also yield high simulation errors. There is a pronounced difference among these variables between the RMS yielded by the current and constant price forms of the variables, another indication of the problem caused by the weakness of the price equations.

With respect to population and employment variables the RMS is, in general, acceptable, although the mining sector again displays the largest error. One reason for the relatively low errors among

Table XI. 1.2

Error analysis of principal economic aggregates:

Root mean square error

Variable	Static simulation	Dynamic simulation
(expressed as percentages)		
Gross domestic product (constant prices)	4.52	5.04
Value added - subsistence sector (constant prices)	1.04	2.33
Value added - commercial agriculture (constant prices)	7.73	9.70
Value added - mining (constant prices)	7.17	14.73
Value added - non-mining urban sector (constant prices)	6.48	6.37
Gross domestic product (current prices)	7.90	6.94
Value added - subsistence sector (current prices)	5.35	5.51
Value added - commercial agriculture (current prices)	15.05	14.90
Value added - mining (current prices)	42.38	49.81
Value added - non-mining urban sector (current prices)	5.70	7.52
Value added - modern sector: (constant prices)	4.90	5.38
Value added - modern sector: (current prices)	8.99	7.84
Private sector final consumption: (constant prices)	20.45	23.47
(current prices)	21.41	27.95
Government final consumption: (constant prices)	32.50	32.62
(current prices)	25.05	25.56
Gross fixed capital formation: (constant prices)	13.65	17.34
(current prices)	14.42	21.01
Total domestic expenditure: (constant prices)	11.25	16.05
(current prices)	11.20	15.57
Capital consumption (current prices)	19.58	23.61
Urban population	1.18	2.81

Table XI. 1.2 (continued)

Error analysis of principal economic aggregates:

Root mean square error

Variable	Static simulation	Dynamic simulation
Rural population	0.59	1.42
Employment in commercial agriculture	5.70	6.01
Employment in mining	4.60	9.86
Employment in non-mining urban sector	3.41	5.00
Deflator of total domestic expenditure on GDP	5.08	5.23
Price index of imports (in domestic currency)	5.16	4.91
Exports (current prices)	1.53	1.53
Imports (current prices)	14.97	14.29
Invisibles (current prices)	8.33	7.75
Money supply (broadly defined)	21.69	16.77
Total claims on government (of banking system)	68.11	158.08
Net foreign assets	54.27	122.43
Domestic credit	182.7 (79.4)	91.4
Mineral revenue	2712.1	10754.7 (513.0)
Income tax revenue	18.73	23.48
Taxes on domestic expenditure	20.77	32.36
Taxes on imports	19.01	16.82
Total government revenue	6.87	9.74
Government interest payments	16.89	11.05
Average earnings in commercial agriculture	8.12	10.93
Average earnings in mining	14.21	13.30
Average earnings in non-mining urban	6.14	10.90
Average earnings in rural sector	11.54	13.45
Average earnings in urban sector	5.03	7.44
TOTAL	4.98	7.57

these variables is that, unlike others, they follow a relatively smooth path, so that a linear equation may provide better predictions than series where large annual fluctuations occur.

Individual government revenue aggregates yield large RMS errors. This is in part a result of little account having been taken of changing tax regimes; it is also due to low absolute observed values in individual years causing distortion in the overall measure. This is well demonstrated by mineral revenue where the simulation error is very large indeed: if 1978 is excluded from the calculation, RMS is reduced to the figure shown in brackets in the table (since in 1978 actual mineral revenue was K0.1 million, and that predicted by the model was -K38.6 million). Similar correction for other years with very low actual receipts would further improve the RMS figure. Despite the high RMS for individual aggregates, the simulated values of total government revenue fall within the range which may be accepted but with reservations.

Similar observations may be made about the simulated values of monetary variables: wherever series fluctuate between positive and negative values (as happened with net foreign assets) there is a risk that during the transition period differences will occur in individual years which are large relative to the absolute observed value in a particular year but which may be small relative to the mean absolute value of the variable, that is when measured over the full sample period. Also in simulating current price series with low initial values (or even negative ones as in the case of net domestic credit and claims on the government) there is a similar risk of distortion.

Thus in several instances the size of the RMS reflects a deficiency in the measure of simulation error adopted, rather than in the simulation itself. As a general point it is noted that in the case of the monetary aggregates predictions in the later years of the simulation period (from about 1973 onwards) were more likely to be accurate than those in the earlier years; so, although caution should rightly be exercised before proceeding to forecasting applications, it is suggested that the errors may not be as serious as first impressions suggest in some cases.

6. Experimental simulations with the model

A number of simulations were conducted, with two objectives. The first, in which variables wholly outside government control were altered, was intended to demonstrate the effects of deteriorating terms of trade and lost copper production on the Zambian economy; the second, in which "policy exogenous" variables were adjusted, was an attempt to test certain of the conventional macro-economic measures which might be available to the government, and are the type of short term "stabilization" measures which might be promoted by the IMF. The whole concept of such simulations is fraught with difficulties - it is the nature of simulation to alter one variable at a time which is clearly unrealistic - many variables can alter simultaneously in practice.

The model described in section 3 does not contain many of the linkages and relationships which had originally been expected or hypothesized. Moreover many of the dependent variables proved to be insensitive to changes in the exogenous variables. Consequently

many of the experiments yielded significant changes only in those equations most closely associated with the variables which were adjusted. For instance when copper prices were increased substantially, the balance of payments and government budget showed a substantial improvement, while no appreciable variation occured in the output or expenditure case. In fact in some cases reactions were perverse - the opposite of those expected - a result of those parameters with unexpected signs which were retained. In general there proved to be weak or non-existent links between the monetary or financial sectors and the "real economy" - an indication of one or more of the following: an inadequately specified model, an economy not amenable to simple econometric analysis or an economy whose real output is largely beyond the control of government or monetary authorities.

A total of 15 simulations were performed which are described in Table XI.1.3 together with results for the historical (static and dynamic) simulations and the original time series. A selection of economic variables is presented in Tables XI.1. 4A and XI.1.4B to allow comparison among the different simulations. In the following paragraphs the principal features of the simulation assumptions and results are discussed.

Case 1 represents actual unadjusted historical data, while cases 2 and 3 are the static and dynamic historical simulations whose accuracy was discussed in the previous section. In cases 4 and 5 two exchange regimes are tested in which a more flexible exchange rate is adopted. In the first it is assumed, that the link to the dollar was maintained after the 1973 devaluation (Zambia maintained

Table XI.1.3

List of simulations

Case Number	Description
1.	Actual
2.	Base data - static
3.	Base data - dynamic
4.	Exchange rate case A - devalued with dollar in 1973: "crawling peg" from 1975 - 10% annual devaluation
5.	Exchange rate case B - adjustment for terms of trade variation from 1971
6.	Copper prices maintain real 1966-70 level relative to world import prices
7.	Copper production constant after 1973 at 700,000 tonnes
8.	6 and 7 combined
9.	Government current expenditure constant
10.	Government current and capital expenditure constant
11.	Government current expenditure grows with population (capital actual)
12.	Government current expenditure grows with population and capital expenditure constant
13.	Government current expenditure is set to allow zero short term borrowing (based on actual data
14.	Budget stabilization fund operated (base data)
15.	Budget stabilization fund operated - zero government short term borrowing: private sector benefits
16.	Net claims on private sector grow with inflation
17.	Net claims on private sector grow with inflation and growth of modern urban sector
18.	Claims on private sector grow with inflation and planned growth rate

Table XII.4A

Selected comparative indicators from simulation exercises

	Historical			Exchange Rate		Copper prices and Production			Government Expenditure					Budget stabilization fund		Net claims on private sector		
Case Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
									(Percentages)									
Trend growth rates (a)																		
Total output	1.24	1.09	0.48	0.39	0.22	0.07	0.98	0.58	0.48	*	*	*	*	*	0.42	0.11	0.22	0.53
Comm'l. agricu.	4.31	4.07	4.21	4.23	4.14	2.45	4.57	2.83	4.21	*	*	*	*	*	3.86	3.48	3.67	3.96
Mining	-0.81	-1.60	-3.02	-2.85	-2.98	-3.30	-1.69	-1.94	-3.02	*	*	*	*	*	-3.02	-3.02	-3.02	-3.02
Other urban	2.40	2.66	2.68	2.44	2.21	2.22	2.78	2.31	2.68	*	*	*	*	*	2.65	2.10	2.28	2.80
Total cons.	0.67	-0.70	0.03	-0.64	-1.13	2.33	2.76	3.03	0.03	0.03	*	*	*	*	-0.03	-0.43	-0.29	0.10
Private cons.	-0.03	-1.83	-0.60	-0.09	0.20	2.94	0.03	3.85	-0.13	-1.08	-0.83	-2.13	0.80	0.59	0.56	-1.34	-1.12	-0.52
Gov't. cons.	5.09	1.60	1.45	-2.35	-5.77	0.37	1.43	0.34	0.48	2.89	2.77	4.74	-2.35	-1.41	-1.70	1.54	1.52	1.47
Gross investment	-5.14	-4.07	-5.33	-5.76	-6.48	-5.22	-3.24	-3.12	-5.33	-5.33	*	*	*	*	*	-6.30	-5.96	-4.71
Total dom. exp.	-0.52	-1.47	-1.40	-2.02	-2.51	0.44	-0.59	1.41	-1.40	-1.40	*	*	*	*	*	-1.97	-1.79	-1.22
Ratios (b)																		
Total expenditure	2.893	2.99	2.826	4.468	5.449	4.711	3.267	5.603	2.826	2.826	*	*	*	*	2.80	2.711	2.755	2.926
Total dom. exp.	3.223	3.88	3.040	4.60	5.498	3.673	3.371	4.144	3.040	3.040	*	*	*	*	3.001	2.882	2.941	3.164
Inflation (c)	10.5	11.2	11.1	15.4	19.3	11.1	11.1	10.6	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Money: Growth of M3 (d)	11.6	11.4	12.7	16.4	2.16	3.14	14.4	33.2	n.c.	544	9.9	18.0	n.c.	10.4	n.c.	15.6	15.0	15.1
									(Million kwacha)									
Domestic credit: (e)																		
Total	1766	1887	1763	1336	768	-1262	1663	-1377	1065	1465	1666	2459	426	1602	723	1820	1834	1995
Claims on gov't.	1354	1365	1258	831	-130	-1768	1158	-1883	166	960	1161	1954	-79	1097	-151	1527	1458	1286
Net foreign assets:																		
1968	140	155	171	171	171	171	171	171	171	171	*	*	*	*	171	171	171	171
1970	381	386	383	383	383	383	383	383	383	383	*	*	*	*	393	387	387	384
1974	76	170	284	383	718	1057	345	1132	284	284	*	*	*	*	311	323	313	297
1978	-819	-826	-766	-501	715	3498	-621	3899	-766	-766	*	*	*	*	-683	-616	-652	-725
1980	-859	-559	-562	211	1823	6285	-262	7272	-562	-562	*	*	*	*	-462	-345	-402	-544

Notes: (a) Trend growth rate for period 1968 - 80.
(b) Ratio of aggregate in 1980 to its value in 1968.
(c) Trend rate of increase of implicit deflator of domestic expenditure on gross domestic product.
(d) Trend rate of increase.
(e) Level in 1980.

n.c. - indicates "not calculated"

* - indicates identical value to that immediately to the left

Table XI.1.4B Imports as a percentage of import capacity in simulation exercises (a)(b)

(Percentages)

	Historical			Exchange rate		Copper prices and production			Government expenditure
Case number	1	2	3	4	5	6	7	8	9
1968	95	89	86	86	86	86	86	86	86
1969	72	75	78	78	78	78	78	78	78
1970	73	71	70	70	70	70	70	70	70
1971	139	141	126	126	102	85	126	85	126
1972	118	122	107	107	82	63	107	63	107
1973	97	87	78	74	66	61	75	59	78
1974	93	82	88	81	71	56	83	54	88
1975	141	119	119	101	66	45	110	43	119
1976	136	185	161	132	87	44	171	45	161
1977	139	159	158	130	87	38	149	37	158
1978	179	230	239	172	106	38	180	34	240
1979	86	121	104	83	66	28	99	27	104
1980	137	105	105	78	63	26	89	24	105

Notes: (a) Both expressed in f.o.b. valuation

(b) Cases 10-18 are identical with case 3.

the kwacha's value relative to sterling), and that from 1975 a "crawling peg" system was adopted. For this exercise it was arbitrarily assumed that a 10 percent devaluation was imposed in each year, regardless of external conditions. In the second case it is assumed that the authorities had perfect foresight concerning terms of trade variations, and that the exchange rate was adjusted to compensate fully for such variations. Thus if the dollar terms of trade declined by 10 percent then the kwacha would have been devalued by 10 percent, so maintaining the domestic currency earnings or exports. In both cases the effect on the balance of payments (as shown by the movement of net foreign assets) is pronounced - in case 4 net foreign (NFA) are positive by 1980 and in case 5 NFA never becomes negative. Moreover the statistic shown in Table XI.1.4B (imports expressed as a percentage of the capacity to import (f.o.b.)) reveals that in only one year in case 5 would imports exceed capacity, and then only marginally so. This suggests that with earlier and more flexible action on the exchange rate the problem of external payments arrears might have been eliminated by the end of the 1970s, and arguably might even have been prevented in the first place. This latter outcome would however have required much greater foresight than is possible in practice. The outcome would not have been costless - the trend rate of inflation is seen to increase sharply in both cases, as higher domestic currency prices for imports are transmitted to domestic price indices. It is also noted that the decline in gross fixed capital formation was even more rapid, and economic growth even slower in these two cases.

In cases 6, 7 and 8 variations are made to two wholly exogenous variables - the international price of copper, and the volume of output and sales of copper. With respect to prices (case 6) simulation was based on an extreme supposition: that copper prices had maintained (from 1971 onwards) their real level relative to the world price of imports; in other words that the terms of trade had effectively remained constant. The effect on the country's external accounts would have been dramatic, with net foreign reserves rising to levels normally associated with OPEC nations and import capacity being substantially improved. It is improbable that such accumulation would have occurred - undoubtedly the economy's absorptive capacity (capacity to import and invest) would have been higher and the economic structure would almost certainly have evolved along a different path. In case 7 copper production and sales are assumed to have remained constant (as opposed to the decline which actually occurred). Although some improvement in the external accounts is observed, it is very small relative to the price effects of case 6. Finally it is observed that in all of cases 4 to 8 the growth of the money supply is very much more rapid than was historically the case, a direct consequence of rising net foreign assets, and it is suggested that such monetary expansion is benign - not a cause for policy action. This monetary growth occurs even though the government's short term borrowing is reduced substantially by the occurrence of higher mineral revenue.

In simulations 9 to 13 variations were made to government expenditure aggregates with all growth rates calculated from the base year of 1968. For purposes of comparison it should be noted

that the historical trend rate of growth of current expenditure was 1.1 per cent, while capital expenditure declined at the trend rate of 9.5 per cent. Thus holding current expenditure constant results in only a small reduction in expenditure, while constant capital expenditure implies a substantial increase. It is an indication of deficient linkages in the model that the only sections of the model to be affected by these variations are the government sector itself and the monetary sector. In summary, the effects of cases 9 to 13 show that monetary aggregates are highly sensitive to changes in expenditure: the reduction of the trend growth rate of current spending from 1.1 percent to zero (case 9) results in a very low level of banking claims on government by 1980. However if capital expenditure is increased to yield zero growth with zero current expenditure growth (case 10) the claims on government are restored to about three-quarters of their level in the dynamic historical simulation. Cases 11 and 12 make more generous allowances for the government with current expenditure rising to match population growth (i.e. notionally to preserve the level of services available in 1968), with case 12 allowing higher (i.e. constant) growth in capital spending. In the latter case, domestic credit and the money supply would have grown very much more rapidly: the money supply's trend growth rate in 1968 to 1980 would have been 18 per cent compared to the actual 11.6 per cent. In case 13 the very highly restrictive and arbitrary assumption of zero short term borrowing is introduced. The effect is deflationary in the extreme with negative total claims on government by 1980, and spurious money supply figures. (Where mone-

tary growth rates are not calculated this is because some freak effect is yielded - such as negative money stock). The results are reported for completeness, and no policy recommendation is implied.

In cases 14 and 15 the operation of the Budget Stabilization Fund discussed in chapter 10 is simulated. Given the unsatisfactory linkages in the model, little evidence could be expected in the way of improving the real level of output in these simulations. In case 14 the fund is introduced without changing any other variable - the sole effect in the reported results is to reduce slightly the accumulation of banking system claims on the government. In case 15 the fund is operated so as to reduce government short term borrowing to zero, with the private sector being permitted to increase its liability to the banking system commensurately, but even this fails to produce any substantial impact on the output variables. This is attributed to the model rather than the policy itself, although the justification for establishing a fund should be that the resulting stabilization of the governments demands for banking system credit should result in a reduction of inflationary pressure; easier access for the private sector (especially the agricultural sector) to credit facilities; or a more stable flow of resources through the government budget into the productive sectors of the economy. If none of these objectives were achieved then there would be little benefit from the establishment of the fund.

Finally in cases 16, 17 and 18 the only monetary aggregate subject to indirect governmental control - net claims on the private sector - is varied according to some plausible yardsticks: limiting growth to the anticipated rate of inflation; or allowing it to grow in line with the actual current price value of output in the modern urban sector of the economy; or, most liberally, allowing growth equal to the planned growth of output (current prices). In the last case, the planned rates of growth in constant prices were taken to be those contained in the First, Second and Third National Development Plans: i.e. 11.7 per cent in 1964-70, 7.5 per cent in 1971-76 and 4.8 per cent in 1977-80. Anticipated inflation was simulated with the actual data. In the first two cases there was an appreciable fall in the simulated trend rate of growth of output, while the latter caused a small increase in growth. One particularly interesting feature of this means of attempting to control the money supply is that it is self-defeating because output falls, causing a reduction in the flow of resources to the government, and consequently necessitating a rise in government short term borrowing. The final result is that the money supply grows appreciably more rapidly in all three cases, even though in cases 16 and 17 the growth of domestic credit to the private sector grows more slowly than the actual series.

7. Conclusion

The attempt to construct a model of the Zambian economy could lead to two diametrically opposite conclusions. One is that any attempt to model the macro-economy is futile, given the magnitude

of the external shocks to which Zambia was subject in the latter part of the 1970s and early 1980s, a period whose data will be critical in any attempt to construct models during the next decade. The other conclusion is that a more sophisticated approach than that used here might improve the results, and some of the ways in which this might be done were suggested in section 4. If this is the case, it seems clear that the structure which emerges from any model using time series for several years after 1974 will be very different from that suggested by the models of earlier studies. Indeed it is probably true that the difficulties encountered in this exercise arose from studying two very different periods, i.e. before and after the sharp decline in the terms of trade during the mid-1970s. On balance the conclusion is that further study should be devoted to this problem.

APPENDIX XI. 2 INVESTMENT, CAPITAL STOCK AND OUTPUT CAPACITY

1. Introduction

In the attempt to construct a model for the Zambian economy described in Appendix XI.1, one of the areas in which serious problems were encountered was in establishing satisfactory sectoral output, production or value added relationships. Attempts were made to fit Cobb-Douglas production functions to sectoral and economy-wide data, but as noted in Appendix XI.1, this yielded parameters inconsistent with *a priori* expectations. In the final version it was decided to attempt to estimate capacity output from the level of capital stock only, without regard to the labour force or employment, thus effectively treating labour as an abundant resource with a marginal product of zero (1). In order to estimate output capacity, the estimates of capital stock, and by implication the capital formation model, assume considerable importance. This appendix outlines the model used to predict gross investment, proceeding to the method used to estimate the captial stock for individual sectors, and then to the estimation of capacity output in the final section.

2. Investment

A simple accelerator model based around a fixed capital output ratio, α, is given by:

$$\Delta K_t = \alpha \Delta Y_t \qquad (1)$$

where ΔK_t is the net change in the capital stock
ΔY_t is the change in output

This gives a very poor statistical fit; for instance, using constant price values a correlation coefficient (R) of -0.0321 was obtained, and with current prices the value of R was 0.1090.

A common approach is to introduce a partial adjustment mechanism in which net investment in any year is only a proportion, λ, of that required to produce the desired level of capital stock (for instance see Wallis (1973,pp.63-66). This is felt to be a plausible behavioual assumption in Zambia where investment has almost certainly been constrained by external factors, so that annual adjustments to the capital stock are indeed rather less than would be desired to achieve planned growth targets. Formally this relationship can be expressed as

$$\Delta K_t = K_t - K_{t-1} = (1-\lambda)(K_t^* - K_{t-1}) \qquad (2)$$

where K^* is the desired capital stock
and K is the actual capital stock.

It is assumed that the capital output ratio, α, determines the desired capital stock, that is

$$K_t^* = \alpha Y_t \qquad (3)$$

Then, combining (2) and (3)

$$K_t - K_{t-1} = (1 - \lambda)(\alpha Y_t - K_{t-1})$$

$$K_t = \alpha(1 - \lambda)Y_t - (1 - \lambda)K_{t-1} \qquad (4)$$

This equation (4) is a Koyck-lagged investment function, and estimates of its parameters appear as equation (64) in Appendix XI.1, and the equation was used in the simulations of the model. The statistical fit yielded by equation (4) is very much better -a correlation coefficient (R) of 0.8414 was obtained.

Equation (4) thus provides an estimate of net investment during a given year. Gross investment (gross fixed capital formation) can then be estimated by adding to this an estimate of capital consumption (it being implicitly assumed that this is equal to actual retirements form the capital stock). For the purposes of the model tests were performed on the relationship (linear) between capital consumption and two variables: the capital stock at the end of the previous year and the gross domestic product of the modern sector of the economy, that is all sectors except subsistence agriculture. It was found that the latter of these two variables gave the better fit, and estimates of the parameters appear as equation (65) of Appendix XI.1.

3. Estimation of the capital stock

The Zambian Census of Industrial Production 1973 was used as the basis for capital stock estimates, being the most recent such census available (see Republic of Zambia (1976, Table 6.2)). This gives capital stock figures for mining, manufacturing, electricity, and water and construction. No data are available for commercial agriculture, transport and communications or any of the other service sectors. Thus some estimate must be made of the total capital stock using available data.

Estimates for the latter sectors were taken by assuming that their capital stock in 1973 bore the same relationship to total capital stock, as that between net fixed capital formation in the sectors in question and total net fixed capital formation in the years 1965 to 1973. Net fixed capital formation was taken as the difference between gross fixed capital formation and capital consumption.

Having obtained estimates of the total capital stock in 1973, estimates were made of the capital stock in previous years from 1965 by successively deducting net fixed capital formation in each year from the 1973 stock figure. For subsequent years estimates were made in a similar manner, that is cumulatively by adding to the 1973 figure the estimate of net fixed capital formation in each year up to 1980.

It should be noted that the capital stock figures were estimated in constant (1970) prices. Where deflation was necessary,

the implicit deflator of gross fixed capital formation was calculated from national accounts data in the annual National Accounts or Monthly Digest of Statistics, published by the Zambian Central Statistical Office, and was then applied to all capital series, whether stock or flow. This was necessary since the Zambian authorities do not publish a constant price series for capital consumption.

The series estimated appear in Table XI.2, XI.2.1.

4. Estimation of capacity output

As explained in section 1 it proved impossible to estimate production functions (aggregate or sectoral). Instead an attempt was made to produce an aggregate measure of output capacity in the economy based on the capital stock available.

A relationship was estimated in which output was expressed as a log-linear function of actual capital stock for the period 1965-74:

$$\ln X = 5.2327 + \underset{(6.4901)}{0.2524} \ln K \qquad (1)$$

$$R^2 = 0.8404 \qquad F = 42.12 \qquad DW = 2.2612$$

The period 1965-74 was used because during these years the Zambian economy was growing fairly rapidly (particularly the non-mineral sectors) and it seems a reasonable assumption that the capital utilization was fairly high. Certainly in subsequent years utilization was lower because of the foreign currency constraints which developed.

The trend curve so fitted is then shifted outwards so as to pass through only one point on the capital-output plane, the maximum

Table XI.2.1 Fixed capital formation and capital stock estimates in 1970 prices

	Gross fixed capital formation	Net Fixed capital formation	Capital Stock at end of year
		Million kwacha	
1965	185.8	114.3	1363.1
1966	227.9	158.3	1521.4
1967	271.5	191.4	1712.8
1968	278.2	188.7	1901.5
1969	302.5	182.9	2084.4
1970	379.1	242.4	2326.8
1971	355.1	207.8	2534.6
1972	389.5	219.3	2753.9
1973	352.5	176.0	2929.9
1974	358.5	202.4	3132.3
1975	393.5	234.6	3366.9
1976	331.0	183.1	3550.0
1977	304.0	165.2	3715.2
1978	213.0	82.5	3797.7
1979	154.0	30.0	3827.7
1980	162.0	43.4	3871.1

Source: Calculated from the following publications of Republic of Zambia, Central Statistical Office.

Census of Industial Production 1973, Lusaka 1976 (Table 6.2)

National Accounts and Input-Output, Lusaka 1980 (Tables 5.4, 5.13 and 6.7)

Monthly Digest of Statistics, April/June 1981 Lusaka (Tables 56 and 57)

output-capital configuration as shown in Figure XI.2.1. It is thus implicitly assumed that in the year so identified (which transpires to be 1974) capital was being used at an optimum level. The shifted curve CC now represents the combinations of output and capital which would have been achieved if capital utilization had been as intensive as in 1974. The effect of this shift is to change the constant term in (1) leaving the coefficient of K_t unaltered; thus

$$\ln XC_t = 5.2807 + 0.2524 \ln K_t \qquad (1a)$$

Equation (1a) is then used to estimate the level of capacity utilization for each of the years 1965 to 1980 as shown in Table XI.2.2. by substituting the annual figures for capital stock into the equation to yield an estimate of output capacity, XC_t.

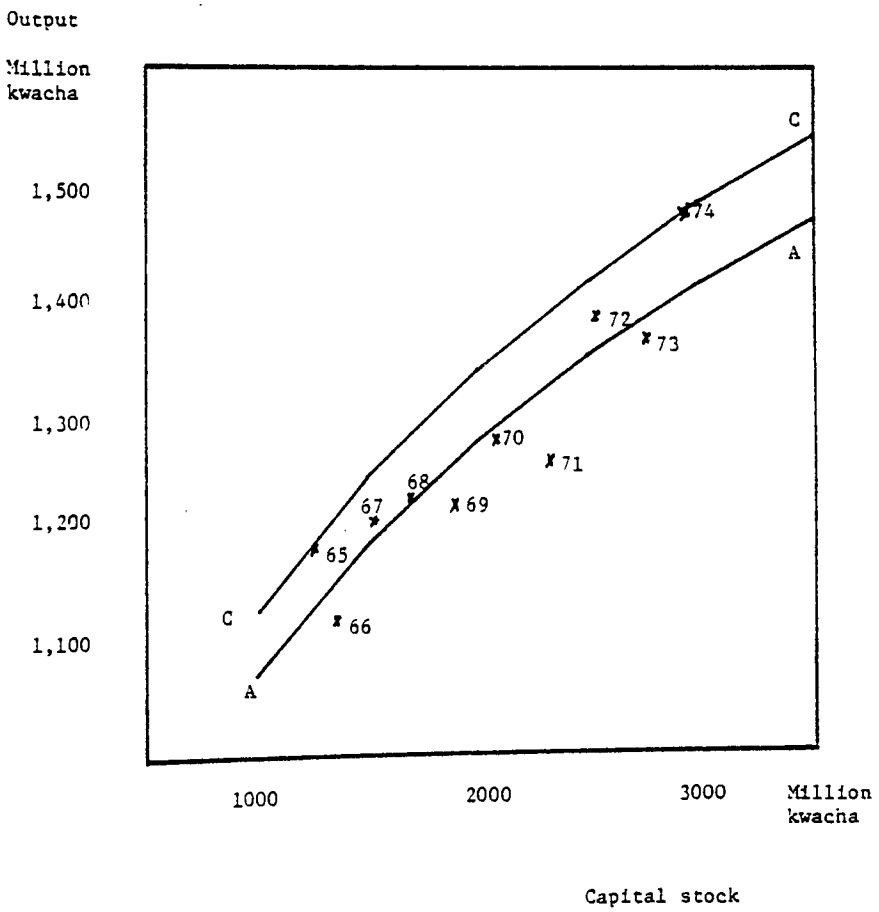
It is almost certainly the case that this results in a measure which overestimates capacity utilization. Nevertheless it does indicate a sharp fall in utilization after 1976, even though net investment was declining in real terms and this may be attributed to the development of other constraints on production.

The index of capacity utilization, IC, is the quotient of actual output and estimated capacity expressed as a percentage, thus:

$$IC_t = \frac{X_t}{XC_t} \times 100\%$$

In estimating the capacity output by the above method some use was made of the survey of measures of capacity utilization by Christiano (1981) although no specific measure was chosen from among those surveyed.

Figure XI.2.1 Estimation of output capacity



Sources: Calculated from Appendix S, Table S.1 and Table XI.2.1.

Table XI.2.2. Estimation of output capacity and capacity utilization

	Total GDP (actual) X_t	Estimated capacity output XC_t	Index of capacity utilization IC_t
1965	1186.9	1188.3	99.9
1966	1120.7	1214.8	92.2
1967	1209.6	1249.0	96.8
1968	1224.7	1286.9	95.2
1969	1219.4	1321.3	92.3
1970	1277.7	1352.3	94.5
1971	1269.3	1390.4	91.3
1972	1386.4	1420.7	97.6
1973	1361.1	1450.8	93.8
1974	1473.9	1473.7	100.0
1975	1438.1	1498.7	96.0
1976	1500.1	1526.3	98.3
1977	1424.2	1546.8	92.1
1978	1458.8	1564.7	93.2
1979	1342.1	1573.4	85.3
1980	1371.8	1576.5	87.0

Source: Calculated from Appendix S Table S.1.1 and Table XI.2.1. (For explanation see text.)

Notes

1. Given the Cobb-Douglas production function

$$Y = AK^{\alpha}L^{\beta}$$

the marginal product of labour is

$$\frac{\partial Y}{\partial L} = \beta AK^{\alpha}L^{\beta-1}$$

$$= \beta \frac{Y}{L}$$

Thus if $\beta = 0$, $\frac{\partial Y}{\partial L} = 0$ and $Y = AK^{\alpha}$

APPENDIX S. STATISTICAL APPENDIX

This appendix contains a number of tables to which reference is made in the text and other appendices. The footnotes in each table provide any further elaboration which is necessary.

Table S.1.0 Gross domestic product by type of expenditure in current market prices 1945-64

(Million pounds)

	Gross domestic products	Private final consumption	Government final consumption	Gross capital formation(a)	Exports (b)	Imports (b)	Net Exports (b)
1945	15.4	8.7	1.3	1.6	12.8	9.2	3.6
1946	18.1	9.9	1.6	2.2	14.9	10.5	4.4
1947	27.8	12.5	2.1	4.4	24.2	13.7	10.5
1948	34.0	15.3	2.7	8.7	28.1	20.8	7.3
1949	43.9	19.1	3.7	12.0	34.7	26.7	8.0
1950	58.5	22.6	4.5	15.1	49.6	34.4	15.2
1951	85.9	29.7	5.9	19.3	74.5	44.9	29.6
1952	96.9	36.1	7.1	26.8	79.8	53.3	26.5
1953	112.2	49.6	9.1	28.9	86.2	63.6	22.6
1954	136.9	64.8	9.5	31.3	...	...	33.6
1955	172.5	76.0	11.5	43.0	...	...	...
1956	189.2	82.4	14.0	57.9	...	...	36.6
1957	156.8	89.5	16.5	63.6	...	...	-8.9
1958	142.5	88.0	17.1	34.2	...	...	4.1
1959	189.9	95.9	20.1	41.1	...	...	30.4
1960	209.3	100.7	21.1	49.7	...	...	37.6
1961	203.1	102.0	24.5	49.3	...	...	30.1
1962	200.5	105.1	26.6	45.6	...	...	24.1
1963	209.9	108.2	28.9	37.5	...	...	37.4
1964	252.1	125.9	29.7	28.7	...	...	70.7

Notes: (a) Includes "Net increase in stocks"
(b) For the years 1954-64 separate figure for gross exports and gross imports are not available.

Sources: 1945-53: Central Statistical Office The National Income and Social Accounts of Northern Rhodesia, 1945-53, Lusaka, December 1964 (Table 2 page 25)
1954 and 1956-64 - Republic of Zambia, National Accounts 1964-65 and Input-output table, 1965, Lusaka: Central Statistical Office (Table 2 page 2)
1955 - International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund

Table S.1.1. Gross domestic product by kind of economic activity at current producers' values, 1965-79.

(Million kwacha)

	1965(a)	1966(a)	1967(a)	1968(a)	1969(a)	1970	1971	1972	1973	1974(b)	1975(b)	1976(b)	1977(b)	1978(b)	1979(b)
Agriculture - commercial	20.4	24.7	25.4	25.0	27.0	41.5	52.7	66.7	62.2	67.4	62.9	95.3	110.0	112.8	105.0
- subsistence	79.1	84.5	87.4	92.4	95.0	94.6	101.3	105.5	117.4	132.0	143.5	178.0	211.5	245.0	270.0
Mining	303.0	376.2	331.9	411.5	645.0	460.3	275.1	324.4	515.0	615.7	215.2	314.8	233.7	286.8	463.5
Manufacturing	48.0	69.0	86.1	109.3	112.2	129.2	149.7	181.4	195.3	238.5	250.3	275.6	314.0	383.9	411.5
Electricity, Gas and Water	5.4	7.4	8.4	12.6	14.2	19.4	22.5	30.7	32.5	41.2	43.0	47.8	50.5	48.5	52.1
Construction	44.7	59.2	63.6	69.9	75.2	90.3	98.2	99.8	102.7	127.0	151.2	184.9	185.4	151.6	124.2
Wholesale and retail trade	81.9	76.0	105.1	126.2	94.7	118.7	112.4	127.9	139.5	168.2	132.8	154.5	180.0	215.0	243.0
Hotels & restaurants	4.6	6.3	7.4	10.5	13.1	14.9	16.7	18.7	18.4	21.8	24.7	29.9	32.0	39.6	47.4
Transport and Communications	31.3	31.4	47.6	45.7	42.2	48.8	62.3	63.5	64.9	76.3	88.5	118.5	135.5	144.0	160.3
Financial & Business Services	30.7	32.4	47.2	54.9	67.2	87.6	96.8	103.8	119.2	135.1	159.8	181.5	202.0	223.0	242.8
Other services - Public admin., Defense, Sanitary & others	30.4	35.7	42.1	45.8	43.2	65.5	80.0	77.6	81.3	94.0	112.7	118.4	137.4	155.7	168.0
Education	15.0	14.3	23.2	25.0	30.0	40.4	47.5	60.2	65.9	73.7	82.4	106.5	115.9	124.2	135.3
Health	8.3	8.7	13.9	15.6	18.1	15.6	20.5	23.6	25.5	27.4	29.7	36.2	38.2	41.7	43.1
Other personal & household	13.1	14.7	18.4	19.8	21.1	28.5	30.3	33.9	34.0	39.9	43.7	48.2	54.0	60.4	66.5
Import duties	14.5	12.3	15.0	19.0	27.8	32.1	36.7	44.4	38.1	55.4	62.0	45.4	46.0	50.0	59.0
Inputed Service charges	...	...	...	...	...	9.7	12.7	12.2	18.5	21.0	19.0	22.0	22.5	23.5	25.4
Total GDP at producers' values	730.4	852.8	922.7	1083.2	1326.0	1277.7	1188.6	1348.0	1591.3	1892.6	1583.4	1940.5	2023.6	2258.7	2566.3

Notes: (a) 1965-69 data conformed to old System of National Accounts (SNA). From 1970 onwards, new SNA conventions were used. No attempt was made to adjust this data.
(b) Provisional estimates

Sources: 1965-73 Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office (Table 5-1. Pages 53-54)
1973-1979 Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April-Sept., 1980 (Table 54, Page 50)

Table S.1.2. Gross domestic product by kind of economic activity at constant (1970) producers' values, 1965-79.

(Million kwacha)

	1965(a)	1966(a)	1967(a)	1968(a)	1969(a)	1970	1971	1972	1973	1974(b)	1975(b)	1976(b)	1977(b)	1978(b)	1979(b)
Agriculture - commercial	31.9	35.0	33.5	34.6	35.9	41.5	44.3	49.6	46.4	52.2	56.3	63.6	62.4	60.5	47.6
- subsistence	91.7	92.3	92.9	93.0	93.7	94.6	95.1	96.0	97.1	98.3	100.7	103.3	105.8	108.5	105.8
Mining & quarrying	663.2	527.5	527.9	479.6	525.9	460.3	415.8	478.1	449.7	474.3	427.9	503.2	469.7	504.8	405.1
Manufacturing	75.5	90.4	106.0	118.2	119.5	129.1	144.3	162.7	165.4	178.9	157.6	151.9	141.4	150.7	151.9
Electricity, Gas and Water	4.8	6.5	7.0	9.7	12.3	19.4	23.5	31.4	38.7	46.0	48.9	52.6	57.8	58.3	61.9
Construction	89.5	100.9	95.3	88.1	97.3	90.3	88.9	94.3	99.9	114.4	138.5	157.6	154.3	119.4	96.0
Trade, hotels & restaurants	115.0	106.6	121.8	139.1	105.1	133.5	129.5	141.8	128.3	147.9	123.8	127.2	114.5	114.9	113.8
Transport and communications	47.7	43.3	61.6	58.1	51.6	48.8	58.8	54.6	51.4	54.6	57.6	67.0	62.0	63.2	66.0
Financial & business Services	50.5	56.1	69.0	77.6	78.1	87.6	99.2	103.2	121.3	119.5	132.9	136.4	125.9	121.9	121.5
Community, social & personal services	91.0	97.7	112.9	120.5	116.0	150.0	158.1	163.5	162.1	172.6	180.6	188.4	190.0	191.0	188.6
Import duties	21.4	26.6	31.7	34.2	31.8	32.1	29.4	29.9	24.7	28.8	26.9	20.1	16.0	12.0	11.5
Imputed bank charges	...	...	...	...	...	-9.7	-17.6	-18.7	-23.9	-13.7	-13.6	-13.1	-11.0	-8.8	-8.2
Total non-mineral activity	619.0	653.4	731.7	773.1	741.3	817.4	853.5	908.3	911.4	999.6	1010.2	1055.0	1019.7	991.6	956.4
Total gross domestic product	1186.9	1120.7	1209.6	1224.7	1219.4	1277.7	1269.3	1386.4	1361.1	1473.9	1438.1	1558.2	1488.8	1496.4	1361.5

Notes: (a) 1965 - 1969 original data is in 1965. Converted to 1970 prices by method derived in Appendix III.1. For these years, column totals will not sum to GDP total given. Adjustment made to bring old SNA (1965-1969) to new SNA basis. Assumes 1970 ratio (between old and new SNA figures) holds for each sector.

(b) Provisional estimates.

Sources: 1965 - 69: Calculated from Table S.1.1.

1970: Republic of Zambia, National Accounts and Input-output tables, 1973 Lusaka: Central Statistical Office (Table 6-3. pages 111-112)

1971-79: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April-September, 1980 (Table 55, pages 51)

Table S.1.3. Expenditure on gross domestic product at current purchasers' values, 1965-79.

(Million kwacha)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Government final consumption	83.2	86.2	114.6	126.6	131.0	205.5	280.3	314.5	344.8	357.8	435.7	501.0	553.3	591.0	680.8
Private final consumption	354.0	394.2	450.8	545.0	521.7	489.7	492.6	535.7	530.2	664.4	814.5	736.7	796.6	1016.4	1144.7
Increase in stocks	35.5	50.4	48.9	56.0	-39.4	-11.5	47.4	31.4	42.0	190.0	40.0	6.5	7.0	100.0	65.0
Gross fixed capital formation	147.1	201.7	249.5	281.5	275.9	379.1	393.4	445.0	422.9	502.0	602.0	600.0	668.0	551.0	476.0
Total domestic expenditure	619.8	732.5	863.8	1009.1	889.2	1062.8	1213.7	1326.6	1339.9	1714.2	1892.2	1844.2	2024.9	2258.4	2366.5
Exports	373.3	455.7	475.2	544.5	862.7	685.4	500.6	586.1	780.4	943.9	575.0	832.3	788.4	768.2	1161.2
Total final expenditure	993.1	1188.2	1339.0	1553.6	1751.9	1748.2	1714.3	1912.7	2120.3	2658.1	2467.2	2676.5	2813.3	3026.6	3527.7
Imports	262.7	335.4	416.3	470.4	425.9	470.5	525.7	564.7	529.0	765.5	883.8	736.8	789.7	767.9	961.4
Gross Domestic Product	730.4	852.8	922.7	1083.2	1326.0	1277.7	1348.0	1188.6	1591.3	1892.6	1583.4	1940.5	2023.6	2258.7	2566.3

Note: 1965-69 data - former SNA

Sources: 1965 - 73 Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office, (Table 1.1(a), page 19)
1974 - 79 Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April-September 1980 (Table 56(a), page 52)

Table S.1.4. Expenditure on gross domestic product at constant purchases vales, 1965-79.

(Millions of kwacha)

	At constant 1965 prices						At constant 1970 prices									
	1965	1966	1967	1968	1969	1970	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Goverment final consumption	83.2	83.9	98.9	105.9	103.1	125.1	205.5	248.0	260.1	260.3	259.0	287.2	291.9	277.0	255.7	260.6
Private final consumption	354.0	365.6	399.3	446.3	414.8	391.2	489.7	465.0	479.6	452.1	501.1	565.2	431.7	390.1	436.5	444.2
Increase in stocks	35.5	41.8	41.6	43.6	-10.4	-1.6	-11.5	46.9	25.2	38.2	137.0	33.8	-8.2	-0.2	91.6	41.6
Gross fixed capital formation	147.0	183.7	215.4	220.9	215.7	290.0	379.1	355.1	389.5	352.5	358.5	393.5	331.0	304.0	212.4	154.0
Total domestic expenditure	619.7	675.0	755.2	816.7	723.2	804.7	1062.8	1115.0	1154.4	1103.1	1255.6	1279.7	1046.4	970.9	996.2	900.4
Exports	373.3	318.7	368.4	344.4	415.0	398.7	685.4	641.7	729.0	666.5	706.7	683.2	830.3	813.0	766.5	780.3
Total final expenditure	993.0	993.7	1123.6	1161.1	1138.2	1203.4	1748.2	1756.7	1883.4	1769.6	1962.3	1962.9	1876.7	1783.9	1762.7	1680.7
Imports	262.7	327.0	391.5	420.0	390.0	394.7	470.5	498.6	506.6	418.8	488.3	454.9	339.4	317.4	259.3	270.6
Gross Domestic Product (a)	730.4	689.8	744.3	753.6	750.3	786.3	1277.7	1269.3	1386.4	1361.1	1493.9	1438.1	1558.2	1488.8	1496.4	1363.5

Notes: (a) Columns may not sum to stated level of GDP due to "statistical discrepancy".

Sources: 1965 - 73 Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office (Table 6.1, page 109)
1974 - 79 Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April - September 1980 (Table 57, page 52)

Table S.1.5. Percentage composition of expenditure on GDP and domestic final expenditure, 1965-79.

	At constant 1965 prices						At constant 1970 prices									
	1965	1966	1967	1968	1969	1970	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Percentage structure of GDP																
Government final consumption	11.4	12.2	13.3	14.1	13.7	15.9	16.1	19.5	18.8	19.1	17.3	20.0	18.7	18.6	17.1	19.1
Private final consumption	48.5	53.0	53.6	59.2	55.3	49.7	38.3	36.6	34.6	33.2	33.5	39.3	27.7	26.2	29.2	32.6
Increase in stocks	4.9	6.1	5.6	5.8	-1.4	-0.2	-0.9	3.7	1.8	2.8	9.2	2.3	-0.5	--	6.1	3.0
Gross fixed capital formation	20.1	26.6	28.9	29.3	28.7	36.9	29.7	28.0	28.1	25.9	24.0	27.4	21.2	20.4	14.2	11.3
Exports	51.1	46.2	49.5	45.7	55.3	50.7	53.6	50.6	52.6	49.0	47.3	47.5	53.3	54.6	51.2	57.2
Imports	36.0	47.4	52.6	55.7	52.0	50.2	36.8	39.3	36.5	30.8	32.7	31.6	21.8	21.3	17.3	19.8
Percentage structure of domestic final consumption																
Government final consumption	13.4	12.4	13.1	13.0	14.3	15.5	19.3	22.2	22.5	23.6	20.6	22.4	27.9	28.5	25.7	28.9
Private final consumption	57.1	54.2	52.9	54.6	57.4	48.6	46.1	41.7	41.5	41.0	39.9	44.2	41.3	40.2	43.8	49.3
Increase in stocks	5.7	6.2	5.5	5.3	1.4	-0.2	-1.1	4.2	2.2	3.5	10.9	2.6	-0.8	--	9.2	4.6
Gross fixed capital formation	23.7	27.2	28.5	27.0	29.8	36.0	35.7	31.8	33.7	32.0	28.6	30.7	31.6	31.3	21.3	17.1

Source: Table S.1.4

Table S.1.6 Cost structure of gross domestic product at current purchasers' values, 1965 - 79.

(Million kwacha)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Compensation of employees	244.1	282.1	349.3	391.3	396.6	481.4	567.7	618.6	672.0	771.2	802.0	886.0	957.0	1066.0	1079.4
Operating surplus (b)	326.8	386.5	358.5	407.0	553.1	591.9	199.2	463.8	647.5	825.8	420.7	622.6	585.6	602.1	913.5
Consumption of fixed capital	56.6	61.6	73.6	90.5	109.1	136.7	163.2	194.6	211.7	218.6	243.0	268.0	305.0	340.0	380.0
Indirect taxes	103.5	140.6	149.4	206.4	283.9	86.6	86.2	103.7	104.4	132.3	207.7	233.9	216.0	294.6	298.4
Subsidies	0.6	18.0	8.1	12.0	16.6	18.9	27.7	32.7	44.3	55.3	90.0	70.0	85.0	44.0	105.0
Gross domestic product	703.4	852.8	922.7	1083.2	1326.0	1277.7	1188.6	1348.0	1591.3	1892.6	1583.4	1940.5	2023.6	2258.7	2566.3

Notes: (a) 1965 - 69 former SNA; 1970 - 79 revised SNA
(b) See Table S.1.7

Sources: 1965 -73 Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office (Table 1.1 (b), page 19)
1974 - 79 Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April - September 1980, (Table 56 (b), page 52).

Table S.1.7 National income and National disposable income in current prices, 1965 - 79.

(Million kwacha)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Compensation of employees	244.1	282.1	349.3	391.3	396.6	481.4	567.7	618.6	672.0	771.2	802.0	886.0	957.0	1066.0	1079.4
Operating surplus	326.8	386.5	358.5	407.0	553.1	591.9	399.2	463.8	647.5	825.8	420.7	622.6	585.6	602.1	913.5
Domestic factor incomes	570.9	668.6	707.8	798.3	949.7	1073.3	966.9	1082.4	1319.5	1597.0	1222.7	1508.6	1542.6	1668.1	1992.9
Net factor income from abroad	-45.5	-58.0	-50.6	-52.1	-47.5	-33.4	-43.6	-74.1	-82.9	-86.9	-78.2	-108.3	-104.8	-102.5	-123.0
Indirect taxes less subsidies	102.9	122.6	141.3	194.4	267.3	67.7	58.5	71.0	60.1	77.0	117.7	163.9	176.0	250.6	193.4
National income at market prices	628.3	733.2	798.5	940.6	1169.5	1107.6	981.8	1079.3	1296.7	1587.1	1262.2	1562.2	1613.8	1816.2	2063.3
Other current transfers from abroad (net)	-3.5	-9.6	0.1	-24.9	-51.0	-104.5	-107.8	-96.1	-90.5	-81.2	-81.8	-79.7	-64.6	-65.0	-76.0
National disposable income	624.8	723.6	798.6	915.7	1118.5	1003.1	874.0	983.2	1206.2	1505.9	1180.4	1484.5	1549.2	1751.2	1987.3
Government final consumption	83.2	86.2	114.6	126.6	131.0	205.5	280.3	314.5	344.8	357.8	435.7	501.0	553.3	591.0	680.8
Private final consumption	354.0	394.2	450.8	545.0	521.7	489.7	492.6	535.7	530.2	664.4	814.5	736.7	796.6	1016.4	1144.7
Saving	187.6	243.2	233.2	244.1	465.8	307.9	101.1	133.0	331.2	483.7	-69.8	246.8	199.3	143.8	161.8

Notes: (a) 1965 - 69 old SNA; 1970 onwards new SNA.
(b) 1974 onwards provisional
(c) It is believed that the data given in the Monthly Digest of Statistics includes in indirect taxes, for 1974 onwards the level of mineral tax which is profit based and so should appear in operating surplus. Adjustment made by transferring level of mineral tax shown in annual financial reports. However, the latter is presented on cash basis while National Accounts are based on accruals.

Sources: 1965-73: Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office (Table 1.2, page 20)
1974-79: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April-September 1980 (Table 58, page 53)

Table S.1.8

Value added in manufacturing by industry at constant producers prices. 1965-79

(Million kwacha)

	At constant 1965 prices					At constant 1970 prices									
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Food	6.6	6.6	6.1	10.0	10.7	17.5	17.5	23.3	16.9	9.8	13.1	16.4	15.9	18.5	18.6
Beverages and tobacco	13.0	17.4	18.9	23.6	22.0	50.9	56.6	64.0	62.6	70.7	61.0	58.4	52.5	52.8	54.3
Textiles, etc.	3.9	3.9	6.6	5.5	7.6	11.1	9.4	12.2	14.2	15.9	16.0	16.6	14.3	19.6	19.1
Wood, etc.	2.4	3.0	2.3	3.6	3.5	5.6	5.3	4.8	6.2	9.2	6.4	4.4	5.0	4.6	6.6
Paper, etc.	2.1	2.1	3.0	3.2	3.8	5.6	5.1	5.0	5.5	5.1	5.7	4.6	5.1	6.1	5.6
Rubber products Chemicals, petroleum, etc.	3.6	3.7	6.3	7.0	8.2	11.2	16.8	17.4	23.5	25.6	24.5	25.1	25.9	24.4	24.5
Non-metallic mineral products	6.1	5.1	5.3	5.3	5.6	9.2	9.8	10.3	9.2	8.7	7.0	6.1	5.8	8.0	10.5
Basic metal products	4.5	4.6	4.3	3.9	1.7	2.5	2.2	2.8	1.9	3.1	2.2	2.1	2.3	2.6	2.3
Fabricated metal products	5.7	10.8	14.3	12.8	11.8	15.2	21.2	22.5	25.0	28.8	21.0	17.6	14.0	13.5	9.7
Other	0.1	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.7	0.7	0.6	0.6	0.6	0.7
Total	48.0	57.5	67.4	75.2	76.0	129.2	144.3	162.7	165.4	177.6	157.6	151.9	141.4	150.5	151.9

Sources: 1965 - 73 Republic of Zambia, National Accounts and Input-output tables, 1973, Lusaka: Central Statistical Office (Table 5 1., page 53)

1974 - 79 Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, (Table 55, page 51)

Table S.2.1 Employment by Kind of Economic Activity, 1965 - 1979 (Thousands)

		1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Agriculture	1	35.0	34.9	34.6	32.7	36.3	34.1	38.7	29.6	30.3	32.1	34.8	31.2	31.2	31.2	32.6
	2	0.7	0.5	0.5	0.5	0.5	0.5	0.6	1.5	1.4	1.4	1.4	1.3	1.4	1.4	2.0
Mining	1	44.8	47.6	48.3	48.6	50.3	52.1	52.8	49.5	50.4	54.3	54.4	55.4	55.6	55.1	52.9
	2	7.7	7.2	6.4	6.1	5.6	5.5	5.4	11.2	11.3	10.8	10.3	9.0	8.5	7.7	6.4
Manufacturing	1	23.4	27.9	29.6	30.5	31.9	35.2	39.0	40.0	40.5	41.0	41.2	40.4	43.7	47.6	48.0
	2	3.4	2.9	2.7	2.6	2.6	2.9	3.0	3.3	3.1	3.1	3.1	2.7	2.7	2.5	2.7
Electricity and Water	1	3.6	3.3	2.5	3.1	3.3	2.8	3.6	4.0	4.1	4.2	4.7	6.6	7.2	7.4	7.5
	2	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.3	0.3
Construction	1	49.2	68.6	64.8	61.4	59.7	66.2	63.1	68.2	66.6	66.3	67.8	47.1	47.3	37.4	37.8
	2	2.6	2.6	2.7	2.6	2.4	2.5	2.7	4.1	3.9	4.3	4.3	3.1	3.0	2.7	2.3
Distribution, hotels, etc.	1	19.5	22.1	26.2	27.4	27.9	28.0	33.3	29.7	31.2	32.2	30.2	32.1	31.1	30.9	31.7
	2	7.9	6.3	5.3	5.2	5.0	4.5	4.6	4.0	3.7	3.4	2.7	2.1	1.9	1.8	1.6
Transport and Communications	1	10.1	18.1	17.9	20.7	19.6	19.7	21.0	23.2	22.5	20.5	20.5	19.3	19.4	20.3	20.8
	2	2.2	2.6	2.4	2.8	2.9	2.6	1.6	1.8	1.7	1.6	1.6	1.2	1.2	1.0	1.1
Financial Services	1	46.0	49.9	4.6	5.2	6.4	7.2	8.6	12.4	13.1	14.5	16.8	17.3	16.7	17.6	19.3
	2	7.5	6.8	2.3	2.3	2.2	2.2	1.9	1.9	1.9	1.9	1.6	1.6	1.2	1.2	1.2
Community & Social Services	1			54.3	59.7	65.0	70.1	78.7	77.1	81.3	86.4	90.7	91.5	93.3	95.6	96.8
	2			6.4	6.6	6.3	6.1	6.3	5.8	5.8	6.2	7.1	6.5	6.8	6.8	6.9
Total	1	266.5	307.4	282.8	289.4	300.5	315.6	338.7	333.8	340.0	351.6	361.2	341.0	345.6	342.9	347.4
	2	31.9	29.4	29.3	29.2	27.8	27.4	26.0	34.1	33.4	33.3	32.3	27.8	27.3	25.5	24.6
Total - all workers		298.4	336.8	312.0	318.6	328.3	343.0	364.7	367.9	373.4	384.9	393.5	368.8	372.9	368.5	372.0

Notes: 1 = African workers up to 1971, Zambian workers from 1972
2 = "Other" workers up to 1971, Non-Zambian workers from 1972.

Sources: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, July 1968, June 1972, June 1979, July-September 1979, April-September 1980.

Table S.2.2. Average Earnings by Industry and Nationality: 1967, 1971, 1974 and 1977

(Kwacha per worker)

	1967			1971			1974			1977		
	African	Other	Total	African	Other	Total	Zambian	Non-Zambian	Total	Zambian	Non-Zambian	Total
Agriculture	248	3142	289	354	4249	413	445	2602	538	612	3546	738
Mining	1322	7608	2057	1569	7336	2104	1701	6629	2522	2576	10723	3657
Manufacturing	676	4581	1002	946	6795	1364	1071	5866	1408	1470	7158	1797
Electricity and Water	795	5736	1476	775	6398	1337	803	6062	1368	1494	8135	1767
Construction	500	4650	666	663	6373	897	716	4371	939	886	4346	1094
Distribution, hotels, etc.	679	3986	1235	762	4531	1219	1019	5066	1406	1547	7764	1911
Transport and Communications	934	3766	1269	1393	5902	1712	1397	4653	1635	1988	5361	2180
Financial Services	439	2196	1025	1142	5899	2003	1356	6947	2005	1992	7086	2401
Community, Social & Personal Services	698	2688	908	844	2971	1002	1299	4168	1490	1375	4032	1556
Total	666	4458	1022	977	5635	1319	1122	5389	1491	1526	6961	1924

Notes: Several discontinuities occur: Firstly a change to presenting earnings in cash only after 1970, whereas previously earnings in kind were included; secondly the change in classification from African/Other to Zambian/Non-Zambian in 1972; thirdly a broader coverage was introduced in 1975. Thus none of the four years shown is strictly comparable.

Sources: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, July 1968, June 1972, June 1974, July-September 1979, April-September 1980.

Table S.2.3 Indices of Prices and earnings 1965-77 (1970 = 100)

	Earnings		Index of prices for	Real Earnings (c)	
	Zambian (a),(b)	Total (a)	low income households	Zambian	Total
1965	46.2	59.6	74.2	62.3	80.3
1966	51.8	63.3	81.7	63.4	77.5
1967	71.7	80.6	85.8	83.6	93.9
1968	76.8	84.9	95.2	80.7	89.2
1969	81.2	88.2	97.5	83.3	90.5
1970	100.0	100.0	100.0	100.0	100.0
1971	111.3	109.6	104.9	106.1	95.7
1972	109.4	111.5	110.2	99.3	101.2
1973	122.4	122.6	117.4	104.3	104.4
1974	121.0	123.8	126.9	95.3	97.6
1975	123.0	124.9	139.7	88.0	89.4
1976	159.4	156.5	166.0	96.0	94.3
1977	164.6	159.8	198.9	82.7	80.3

Note: (a) to overcome discontinuity noted in footnote to Table S.2.2 the 1970 ratio of earnings (cash only) to earnings (cash and kind) was assumed constant and applied to each of the years1965-69. The indices are for cash earnings only.

(b) To overcome the discontinuty caused by nationality classification change noted in Table S.2.2 the 1972 ratio between "Zambian" and "African" earnings was assumed constant.

(c) Both earnings indices deflated by price index for law income households.

Source: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office (various issues)

Table S.2.4 Value added per worker by sector in constant, (1970) prices

(Kwacha per worker)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total GDP (a)	3598	2974	3478	3445	3332	3384	3187	3477	3383	3535	3365	3926	3695	3758	3367
Agriculture	893	989	954	1042	976	1199	1127	1595	1464	1558	1560	1957	1914	1856	1376
Mining	12632	9626	9651	8769	9409	7991	7144	7876	7288	7286	6614	7814	7328	8038	6831
Manufacturing	2817	2935	3282	3571	3464	3388	3436	3757	3794	4057	3558	3524	3047	3008	2996
Electricity and Water	1200	1757	2414	2771	3324	6062	5875	6978	8413	9787	9588	7623	7707	7571	7934
Construction	1728	1417	1412	1377	1567	1314	1351	1304	1417	1620	1929	3139	3068	2978	2394
Distribution, hotels, etc.	4259	3753	3867	4267	3194	4108	3417	4297	3676	4154	3763	3719	3470	3514	3417
Transport and communications	3878	2092	3034	2472	2293	2188	2602	2184	2124	2471	2606	3268	3010	2967	3014
Financial & business services	)	)		10000	10347	9081	9319	9448	7217	8087	7287	7107	7217	6956	6484	5927
Community services, etc.	) 2645	) 2677		1860	1817	1627	1968	1860	1972	1861	1864	1847	1922	1898	1865	1819
Non-mining activity (a)	1670	1682	2165	2341	2085	2454	2436	2608	2610	2771	2726	3103	2941	2953	2762

Notes: (a) Before adding import duties or subtracting imputed bank charges, but excluding subsistence agriculture

Sources: Tables S.1.2. and S.2.1

Table S.3.1 Copper World Production, Consumption and Trade. 1979

(Thousand Tonnes)

	Production				Consump-tion	Exports			Imports		
	Mine(a)	Smelter(b)	Refined(b)	Scrap(c)		Ores	Blister	Refined	Ores	Blister	Refined
1. Primary Producing Countries (d)	3711.4	2914.8	2301.7	230	934.9	802.7	697.8	1780.6	56.3	--	311.5
Peru	397.0	370.6	230.8	--	19.3	31.2	138.8	212.0	--	--	--
Chile	1060.6	946.9	779.5	--	49.0	98.4	163.3	741.8	--	--	--
Zaire	399.8	370.2	103.2	--	2.4	29.6	266.2	70.0	--	--	--
Zambia	588.3	595.1	563.6	--	1.6	--	20.9	625.8	--	--	--
Philippines	297.0	--	--	--	2.9	219.7	--	--	--	--	--
Papua New Guinea	170.8	--	--	--	--	172.0	--	--	--	--	--
South Africa	203.2	182.3	152.3	--	69.3	21.9	31.7	84.0	--	--	1.1
Total	3116.7	2647.4	1829.4	--	144.5	644.8	620.9	1733.6	--	--	1.1
2. Industrialized Countries	2410.0	3392.1	4739.0	2217	6574.4	397.9	57.9	887.3	1033.0	560.6	2554.5
USA	1443.6	1395.8	1980.3	940	2168.3	44.6	7.4	74.9	22.9	68.0	215.2
Canada	643.8	384.5	397.3	23	243.3	318.3	--	191.1	--	--	32.5
Japan	59.1	921.4	983.7	406	1330.1	....	--	46.9	798.8	88.6	305.4
W. Europe	263.5	690.4	1377.7	848	2832.7	35.0	50.5	574.4	211.3	404.0	2001.4
Total 1 + 2	6121.4	6306.9	7040.7	2447	7509.3	1200.6	755.7	2667.9	1089.3	560.6	2866.0
3. Centrally Planned Economies	1818.1	1839.5	2316.3	...	2291.1	...	...	139.7	...	...	105.6
World Total	7939.5	8146.4	9357.0	...	9800.4	...	...	2807.6	...	...	2971.6

General: Production figures are not additive; but export and import figures are additive

Notes: a) Recoverable copper content
b) Includes scrap recovery
c) Some goes directly to chemical users, etc. and is not included. "Scrap" here covers production of regular copper.
d) Includes Australia

Source: World Bureau of Metal Statistics World Metal Statistics, February 1981

Table S.3.2. Leading Producers and Exporters of Copper, Selected Years (a)
(Thousand tonnes copper content)

	Ore				Refined			
	1965	1970	1975	1979	1965	1970	1975	1979
Production								
USA	1226.3	1560.0	1282.8	1441.3	1956.7	2034.5	1610.2	1981.3
USSR	750.0	925.0	1100.0	1140.0	875.7	1075.0	1420.0	1500.0
Zambia	695.7	684.1	676.9	588.3	522.2	580.7	629.2	570.6
Chile	585.6	691.6	828.3	1060.6	288.8	465.1	535.2	779.5
Canada	462.5	610.3	733.8	643.8	393.8	492.6	529.2	397.3
Zaire	288.6	387.1	494.8	399.8	152.6	189.6	225.9	103.2
Peru	177.4	212.1	189.2	397.0	40.5	35.9	71.6	229.0
Japan	107.1	119.4	85.0	60.0	365.7	705.3	818.9	983.7
Australia	92.4	157.8	219.0	232.8	95.2	145.5	192.0	173.8
China	75.0	120.0	155.0	180.0	100.0	130.0	248.0	300.0
(Papua New Guinea)	...	...	172.5	170.8	...	...	...	...
Exports								
Zambia	...	...	...	...	502.4	578.4	616.1	625.8
USA	...	...	...	...	290.2	201.4	156.2	74.9
Belgium-Luxembourg	...	...	...	...	258.9	295.2	148.6	297.6
Chile	...	...	...	...	213.3	440.0	504.2	741.8
Canada	...	...	...	...	178.4	265.3	319.6	191.1
W. Germany	...	...	...	...	101.2	93.6	97.3	99.6
United Kingdom	...	...	...	...	46.2	45.5	15.7	22.6
Peru	...	...	...	...	37.3	32.6	36.9	212.0
Zaire	...	...	...	...	...	180.0	224.0	70.0

Note: (a) Ranked by 1965 level.

Source: Metal Bulletin Handbook 1980, Worcester Park: Metal Bulletin Handbooks.

Table S.3.3 Comparative copper prices: US producer prices and London Metal Exchange prices

	US producer prices (cents per pound)(1)	Exchange rate (dollars per pound)(2)	US producer prices (pounds per tonne)(3)	LME price (pounds per tonne)(4)	LME prices as percentage of (5) US producer price
1948	22.32	4.00	175.7	131.9	105.6
1949	19.50	2.80	153.5	130.9	85.3
1950	21.58	2.80	169.9	176.2	103.7
1951	24.50	2.80	192.9	217.2	112.6
1952	24.50	2.80	192.9	255.4	132.4
1953	29.05	2.80	228.7	252.2	110.3
1954	29.94	2.80	235.7	245.5	104.2
1955	37.51	2.80	295.3	346.2	117.2
1956	42.00	2.80	330.7	323.9	97.8
1957	30.17	2.80	237.5	216.0	90.9
1958	26.31	2.80	207.5	194.5	93.9
1959	30.99	2.80	244.0	233.9	95.9
1960	32.34	2.80	254.6	241.9	95.0
1961	30.32	2.80	238.7	226.0	94.7
1962	31.00	2.80	244.1	230.3	94.3
1963	31.00	2.80	244.1	230.2	94.4
1964	32.35	2.80	254.7	346.5	136.0
1965	35.36	2.80	278.4	461.4	165.7
1966	36.00	2.80	283.4	545.0	192.3
1967	38.10	2.40	350.0	410.3	117.2
1968	41.17	2.40	378.2	515.2	136.2
1969	47.43	2.40	435.7	611.0	140.2
1970	58.07	2.40	533.4	587.6	110.2
1971	52.09	2.43	472.6	444.1	94.0
1972	51.44	2.50	453.6	427.7	94.3
1973	59.53	2.45	535.7	726.3	135.6
1974	77.06	2.34	726.0	876.2	120.7
1975	64.53	2.22	640.8	556.5	86.8
1976	69.62	1.81	848.0	782.1	92.2
1977	66.72	1.75	840.5	749.9	89.2
1978	66.53	1.92	763.9	710.2	93.0
1979	92.75	2.12	964.5	936.2	97.1
1980	101.30	2.33	958.5	941.4	98.2

Sources: Column (1) American Metal Market, Metal Statistics 1967 and 1980 (New York)
Column (2) International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund
Column (3) Metal Bulletin Handbooks Ltd, Metal Bulletin Handbook, 1980 (Worcester Park)

Appendix Table S.3.4

Copper prices 1875-1980: Nominal and deflated values

	Nominal prices pounds/tonne	Wholesale price index	Deflated price (a)		Nominal prices pounds/tonne	Wholesale price index	Deflated price (a)		Nominal prices pound/tonne	Wholesale price index	Deflated price (a)
1875	79.97	21.4	374	1911	55.20	16.7	330	1947	128.50	41.6	309
1876	74.68	20.9	357	1912	71.91	17.5	441	1948	131.88	47.6	277
1877	68.43	21.4	320	1913	67.21	17.8	378	1949	130.93	49.9	262
1878	59.81	20.0	299	1914	58.62	17.9	327	1950	176.17	57.0	309
1879	59.32	19.1	311	1915	71.49	22.0	325	1951	217.17	64.4	337
1880	61.74	19.7	313	1916	114.23	28.5	401	1952	255.37	66.0	387
1881	60.86	19.3	315	1917	123.14	37.1	332	1953	252.22	64.6	390
1882	64.98	19.5	333	1918	113.75	40.9	278	1954	245.51	65.1	377
1883	61.90	19.2	322	1919	89.53	45.2	198	1955	364.18	66.7	519
1884	53.02	17.4	305	1920	96.07	56.3	171	1956	323.53	69.7	464
1885	42.86	16.3	263	1921	68.33	36.1	189	1957	215.97	71.9	300
1886	39.45	15.4	256	1922	61.20	29.1	210	1958	194.54	72.3	269
1887	45.29	15.1	300	1923	64.86	29.1	223	1959	233.90	72.4	323
1888	80.27	15.5	518	1924	62.21	30.4	205	1960	241.89	73.6	329
1889	48.95	15.8	310	1925	61.00	29.1	210	1961	226.02	75.6	299
1890	53.40	15.8	338	1926	57.12	27.1	211	1962	230.27	77.3	298
1891	50.65	16.3	311	1927	54.81	25.9	212	1963	230.44	78.0	295
1892	44.94	15.4	292	1928	62.73	25.7	244	1964	346.46	80.4	431
1893	43.08	15.2	283	1929	74.29	25.0	297	1965	461.39	83.4	553
1894	39.73	14.3	278	1930	53.81	21.7	248	1966	544.97	85.6	637
1895	42.30	13.8	306	1931	39.87	19.1	198	1967	410.34	86.5	474
1896	46.16	13.5	342	1932	31.23	18.6	168	1968	515.25	90.0	572
1897	48.35	13.7	353	1933	32.05	18.6	172	1969	610.99	93.3	655
1898	51.01	14.2	359	1934	29.84	19.1	156	1970	587.55	100.0	588
1899	72.52	14.1	514	1935	31.40	19.3	163	1971	444.15	109.0	407
1900	72.46	15.3	474	1936	37.87	20.5	185	1972	427.69	114.8	372
1901	65.92	14.8	445	1937	53.67	23.6	227	1973	726.27	123.3	589
1902	51.74	14.7	352	1938	40.11	22.0	182	1974	876.16	151.2	579
1903	57.24	14.8	387	1939	43.03	22.3	193	1975	556.51	184.8	301
1904	58.09	15.0	387	1940	61.02	29.7	205	1976	782.09	216.8	361
1905	68.50	14.9	460	1941	61.02	33.1	184	1977	749.95	259.7	289
1906	86.04	15.4	559	1942	61.02	34.6	176	1978	710.22	283.4	251
1907	85.71	16.2	529	1943	61.02	35.3	173	1979	936.16	317.9	294
1908	59.08	15.7	376	1944	61.02	36.1	169	1980	941.40	368.4	256
1909	57.93	15.9	364	1945	61.02	36.7	166				
1910	56.25	16.6	339	1946	75.95	38.0	200				

Note: (a) Nominal price deflated to 1970 values by Wholesale price index of UK wholesale prices

Sources: Copper prices: Metal Bulletin Handbooks Metal Bulletin Handbook, 1979. Wholesale price indices.
1875-1965: B. R. Mitchell & P. Deane (1962) and B.R. Mitchell and H. G. Jones (1971):
1954-1980: Central Statistical Office, Economic Trends Annual Supplement 1979 and December 1980

Table S.3.5 Relative instability and trend growth of commodity prices relative to world export prices (a)

	Indices of instability (b)								Trend growth rates			
	1960-66		1966-73		1973-79		1960-79					
	I	IG	I	IG	I	IG	I	IG	1960-66	1966-73	1973-79	1960-79
1. All Commodities	2.8	2.7	7.7	7.5	8.7	11.5	8.1	9.4	0.68	0.35	-4.56	-0.83
2. Aluminium	2.0	2.0	8.9	11.4	5.7	4.5	10.8	15.5	-0.10	-3.52	4.20	-1.86
3. Bananas	7.2	6.6	6.9	9.8	7.4	7.5	11.1	20.4	1.44	-4.95	-0.14	-3.12
4. Beef	13.2	9.3	10.1	5.1	30.7	59.7	32.7	28.1	6.00	10.34	-10-48	0.80
5. Cocoa	12.2	15.7	21.1	21.0	24.7	13.5	25.8	12.6	-4.19	0.69	10.55	3.83
6. Coffee	8.9	7.4	6.3	5.7	32.0	17.8	23.0	15.0	3.15	1.38	10.27	2.20
7. Copper	14.8	6.4	14.2	20.3	19.5	41.3	35.6	55.5	15.09	-4.97	-11.78	-2.30
8. Copra	9.8	9.3	20.1	24.5	33.4	44.7	25.5	33.0	0.75	-2.83	-4.79	-1.35
9. Cotton	2.4	2.5	11.3	9.5	13.0	19.7	12.5	14.6	-1.11	2.51	-6.64	-0.81
10. Fishmeal	6.6	4.3	24.9	14.7	28.0	55.8	31.0	30.8	7.22	7.88	-10.84	4.27
11. Groundnut Kale	4.0	3.5	19.3	13.7	26.3	50.2	25.5	33.1	2.21	5.07	-10.21	-1.38
12. Groundnut Oil	7.5	8.4	7.0	5.3	15.6	22.0	15.2	13.8	-1.88	4.02	-5.60	0.51
13. Hides	16.5	16.4	25.7	16.7	30.6	24.4	25.6	22.1	-0.13	6.33	3.83	0.76
14. Iron Ore	2.6	3.2	7.7	10.3	6.6	10.4	7.2	19.6	-3.49	-4.20	-7.39	-5.11
15. Jute	22.6	25.8	5.6	8.3	8.0	12.3	19.6	47.1	-2.17	-5.56	-7.02	-4.50
16. Lamb	6.9	5.9	7.6	6.0	11.6	12.7	10.1	9.4	2.61	3.36	-1.5	0.34
17. Lead	16.9	10.5	9.0	8.7	21.8	19.1	19.6	16.6	8.17	0.52	2.28	0.87
18. Maize	2.4	2.1	10.6	10.6	5.1	10.3	14.3	19.9	1.96	-0.08	-11.21	-1.71
19. Nickel	2.5	2.6	9.0	6.7	7.9	9.4	13.9	12.9	-0.46	4.35	-2.95	0.37
20. Palm Oil	5.9	5.7	14.4	14.1	16.3	22.1	15.9	19.8	0.63	0.26	-4.92	-1.14
21. Petroleum	0.7	0.9	8.5	6.7	25.4	13.0	35.9	8.7	-3.29	3.50	11.77	7.73
22. Rice	6.6	6.1	24.5	31.4	18.5	44.7	27.8	34.9	1.33	-3.45	-13.63	-1.19
23. Rubber	6.0	9.5	17.4	22.0	15.3	17.0	16.2	35.5	-7.52	-3.27	-1.70	-4.05
24. Sisal	23.9	27.3	27.6	20.8	23.9	54.6	40.1	52.2	-2.23	4.15	-12.85	-1.38
25. Soybeans	4.8	4.2	18.8	14.6	14.7	27.0	18.9	20.9	2.92	3.66	-9.64	-0.53
26. Soybean meal	2.8	2.4	22.7	15.3	27.8	53.2	28.0	31.6	2.65	5.77	-10.25	-0.63
27. Sugar	70.2	104.6	10.2	2.6	35.1	144.2	75.3	51.6	-6.42	21.5	-21.00	2.00
28. Tea	1.8	2.2	5.7	9.8	18.7	16.4	14.9	37.4	-3.15	-7.50	2.24	-4.75
29. Tin	12.2	8.4	3.6	4.2	10.7	7.3	13.8	10.6	6.45	-2.04	6.53	1.40
30. Wheat	5.4	5.4	18.1	16.5	12.1	26.7	19.7	25.8	-0.21	1.38	-12.43	-1.41
31. Wool	8.5	8.7	27.7	24.4	20.7	31.0	21.9	37.4	-0.33	1.79	-6.51	-2.77
32. Zinc	15.4	11.4	20.3	13.1	14.8	45.1	33.1	28.7	5.12	6.46	-16.9	0.76

Note: (a) Commodity prices deflated by world export unit values.
(b) Indices introduced in Chapter 4. I - simple instability index (deviation from trend). IG - composite growth and instability index.

Source: Calculated from data in International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund

Table S.3.6 Production, consumption, stocks and prices of copper: world levels(a)

	Thousand tonnes			Pounds per tonne		Index of GDP of industrial countries(1966 = 100)
	Production	Consumption	Commerical Stocks(b)	Price(c) (pounds/tonne)	Deflated price(d)	
1960	5006	4719	...	241.9	605	...
1961	5145	5021	...	226.0	565	...
1962	5278	5137	...	230.3	576	...
1963	5374	5411	...	230.4	562	...
1964	5806	5980	...	346.5	845	...
1965	6161	6171	...	461.4	1099	...
1966	6357	6421	301	545.0	1267	100.0
1967	6001	6158	271	410.3	954	103.5
1968	6667	6506	285	515.2	1198	108.6
1969	7191	7165	329	611.0	1389	114.1
1970	7538	7271	583	587.6	1250	117.9
1971	7339	7289	611	444.1	906	122.3
1972	8093	7951	659	427.7	792	129.2
1973	8521	8762	393	726.3	1100	137.2
1974	8903	8340	832	876.2	952	137.7
1975	8344	7475	1743	556.5	557	136.8
1976	8790	8536	1828	782.1	767	144.1
1977	9100	9050	1963	749.9	676	149.6
1978	9201	9455	1534	710.2	582	155.5
1979	9359	9800	1075	936.2	637	160.8
1980	9373	9528	1028	941.4	529	162.4

Notes: (a) Excluding centrally planned economies
(b) Held by producers consumers, merchants or exchanges.
(c) LME cash settlement price (wirebars)
(d) Deflated by index of world export unit values.

Sources: Compiled or calculated from: World Bureau of Metal Statistics, World Metal Statistics (Jan. 1972, Jan. 1976, July 1979, May 1981) for columns 1-4.
International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund (for world export unit values and GDP data

Table S.3.7 World Stocks of Refined Copper

	Commercial Stocks								Strategic Stockpiles			
	Metal exchanges											
	LME	COMEX	Total	Producers	Merchans	Consumers	Total	Total Commmercial	USA	Japan	Total	Total Refined Stocks
1965	7.5	...	...	...	...	...	...					
1966	14.3	...	...	...	...	...	287.2(a)	301.5	410.4	...	410.4	711.9
1967	11.5	...	...	...	...	...	259.9(a)	271.4	249.6	...	249.6	521.0
1968	19.4	...	...	...	...	...	266.3(a)	285.7	237.1	...	237.1	522.8
1969	18.6	...	...	...	...	...	292.2(a)	329.4	229.9	...	229.9	559.3
1970	72.1	16.3	88.4	...	...	...	495.1	583.5	229.9	...	229.9	813.4
1971	140.3	18.4	158.7	...	...	...	453.2	611.9	228.3	...	228.3	840.2
1972	183.0	52.4	235.4	...	...	...	423.7	659.1	234.6	...	234.6	893.7
1973	34.8	5.3	40.1	129.7	21.0	202.8	353.5	393.6	228.2	...	228.2	621.8
1974	125.9	39.2	165.1	324.5	29.0	313.4	666.9	832.0	32.0	...	32.0	864.0
1975	497.0	90.7	587.7	762.8	55.7	337.7	1156.2	1743.9	23.7	...	23.7	1767.9
1976	603.5	182.3	785.8	657.3	58.2	326.9	1042.4	1828.2	38.2	50.4	88.6	1916.8
1977	641.2	167.3	808.5	711.0	69.2	375.1	1155.3	1963.8	20.5	65.4	85.9	2049.7
1978	373.7	162.9	536.6	651.4	36.4	310.2	998.0	1534.6	29.0	71.9	100.9	1635.5
1979	126.5	89.7	216.2	510.2	35.0	314.1	859.2	1075.4	29.0	36.9	65.9	1141.3
1980	122.6	162.9	285.5	385.7	27.6	329.6	742.9	1028.4	20.2	7.6	27.8	1056.2

Note: (a) Inclues Comex stocks

Source: World Bureau of World Statistics, World Metal Statistics (Jan 1972, Jan 1976, July 1979, May 1981)

Table S.4.1 Zambian mining companies' profit and loss accounts
(Million kwacha)

	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79(g)	1979/80(g)
NCCM										
Sales revenue	359.0	348.2	363.0	555.0	479.3	327.3	506.4	422.1	488.9	701.7
Cost of sales (b)	-196.5	248.4	-262.4	-275.8	-339.7	-336.3	-402.6	-437.6	-441.1	546.1
Profit on sales	162.5	99.8	100.6	279.2	139.6	-38.9	103.8	-15.5	47.8	155.6
Interest payable	-2.1	-2.3	-0.7	-2.7	-2.8	-15.0	-22.1	-20.8	-23.1	-28.1
Other income/payments	2.5	2.9					1.9	2.7	1.3	3.7
Profit before taxation	162.9	100.4	99.9	276.5	136.8	-53.9	83.6	-33.6	26.0	131.2
Taxation (d)	-85.4	-32.1	-22.6	-164.0	-78.0	54.3	-49.1	40.1	-0.1	-75.0
Other items (e)	-	-	6.2	0.7	-0.2	4.5	-32.1	-16.4	-	-
Net profit	77.5	68.3	83.5	113.2	58.6	4.9	2.4	-9.9	25.9	56.2
Memorandum item:										
Dividends	51.0	36.0	36.0	67.0	17.0	--	--	--	--	9.3
RCM										
Sales revenue	218.8	190.9	237.2	407.7	269.7	226.5	309.4	261.9	397.1	387.5
Cost of sales	-136.3	-137.4	-160.3	-183.1	-225.3	-229.8	-263.2	-256.7	-305.0	274.5
Profit on sales	82.5	53.5	76.9	224.6	44.4	-3.3	46.2	5.2	92.1	113.0
Interest payable	-0.9	-1.7	-3.9	-4.1	-5.6	-10.8	-13.3	-15.3	-15.5	-10.0
Other income/payments	4.2	1.9	2.8	2.0	2.2	0.5	0.9	1.5	0.4	1.8
Profit before taxation	85.8	53.7	75.7	222.5	41.1	-13.6	33.8	-8.6	74.4	101.7
Taxation (d)	-36.1	-10.7	-28.5	-144.1	-9.9	9.1	-0.4	0.7	-	-17.2
Other items (e)	-	-	1.0	0.9	1.1	4.1	-12.6	-4.5	-2.5	-3.1
Net profit	49.7	43.0	48.2	79.4	32.3	-0.4	20.8	-12.4	74.4	84.5
Memorandum item:										
Dividends	20.5	22.0	31.0	44.3	6.5	--	--	--	4.7	15.1

Notes: (a) During the period summarized in this Table NCCM's financial year was April to March and RCM's was July to June. No attempt has been made to reconcile the two.
(b) For NCCM calculated as a residual.
(c) Includes interest received, income from associated companies
(d) Negative figures indicate tax paid, positure figures show tax recoverable.
(e) Consists largely of "extraordinary items" e.g. the cost of or gains from exchange rate variations charged to profit and loss accounts.
(f) NCCM's financial year 1970/71 was 15 months in length. These figure have been annualized for the sake of comparison.
(g) For the year 1978/79 and subsequently NCCM adopted new accounting conventions relating mainly to depreciation which may result in there being discontinuities in the time series.
(h) In 1979/80 RCM adopted similar new accounting conventions to those for NCCM (see note (g)). Also in that year RCM changed to an April-March financal year, so that the "year" 1979/80 is nine months only.

Sources: Nchanga Consolidated Copper Mines Annual Reports 1971-79 .
Roan Consolidated Mines Annual Reports 1972, 1973, 1975, 1976, 1978.

Table S.4.2

NCCM Balance sheets

(Million kwacha)

At 31 March	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Mining assets: gross (a)	426.2	468.4	527.1	596.1	655.0	694.3	710.4	733.6	) 519.9	) 548.9
less written off	153.0	163.1	170.3	176.8	185.7	195.0	200.0	215.4	)	)
Other investments	15.9	18.8	22.9	19.6	17.3	18.5	22.6	50.1	) 52.3	) 55.6
Net fixed assets	289.1	324.1	379.7	438.9	486.5	517.8	533.0	568.3	572.2	604.5
Current assets	151.3	141.1	134.1	244.4	197.4	293.5	322.4	295.7	370.4	412.5
of which: Stocks (b)	58.6	50.1	42.4	59.4	63.7	96.0	100.8	106.3	122.2	137.9
Stores	22.1	28.3	27.0	38.8	78.5	77.0	79.0	88.2	81.0	97.3
Debts	40.3	49.4	47.4	105.5	50.7	62.6	65.9	39.0	94.	
Current liabilities	104.7	90.4	94.7	228.3	165.4	244.0	283.6	253.4	293.6	338.5
of which: Creditors	51.8	52.7	66.5	88.9	113.4	126.6	137.9	152.2	114.3	143.5
Current maturities	...	...	...	...	...	...	...	...	49.9	63.8
Short-term borrowing	2.6	5.9	7.2	26.5	28.7	111.0	145.7	101.1	129.4	98.8
Dividends	9.0	10.0	11.0	26.0	--	--	--	--	--	9.3
Net current assets	46.6	50.6	39.4	16.1	32.0	49.5	38.8	42.4	76.8	74.0
Other assets	1.0	--	--	--	24.0	13.7	7.5	--	--	
Total assets (net)	336.7	374.7	419.1	455.0	542.5	581.1	579.2	610.6	649.0	678.5
Financed by:										
Share capital	251.0	254.0	253.8	253.6	253.5	253.5	253.3	253.2	310.2	310.0
Reserves	57.3	79.7	119.9	159.7	192.3	187.9	185.3	188.9	255.5	302.3
Total shareholders funds	308.3	333.7	373.7	413.3	445.3	441.4	438.7	442.1	565.6	612.3
Long/medium term debt	25.2	41.1	45.4	41.6	96.7	139.7	140.6	168.5	83.4	66.2
Others	3.2	--	--	--	--	--	--	--	--	--

Notes: (a) This is a cumulative figure of assets written off.
(b) Stocks of metals and concentrates.

Source: Nchanga Consolidated Copper Mines Annual Reports 1971-80

Table S.4.3 RCM Balance sheets

(Million kwacha)

At 31 June	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Mining assets gross	296.8	330.3	358.6	385.2	421.8	456.1	512.0	563.3	589.2	) 418.9
less written off	130.1	133.0	137.1	149.0	157.3	161.0	165.9	170.3	175.8	)
Other investments	17.4	19.0	21.3	20.6	21.7	21.8	23.5	50.4	51.4	51.8
Net fixed assets	184.1	216.3	242.8	256.8	286.2	316.9	369.6	443.4	464.9	470.7
Current assets	96.4	87.6	109.5	204.3	179.1	166.8	174.1	202.8	236.0	312.5
of which: Stocks	25.7	20.8	27.9	41.2	42.0	51.7	66.7	73.7	72.9	84.6
Stores	28.9	29.5	30.8	48.3	65.7	72.8	72.5	71.2	76.2	91.0
Debts	30.1	27.3	38.0	62.3	35.6	39.2	31.9	54.7	53.0	78.6
Current liabilities	67.6	53.3	72.4	156.9	131.1	149.0	181.1	154.4	170.0	218.7
of which: Creditors	26.7	32.2	31.0	52.4	69.7	53.7	69.4	73.5	90.7	112.5
Current maturities	--	--	--	--	--	19.4	30.5	22.3	21.0	29.2
Short-term borrowing	--	--	--	--	34.6	75.9	81.1	58.6	38.9	37.7
Dividends	2.0	7.5	16.0	25.8	--	--	--	--	4.7	9.4
Net current assets	28.6	34.3	37.1	47.4	44.0	17.8	(7.0)	48.3	66.0	93.8
Other assets	--	--	--	--	14.0	6.4	--	--	--	--
Total assets (net)	212.7	250.6	280.0	304.3	344.2	341.1	362.7	491.8	530.9	564.5
Financed by:										
Share capital	143.0	143.0	143.0	143.0	143.0	143.0	143.0	143.0	183.0	183.0
Reserves	56.5	76.1	89.2	112.4	129.9	125.9	141.9	153.5	217.7	282.8
Total shareholders funds	199.5	219.1	232.2	255.4	272.9	268.9	284.9	296.5	400.7	465.8
Long/medium term debt	13.2	31.5	47.7	48.9	71.3	72.2	77.7	195.3	130.2	98.7

Sources: Roan Consolidated Mines, Annual Reports 1972, 1973, 1975, 1976, 1978, 1980.

Table S.4.4 Mining companies fixed assets, financial years 1971-80

Year ending	NCCM				RCM			
	Property and mine development	Treatment and other plant	Employee housing and services	Total(b)	Property and mine development	Treatment and other plant	Employee housing and services	Total(
	Gross assets - Million kwacha							
1971	193.3	174.5	58.5	426.2	127.5	118.3	51.0	296.8
1972	...	...	...	468.4	143.8	133.3	53.2	330.3
1973	...	...	...	527.1	167.1	136.4	55.1	358.6
1974	...	...	...	596.1	181.9	145.9	57.4	385.2
1975	244.7	333.2	77.0	655.0	198.5	162.1	61.2	421.8
1976	256.3	355.5	82.5	694.3	213.2	180.2	62.6	456.1
1977	243.2	381.9	85.3	710.4	236.1	209.7	66.2	512.0
1978	258.7	386.1	88.8	733.6	256.3	240.0	67.0	563.3
	Net assets							
1978(a) restated	159.8	250.4	64.6	521.3	...	...	...	...
1979	...	...	...	...	272.2	249.3	67.7	589.2
					Net assets			
1979(a) restated	152.3	248.9	64.4	519.9	161.6	142.8	0.4	408.7
1980(a)	152.8	256.6	68.0	548.9	176.2	169.0	1.7	418.9

Note: (a) Accounting practices revised with particular reference to depreciation provisions therefore not directly comparable. Expressed in net terms. Adopted by NCCM in 1978/9 and RCM in 1979/80.

(b) Includes work in progress

Source: Nchanga Consolidated Copper Mines, Annual Reports 1971-80
Roan Consolidated Mines, Annual Reports 1972-80

Table S.4.5 Production and export of copper, production of zinc, lead and cobalt: Zambia 1954-80

	Thousand tonnes				Million Kwacha				Thousand Tonnes		Tonnes
	Production			Exports	Production			Exports	Lead	Zinc	Cobalt
	Blister	Refined	Total		Blister	Refined	Total				
1954	208	176	384	389	91.0	82.0	173.0	173.0	15.2	26.9	...
1955	168	180	348	348	102.9	119.8	222.7	221.2	16.3	28.3	...
1956	160	230	390	374	89.3	140.0	229.3	227.6	15.4	29.4	...
1957	172	251	423	415	60.3	97.0	157.3	165.0	15.3	30.0	...
1958	135	245	380	409	40.4	82.9	123.3	135.4	13.2	30.7	...
1959	168	370	538	521	66.1	156.7	222.8	214.4	14.6	30.4	...
1960	164	402	566	557	66.9	174.9	241.8	239.2	14.7	30.3	...
1961	151	416	567	545	57.7	171.6	229.3	220.2	15.4	31.0	...
1962	114	433	547	531	44.0	180.4	224.4	217.6	14.9	40.4	727
1963	137	439	576	574	53.2	182.8	236.0	235.6	17.7	49.6	682
1964	145	497	642	681	59.3	220.6	279.9	296.8	13.2	46.8	1362
1965	164	521	685	683	77.4	265.5	342.9	343.2	21.3	47.5	1544
1966	88	498	586	599	62.8	376.6	439.4	460.6	18.8	42.4	1515
1967	82	534	616	601	56.5	386.5	443.0	443.0	19.5	45.2	1455
1968	93	572	665	643	70.8	442.8	513.6	516.1	21.8	53.2	1197
1969	105	643	748	730	101.5	636.4	737.9	724.5	23.0	50.2	1799
1970	103	580	683	684	95.2	552.8	648.0	681.4	27.3	53.5	2052
1971	99	535	634	635	65.3	376.4	441.7	450.2	27.7	57.0	2079
1972	84	614	698	711	53.8	426.1	479.9	490.4	25.9	55.9	2055
1973	43	638	681	670	44.3	694.8	739.1	698.3	25.0	53.5	1929
1974	33	669	702	673	42.8	833.9	876.7	838.5	24.5	58.3	1964
1975	21	619	640	641	12.7	442.5	455.2	472.0	19.1	46.8	1843
1976	18	695	713	746	16.3	617.4	633.7	688.6	13.5	37.1	1620
1977	11	649	660	667	11.6	546.2	557.8	644.9	13.3	40.0	1703
1978	27	629	656	593	23.3	534.1	557.4	597.7	12.7	42.5	1560
1979	20	584	604	651	29.2	769.2	825.4	900.7	12.8	38.2	3271
1980	2	607	609	558	2.8	666.8	669.6	807.6	6.9	20.7	2294

Source: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office 1954-59 June 1965 Table 22 (page 16) and Table 32 (page 25); 1960-69 July, Table 16 (page 15) and Table 21 (page 20); 1970-79 April/September 1980, Table 18 (b) (page 16) Table 24 (page 22)

Table S. 4.6 Average copper prices realized by Zambian mining companies

(Kwacha per tonne)

	NCCM	RCM	Total(b)	Unweighted Average(d)	Aver. price deflated by deflator of Zambian non-mineral GDP	Aver. price deflated by deflator of US GNP
1970	(916)(c)	(822)(c)	(869)(c)	1011	-	-
1971	804	794	799	767	753	760
1972	749	791	770	765	689	703
1973	1161	1130	1145	1156	976	989
1974	1140	1178	1159	1327	908	913
1975	848	859	853	794	630	613
1976	996	962	979	1006	664	669
1977	1019	1046	1032	1016	579	665
1978	1120	1125	1122	1090	548	674
1979	1557	1497	1572	1572	694	843

Notes: (a) Converted to calendar year basis using weighted averages of financial year data

(b) Simple arithmetic average of each company's prices

(c) Incomplete financial year.

(d) Arithmetic average of daily prices on London Metal Exchange

Source: Realization prices: calculated from NCCM and RCM, Annual Reports 1971-80
Unweighted averages: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office, April/September 1980 Table 5.3 pg.49

Deflators: Zambia non - mineral GDP - calculated from Appendix S, Table S.1.1/ S.1.2
US GDP - calculated from International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund

Table S. 5.1 Instability and growth of real export earnings (a): 44 countries

COUNTRY	1964-71			1971-78			1964-78		
	I(b)	IG(c)	G(d)	I(b)	IG(c)	G(d)	I(b)	IG(c)	G(d)
Algeria	10.8	8.5	3.5	20.2	6.7	17.1	19.2	4.5	11.0
Australia	4.5	2.9	6.2	8.5	8.2	0.5	10.6	5.6	4.7
Central African Rep.	9.8	9.6	0.3	14.3	15.4	-1.1	13.3	17.0	-1.7
Chile	10.4	6.3	7.4	16.2	15.3	0.8	18.2	15.4	1.2
Cyprus	4.9	3.0	7.0	20.1	17.1	2.3	16.0	10.5	3.0
Dominican Republic	14.7	9.9	5.8	16.2	14.1	1.9	17.4	7.5	6.2
Ecuador	9.2	6.9	4.3	19.5	7.9	13.8	16.9	4.0	10.8
Egypt	5.4	4.3	3.2	5.1	5.7	-1.6	7.7	7.0	0.7
Ethiopia	4.6	4.6	-0.1	12.4	13.9	-1.7	11.2	10.1	0.7
Greece	6.4	3.4	9.6	9.2	4.9	9.5	7.9	2.1	10.1
Honduras	9.7	8.1	7.0	13.6	11.3	2.7	13.9	9.7	2.6
India	3.9	3.8	0.4	6.3	4.6	4.6	7.2	5.3	2.2
Indonesia	10.6	7.1	6.0	19.9	5.1	21.4	24.3	2.7	16.9
Iran	10.2	4.1	13.7	31.9	10.1	17.9	26.4	2.5	18.3
Ivory Coast	9.1	5.9	6.4	8.3	4.0	11.0	10.0	3.6	7.6
Japan	3.2	1.1	16.3	4.8	3.0	6.8	10.5	2.3	11.6
Kenya	2.8	2.3	2.7	11.6	8.2	5.0	9.2	5.5	3.8
Kuwait	8.2	5.8	4.9	25.8	12.1	11.5	22.5	5.5	10.6
Liberia	2.7	1.6	8.0	4.8	6.2	-3.6	13.5	10.4	1.9
Libya	12.8	3.6	19.8	13.9	8.2	7.8	21.6	6.0	9.6
Malaysia	6.2	4.7	4.1	9.9	5.5	8.7	9.5	4.5	5.5
Mexico	4.2	3.4	3.1	10.3	7.1	5.4	9.1	5.8	3.3
New Zealand	5.8	5.3	1.3	16.2	18.0	-1.5	14.4	11.9	1.4
Nicaragua	3.9	3.2	2.7	10.2	7.4	4.8	8.2	5.0	3.7
Nigeria	19.7	9.5	11.0	25.2	9.1	15.7	27.0	2.6	18.1
Papua New Guinea	6.8	3.2	11.4	32.5	17.2	9.5	30.2	4.1	15.3
Paraguay	8.2	7.8	0.8	10.5	6.8	6.4	12.4	6.1	5.2
Peru	6.9	5.4	3.5	10.3	12.5	-2.8	13.1	16.3	-1.6
Senegal	9.4	10.0	-0.9	20.3	10.7	9.6	20.1	13.9	2.6
Sierra Leone	11.9	11.8	0.1	15.1	30.5	-9.5	18.4	36.5	-4.8
Singapore	4.3	2.5	7.7	9.5	4.4	11.5	8.1	2.1	10.1
South Africa	4.6	3.7	2.9	8.9	7.0	3.5	7.0	4.4	3.4
Sri Lanka	3.3	4.7	-4.7	8.4	8.5	-0.3	9.2	14.9	-3.4
Swaziland	8.6	4.7	9.1	9.8	9.1	1.1	12.1	6.3	4.7
Syria	6.7	6.3	1.0	16.2	7.1	12.6	17.3	5.9	8.0
Tanzania	6.0	5.9	0.3	11.4	16.3	-5.0	11.0	15.0	-2.1
Thailand	3.3	2.9	1.5	8.1	4.4	9.2	10.3	4.3	6.1
Togo	9.0	5.5	7.2	27.9	16.0	8.3	21.2	9.1	6.1
Tunisia	4.2	2.9	5.5	17.1	9.3	9.1	15.1	4.0	9.1
Turkey	11.4	11.1	0.4	15.9	17.9	-1.7	18.0	12.1	2.9
United Kingdom	3.3	2.3	5.4	7.1	5.8	2.8	5.9	3.4	3.9
Yemen A.R.	15.6	9.4	7.5	28.1	36.2	-3.6	27.2	16.1	3.8
Zaire	10.7	4.7	12.4	14.4	29.4	-9.7	29.1	29.2	-0.6
Zambia	18.9	12.1	6.6	18.9	43.7	-11.3	31.3	59.3	-4.1

Notes: (a) Export earnings epressed in US dollars deflated by index of world export unit values
(b) I - simple instability index (deviations from exponential trend)
(c) IG - composite instability and growth index (see chapter 4)
(d) Exponential trend growth rate.

Source: Calculated from International Monetary Fund, International Financial Statistics Yearbook, 1980, Washington: International Monetary Fund

TABLES S.5.2 Income Terms of Trade: Selected Countries 1966-78

(1969=100)

Country	1964	1969	1974	1978
Algeria	83.6	100.0	240.0	245.0
Australia	77.6	100.0	125.5	123.1
Central African Republic	87.7	100.0	65.3	73.1
Chile	59.1	100.0	110.4	80.8
Cyprus	63.0	100.0	73.4	125.3
Dominican Republic	104.6	100.0	165.4	132.2
Ecuador	79.8	100.0	281.2	283.3
Egypt	77.7	100.0	97.5	84.2
Ethiopia	94.5	100.0	107.8	92.6
Greece	59.8	100.0	175.3	219.3
Honduras	59.6	100.0	83.6	127.4
India	99.7	100.0	102.2	130.8
Indonesia	91.0	100.0	415.9	491.7
Iran	64.0	100.0	491.3	381.0
Ivory Coast	69.9	100.0	127.5	184.1
Japan	44.8	100.0	166.3	220.3
Kenya	87.5	100.0	116.0	135.6
Kuwait	91.1	100.0	335.3	255.6
Liberia	68.8	100.0	97.7	89.5
Libya	30.3	100.0	129.8	130.5
Malaysia	71.8	100.0	122.7	161.2
Mexico	77.4	100.0	99.9	150.3
New Zealand	95.3	100.0	96.0	111.4
Nicaragua	84.6	100.0	114.8	146.8
Nigeria	70.8	100.0	516.2	423.2
Papua New Guinea	53.8	100.0	334.1	281.0
Paraguay	104.7	100.0	159.1	182.1
Peru	82.7	100.0	84.7	83.5
Senegal	89.6	100.0	59.0	167.7
Sierra Leone	93.5	100.0	62.5	51.4
Singapore	62.7	100.0	179.4	235.4
South Africa	79.9	100.0	125.0	138.4
Sri Lanka	131.3	100.0	78.3	94.7
Swaziland	54.7	100.0	137.3	113.7
Syria	91.4	100.0	181.0	184.8
Tanzania	98.9	100.0	78.6	69.6
Thailand	90.0	100.0	165.3	207.5
Togo	73.3	100.0	203.3	196.2
Tunisia	83.2	100.0	263.4	245.2
Turkey	104.9	100.0	167.1	152.9
United Kingdom	78.4	100.0	106.9	146.7
Yemen A.R.	46.3	100.0	156.7	61.0
Zaire	50.2	100.0	97.1	49.4
Zambia	46.9	100.0	62.7	27.5

NOTES: (a) Income terms of trade defined as $\frac{E}{P_m} = \frac{P_E Q_E}{P_m}$

where E is total value of experts

, P_E, P_m are respectively export and import unit values and Q_E-is the volume of exports

Source: Calculated from IMF IFS

TABLE S. 5.3 Net terms of trade (a): selected countries, 1964-78

Country	1964	1969	1974	1978
Algeria	DATA NOT AVAILABLE			
Australia	116.3	100.0	104.6	83.4
Central African Rep.	DATA NOT AVAILABLE			
Chile	DATA NOT AVAILABLE			
Cyprus	97.6	100.0	74.8	70.2
Dominican Rep.	92.0	100.0	86.1	71.1
Ecuador	112.7	100.0	132.7	115.4
Egypt	DATA NOT AVAILABLE			
Ethiopia	DATA NOT AVAILABLE			
Greece	111.4	100.0	87.5	74.9
Honduras	114.6	100.0	80.3	116.8
India	102.0	100.0	74.1	73.9
Indonesia	DATA NOT AVAILABLE			
Iran	107.3	100.0	317.7	301.4
Ivory Coast (b)	-	-	100.0	140.2
Japan	99.2	100.0	90.2	91.2
Kenya	113.4	100.0	80.3	104.8
Kuwait	107.3	100.0	364.2	319.0
Liberia	107.3	100.0	75.7	81.1
Libya	107.3	100.0	267.8	211.0
Malaysia	105.4	100.0	100.7	94.3
Mexico	DATA NOT AVAILABLE			
New Zealand	131.4	100.0	96.5	86.4
Nicaragua	DATA NOT AVAILABLE			
Nigeria	DATA NOT AVAILABLE			
Papua New Guinea	DATA NOT AVAILABLE			
Paraguay	122.3	100.0	112.3	118.3
Peru	84.5	100.0	114.0	96.1(c)
Senegal	-	100.0	130.5	107.1(c)
Sierra Leone	DATA NOT AVAILABLE			
Singapore (b)	-	-	100.0	93.5
South Africa	101.9	100.0	79.4	70.9
Sri Lanka	124.2	100.0	77.2	80.4
Swaziland	DATA NOT AVAILABLE			
Syria	98.4	100.0	154.1	140.3
Tanzania	123.0	100.0	97.6	-
Thailand	98.2	100.0	95.7	73.5
Togo	83.5	100.0	155.9	148.3
Tunisia	98.7	100.0	174.1	137.0
Turkey	-	100.0	97.5	82.5
United Kingdom	105.2	100.0	80.6	95.5
Yemen A.R.	DATA NOT AVAILABLE			
Zaire	DATA NOT AVAILABLE			
Zambia	46.2	100.0	61.7	31.5(c)(d)

Notes: (a) Net terms of trade
$= P_E/P_m$ where
P_E is unit value of exports and P_m is import unit value approximated by index of world exports unit value

(b) 1974 = 100

(c) 1977 used in place of 1978

(d) Calculated from Zambian data the primary source for IMF data.

Source: Calculated from International Monetary Fund, International Financial Statistics Yearbook 1980, Washington: International Monetary Fund

Table S.6.1 Balance of payments - analytic presentation: Zambia, 1965-80

(Million kwacha)

	1965		1966		1967		1968		1969		1970	
	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr
1. Merchandise (f.o.b.)	366.8	214.1	446.0	253.6	465.2	318.8	534.0	356.7	852.6	313.3	673.2	347.7
Trade balance	152.7		192.4		146.4		177.3		539.3		325.5	
2. Freight/insurance	1.3	27.8	0.3	40.4	--	54.8		65.3	--	60.0	--	60.3
3. Other transportation	) 3.7	16.2	4.2	21.6	4.5	22.1	4.5	26.0	4.8	28.8	5.0	32.4
4. Travel	)											
5. Investment income (b)	17.0	62.6	17.6	75.6	27.8	78.4	7.4	59.5	16.3	63.8	28.8	62.2
5.1 Government	3.5	4.7	4.7	4.6	) 4.1	) 5.1	) 3.9	) 6.4	) 4.1	) 5.5	...	...
5.2 Public corporations	7.9	4.1	0.9		)	)	)	)	)	)	...	...
5.3 Other	5.6	53.8	12.0	71.0	23.7	73.3	3.5	53.1	12.2)	58.3	...	...
6. Other government	) 1.5	) 4.6	) 5.2	) 19.8	) 5.5	)20.6	)6.0	)22.4	)5.3	)23.8	1.9	1.5
7. Other private	)	)	)	)	)	)	)	)	)	)	5.3	28.6
8. Unrequited transfer (c)	23.8	27.3	12.5	22.1	25.0	24.9	7.1	32.0	7.7	58.7	5.9	110.4
8.1 Private	4.7	15.1	1.8	11.3	2.0	11.3	2.0	26.7	2.2	54.7	2.3	107.4
8.2 Government	19.1	12.2	10.7	10.8	23.0	13.6	5.1	5.3	5.5	4.3	3.6	3.0
Balance on services & transfers		91.2		139.7		138.0		180.2		201.0		248.5
Balance on current account	61.5		52.7	...	8.4	...		2.9	338.3		77.0	
9.Private capital (net)	...	...	...	...	...	...	...	...		166.1	44.5	
9.1 Long-term	...	...	...	...	...	...	...	...	11.6	27.7		97.8
9.2 Short-term	...	...	...	...	...	...	...	...		150.0	142.3	
10. Government (net)	...	...	...	...	...	...	...	...	7.6			6.3
10.1 Loans received (net)	...	...	...	...	...	...	...	...	11.6		9.9	
10.2 Other	...	...	...	...	...	...	...	...	1.0	5.0		16.7
11. Monetary movement (net)	...	...	...	...	...	...	...	...		119.0		100.3
of which Reserves	...	...	...	...	...	...	...	...		114.9		98.4
IMF	...	...	...	...	...	...	...	...				
Payment arrears	...	...	...	...	...	...	...	...				
12.Errors/omissions (net)(e)	3.0	...	...	14.2	...	12.7		30.2		60.8		14.9

Table S.6.1 cont. Balance of payments - analytic presentation: Zambia, 1965-80

(Million kwacha)

	1971		1972		1973		1974		1975	
	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr
1. Merchandise (f.o.b.)	479.2	401.3	543.2	404.5	733.5	349.4	898.2	509.1	516.2	609.6
Trade balance	77.9		138.7		384.1		389.1			93.4
2. Freight/insurance	8.1	67.2	16.1	81.2	20.6	83.9	22.9	127.6	35.8	151.3
3. Other transportation	1.4	1.0	7.1	16.3	7.6	23.5	9.3	31.2	9.0	32.0
4. Travel	6.7	29.1	7.0	21.4	4.6	17.4	4.8	26.6	6.0	23.6
5. Investment income (b)	22.3	65.9	13.9	88.0	10.4	87.7	19.0	105.9	4.3	79.4
5.1 Government	...	...	...	...	...	...	1.0	19.4	0.8	17.9
5.2 Public corporations	...	...	...	...	...	...	18.0	2.6	3.5	14.2
5.3 Other	...	...	...	...	...	...	--	83.9	--	47.3
6. Other government	2.0	3.3	3.4	3.5	4.1	3.1	5.0	3.2	6.0	5.7
7. Other private	3.2	23.8	9.3	37.8	10.1	51.7	3.7	67.8	2.0	61.6
8. Unrequited transfer (c)	3.9	111.7	4.0	100.1	13.9	94.7	7.9	89.1	5.4	85.3
8.1 Private	2.0	110.6	2.0	99.5	2.5	94.1	2.0	88.5	2.0	85.3
8.2 Government	1.9	1.1	2.0	0.6	11.4	0.6	5.9	0.6	3.4	
Balance on services & tranfers		254.4		287.5		290.7		378.8		370.4
Balance on current account		176.5		148.8	93.4		10.3			463.8
9.Private capital (net)	11.5		63.6			180.1	104.4		176.4	
9.1 Long-term	111.2	142.7	62.4	1.8	6.6	142.3	52.5		164.2	
9.2 Short-term	43.0		15.1	12.1	5.1	49.5	51.9		12.2	
10. Government (net)	19.9		13.3		137.0			1.2	83.0	
10.1 Loans received (net)	22.3		22.3		138.8		39.6		84.9	
10.2 Other	1.3	3.7	3.2	12.2	3.2	5.0		40.8		1.9
11. Monetary movement (net)	194.1		111.8		13.7			20.2	250.0	
of which Reserves	181.5		96.1		9.2			8.3	144.1	
IMF	13.6		14.7		14.7				14.8	
Payment arrears	--		--						102.1	
12.Errors/omissions (net)(e)		49.0		39.9		64.0		93.3		45.6

Table S.6.1 cont. Balance of payments - analytic presentation: Zambia, 1965-80

(Million kwacha)

	1976		1977(a)		1978(a)		1979(a)		1980(a)	
	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr	Cr	Dr
1. Merchandise (f.o.b.)	742.4	482.3	707.6	538.7	663.8	496.1	1144.7	599.2	1104.3	860.0
Trade balance	260.1		168.9		167.7		545.5		244.3	
2. Freight/insurance	59.1	125.4	47.4	116.9	48.0	122.8	50.0	150.0		)
3. Other transportation	12.8	40.6	14.4	45.1	15.4	49.1	15.0	50.0		) 309.0
4. Travel	9.0	12.8	9.0	21.9	10.0	31.3	12.0	30.0		)
5. Investment income (b)	7.1	112.9	4.0	108.8	2.7	112.2	2.0	125.0		183.0
5.1 Government	(0.9)	(23.5)	(1.0)	(22.7)	(0.5)	(22.2)	--	(55.0)		
5.2 Public corporations	(6.2)	(7.5)	(3.0)	(17.2)	--	)(90.0)		)(70.0)		
5.3 Other	--	(81.9)	--	(68.8)	(2.2)	)	(2.0)	)		
6. Other government	7.0	6.7	8.0	6.4	8.0	6.2	9.0	13.0		
7. Other private	2.0	68.2	2.0	60.7	2.0	60.8	2.0	55.0		
8. Unrequited transfer (c)	8.4	88.1	13.6	78.2	21.5	86.5	14.0	90.0		69.0
8.1 Private	2.0	87.3	2.0	78.2	2.0	86.5	2.0	90.0		
8.2 Government	6.4	0.8	11.6		19.5		12.0			
Balance on services & tranfers		349.3		339.6		361.3		409.0		561.0
Balance on current account		89.2		170.7		193.6	136.5			316.7
9. Private capital (net)	11.7		19.5			69.6		123.8		82.4(d)
9.1 Long-term	65.0	2.0		0.4		37.8				
9.2 Short-term		51.3	24.4	4.5		31.8				
10. Government (net)	28.2		15.5		4.3		103.0			
10.1 Loans received (net)	30.5		19.3		7.7					
10.2 Other	1.3	3.6		3.8		3.4				
11. Monetary movement (net)	136.4		223.5		258.9			115.7	219.7	
of which Reserves	39.7		53.9		141.6		76.4		49.7	
IMF	15.8				152.8		76.8		6.1	
Payment arrears	103.6		156.9		145.3			148.8	112.6	
2. Errors/omissions (net)(e)		87.1		87.8						

Notes: (a) Preliminary estimates
(b) Includes profits dividends and interest on external debt
(c) Includes grants from abroad
(d) Includes errors and omissions
(e) Not available for 1978-80

Sources: Republic of Zambia, Monthly Digest of Statistics, Lusaka: Central Statistical Office
1965-68 June 1970 Table 58 page 58
1969-70 May 1973 Table 60 page 58
1971-73 July/August 1975 Table 60 page 54
1976-79 April/September 1980 Table 60 page 54
1980 October/December 1980 Table 60 page 54

Table S.6.2

Zambia's Foreign Assets: 1965-80

(Million kwacha)

	Assets								Liabilities				
	Monetary Authorities						Commercial Banks					Net Foreign Assets	Arrears on External Payments
	Gold	SDRs	IMF Reserve	Foreign Exchange BoZ(b)	Foreign Exchange Govt(b)	Total		Total	Monetary Authority	Commercial Banks	Total		
1965	2.5	--	2.3	52.5	85.2	142.6	10.2	152.8	--	4.2	4.2	148.6	--
1966	4.1	--	2.3	59.7	84.3	150.4	16.8	167.2	--	9.3	9.3	158.0	--
1967	4.1	--	4.5	60.2	60.0	128.8	15.4	144.2	0.1	9.6	9.7	134.6	--
1968	4.1	--	4.6	87.2	46.5	142.4	5.0	147.4	0.1	7.1	7.2	140.2	--
1969	4.2	--	6.4	160.0	92.9	263.4	10.2	273.7	0.2	5.7	5.9	267.8	--
1970	4.2	6.3	13.6	264.3	78.6	367.0	17.8	384.8	0.2	3.0	3.2	381.6	--
1971	4.5	13.6	13.6	163.1	5.4	200.2	9.8	210.0	13.8	10.0	23.8	186.2	--
1972	4.6	0.1	--	110.2	2.8	117.6	7.6	125.2	28.4	18.3	46.7	78.6	--
1973	4.6	--	--	118.0	1.2	123.8	5.8	129.6	43.8	18.6	62.4	67.2	--
1974	4.6	9.0	--	115.3	3.0	131.8	12.0	143.8	43.5	23.6	67.2	76.6	--
1975	4.6	11.9	--	77.2	2.3	96.0	4.9	100.8	151.8	24.0	175.8	-75.0	-102.1
1976	5.4	17.7	--	55.1	1.1	79.3	9.9	89.2	174.8	29.0	203.9	-114.7	-205.7
1977	5.4	10.5	--	38.7	1.1	55.8	8.1	63.9	205.2	42.2	247.4	-183.5	-362.6
1978	7.2	12.4	--	26.0	1.7	47.3	26.3	73.6	338.4	46.8	385.2	-311.6	-507.9
1979	8.4	4.3	--	56.3	1.7	70.7	75.2	145.9	391.5	37.5	429.0	-283.1	-359.1
1980	8.4	--	--	60.4	2.4	62.8	45.1	116.3	441.7	62.5	504.2	-387.9	-471.7

Note: (a) Total assets minus total liabilities
(b) BoZ = Bank of Zambia; Govt = Government

Source: Bank of Zambia, Quarterly Statistical Review Lusaka: Bank of Zambia
1965-79 September 1975 Table 1 (xiii) pg. 33
1970-80 March 1981 Table 1 (xiii) pg. 39

Appendix S Table S.6.3 Zambia's use of IMF resources (a) (Million SDRs)

	Quota	Reserve Tranche (b)	Comp. Credit Tranche	Financing Facility	Extended Financing Facility	Oil Facility	Trust Fund	Overall position (c) (d) Balance	Drawing	Repurchases
1965	50.0	--	--	--	--	--	--	--	--	--
1966	50.0	--	--	--	--	--	--	--	--	--
1967	50.0	--	--	--	--	--	--	--	--	--
1968	50.0	--	--	--	--	--	--	--	--	--
1969	50.0	--	--	--	--	--	--	--	--	--
1970	76.0	--	--	--	--	--	--	--	--	--
1971	76.0	--	--	19.0	--	--	--	19.0	19.0	--
1972	76.0	19.0	--	38.0	--	--	--	57.0	38.0	--
1973	76.0	19.0	19.0	38.0	--	--	--	76.0	19.0	--
1974	76.0	19.0	19.0	38.0	--	--	--	76.0	--	--
1975	76.0	19.0	19.0	38.0	--	19.0	--	94.9	56.9	38.0
1976	76.0	19.0	27.5	38.0	--	29.7	--	114.2	38.3	19.0
1977	76.0	19.0	8.6	57.0	--	29.7	--	114.2	19.0	19.0
1978	141.0	19.0	108.5	105.8	--	29.7	--	263.0	148.8	--
1979	141.0	19.0	200.9	93.1	--	23.7	--	336.7	100.0	26.3
1980	211.5	19.0	220.0	68.0	--	16.2	23.0	342.7	50.0	44.0
1981	211.5	--	--	--	120.0	--	42.4	435.2	120.0	27.5

Notes: (a) Balance outstanding at end of period
(b) Reserve Tranche "drawing" appears in other tables as a reduction in "Reserve position in Fund"
(c) Components may not sum to total for reason explained in IMF IFS August 1981 pg.7
(d) Excludes Trust Fund

Source: International Monetary Fund, International Financial Statistics Yearbook, 1981, Washington: International Monetary Fund page 434-5 and page 22-23 (converted from US dollars at exchange rates on page 438-39)

Table S.6.4 Exchange Rates Among Kwacha, SDR, US Dollar and Pound Sterling, 1965-80

	SDR's per kwacha	US Dollars per kwacha	Kwacha per pound	Pounds per kwacha	Dollars per SDR	Dollars per pound
	End of period	Period average	Period average	Period average	Period average	Period average
1965	1.40	1.40	1.997	0.5007	1.0	2.7962
1966	1.40	1.40	1.9951	0.5012	1.0	2.7932
1967	1.40	1.40	1.9619	0.5097	1.0	2.7466
1968	1.40	1.40	1.7098	0.5849	1.0	2.3937
1969	1.40	1.40	1.7074	0.5857	1.0	2.3903
1970	1.40	1.40	1.7114	0.5843	1.0	2.3960
1971	1.2895	1.40	1.7458	0.5728	1.0030	2.4441
1972	1.2883	1.3999	1.7871	0.5596	1.0857	2.5018
1973	1.2883	1.5411	1.5912	0.6285	1.1921	2.4522
1974	1.2693	1.5541	1.5050	0.6644	1.2026	2.3390
1975	1.3275	1.5541	1.4296	0.6995	1.2141	2.2218
1976	1.0848	1.4019	1.2884	0.7761	1.1545	1.8062
1977	1.0848	1.2675	1.3771	0.7262	1.1675	1.7455
1978	0.9763	1.2307	1.5597	0.6411	1.2520	1.9195
1979	0.9763	1.2621	1.6810	0.5949	1.2920	2.1216
1980	0.9763	1.2682	1.8343	0.5452	1.3015	2.3263

Source: Calculated from International Monetary Fund, International Financial Statistics Yearbook, 1981, Washington: International Monetary Fund (pp. 435,439,463)

Table S.7.1. Summary of Zambian central government financial operations in current prices, 1965 - 82

(Million kwacha)

Year (1)	1964/65	1965/66	1966/67	1968	1969	1970	1971	1972	1973
Current revenue	157.1	217.4	416.3	306.1	400.7	432.4	309.0	311.1	385.2
of which mineral revenue (2)	...	(141.5)	(245.7)	(176.2)	(235.1)	(251.1)	(114.1)	(55.7)	(107.8)
Current expenditure(3)	-100.8	-129.0	-280.5	-213.7	-226.0	-258.9	-327.2	-328.5	-370.1
of which Constitutional & statutory(4)	(-18.1)	(-35.5)	(-61.7)	(-41.6)	(-45.1)	(-55.0)	(-85.1)	(-94.8)	(-95.6)
Other current	(-82.7)	(-93.5)	(-218.8)	(-172.1)	(-180.9)	(-203.9)	(-242.1)	(-233.7)	(-274.5)
Current surplus/deficit	56.3	88.4	135.8	92.4	174.7	173.5	-18.2	-17.4	15.1
Capital receipts(3),(5)	0.5	0.3	0.4	0.9	3.3	22.2	0.8	35.6	86.5
Capital expenditure	-19.0	-44.9	-93.5	-102.4	-101.1	-97.4	-150.8	-103.2	-97.5
Net lending-long term(6)	-7.5	-13.2	-55.4	-86.5	-43.4	-76.0	-26.0	-43.1	-280.3
short term	-44.3	-45.5	-9.0	-2.1	2.3	5.5	-7.8	2.6	12.1
Other funds & accounts(7)	-44.3	-45.5	23.6	37.2	-40.9	15.0	78.0	23.3	-2.1
Overall surplus deficit = CGBR (8)	-14.0	-14.9	1.9	-60.5	-5.1	42.8	-124.0	-102.2	-266.2
Long term borrowing (9)									
External (net)	9.9	-0.9	9.9	49.6	18.6	8.6	34.7	21.7	138.1
Internal (net))	9.9	-0.9	13.8	49.6	11.3	16.0	15.5	32.4	31.3
of which Stocks (gross)	...	...	(24.0)	...	(16.0)	(23.4)	(30.0)	(40.0)	(40.0)
Loans (gross)	...	...	(0.2)	...	(0.2)	(0.2)	(0.2)	(0.2)	(4.7)
Residual deficit/surplus (=STBR)(10)	-4.1	-15.8	25.6	-10.9	24.8	67.4	-73.8	-48.1	-96.8
Financed by									
Treasury Bills	5.6	11.9	-6.9	19.1	3.8	-11.6	-6.3	39.4	46.5
Bank of Zambia advances	...	...	...	...	...	...	...	...	45.0
Bank of Zambia accounts	-1.5	3.9	18.7	-8.2	-28.6	-55.8	80.1	8.7	5.3

Table S.7.1 cont. Summary of Zambian central government financial operations in current prices, 1965 - 82

(Million kwacha)

Year (1)	1974	1975	1976	1977	1978	1979	1980	1981	1982
Current revenue	649.6	448.2	443.0	499.0	549.9	592.7	767.6	780.4	975.3
of which mineral revenue (2)	(341.5)	(59.4)	(11.6)	(-1.2)	(-)	(-9.8)	(41.7)	(1.0)	(0.1)
Current expenditure	-405.8	-546.9	-562.5	-595.3	-580.1	-722.1	-1019.5	-974.2	-1068.8
of which Constitutional & statutory	(-128.7)	(-181.0)	(-185.7)	(-196.5)	(-208.3)	(-245.0)	(-334.1)	(-229.7)	(-324.4)
Other current	(-277.1)	(-365.9)	(-376.8)	(-398.8)	(-371.8)	(-477.1)	(-685.4)	(-744.5)	(-744.4)
Current surplus/deficit	243.8	-98.7	-119.5	-96.3	-30.2	-129.4	-251.9	-193.8	-93.5
Capital receipts(3),	1.3	14.0	183.8	33.7	26.4	27.9	23.8	16.9	39.8
Capital expenditure	-112.9	-131.0	-122.9	-114.5	-91.7	-88.6	121.4	-179.7	-251.0
Net lending-long term	-49.4	-100.8	-196.0	-38.7	-68.7	-62.6	-437.2	-44.6	-57.4
short term	-8.0	-25.7	-15.4	-45.4	-160.3	19.8	225.0	...	...
Other funds & accounts	16.3	-2.7	10.2	-18.5	-19.8	10.0	-16.5	...	...
Overall surplus deficit = CGBR (8)	91.1	-344.9	-259.8	-279.7	-344.1	-222.9	-578.2	-401.2	362.1
Long term borrowing (9)									
External (net)	36.5	58.7	30.0	18.8	20.2	137.5	263.9	37.7	203.4
Internal (net)	14.8	20.8	34.9	13.5	14.9	14.8	38.8	28.9	28.8
of which Stocks (gross)	(20.5)	(20.0)	(20.0)	(2.0)	...	...	(20.0)	...	...
Loans (gross)	(7.8)	(21.3)	(38.4)	(38.0)	(42.0)	(41.0)	(45.0)	(59.5)	(62.0)
Residual deficit/surplus (=STBR)(10)	142.4	-265.4	-194.9	-247.4	-309.0	-70.6	-275.5	-334.6	-130.0
Financed by									
Treasury Bills	-93.9	148.0	222.0	266.0	163.0	72.3	98.4	...	...
Bank of Zambia advances	-45.0	98.0	-16.0	-19.0	-63.0	...	...	...	...
Bank of Zambia accounts	-3.5	19.4	-11.1	0.4	209.0	-1.7	177.2	...	...

Table S.7.2 Government budget: principal items expressed in constant (1970) prices, 1965-80 (a) (b)

(Million kwacha)

	1964/65	1965/66	1966/67(c)	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Current revenue	209.2	269.1	324.2	330.9	421.8	432.4	330.3	274.8	316.0	476.6	301.4	254.2	240.1	230.5	211.8	254.4
of which:																
mineral revenue	...	175.1	191.4	190.5	247.5	251.1	104.5	48.6	88.3	230.9	39.9	6.7	-0.6	--	-3.5	13.8
Non-mineral	...	94.0	132.8	140.4	174.3	181.3	225.8	226.2	227.7	245.7	261.5	247.5	240.7	230.5	215.3	240.6
Current expenditure	134.2	171.8	218.5	231.0	237.9	258.9	299.6	286.4	303.6	297.7	367.8	322.7	286.5	243.1	258.1	337.9
of which:																
Const. and Stat.	24.1	47.3	48.1	45.0	47.5	55.0	77.9	82.6	78.4	94.4	121.7	106.5	94.6	87.3	87.6	110.7
Other	110.1	124.5	170.4	186.1	190.4	203.9	221.7	203.7	225.2	203.3	246.1	216.2	191.9	155.8	170.5	227.2
Current surplus/ deficit	75.0	117.7	105.8	99.9	183.9	173.5	-16.7	-15.2	12.4	178.9	-66.4	-68.6	-46.3	-12.7	-46.2	-83.5
Capital expenditure	25.3	59.8	72.8	110.7	106.4	97.4	138.1	90.0	80.0	82.8	88.1	70.5	55.1	38.4	31.7	40.2
Net lending	10.0	17.6	50.2	95.8	43.3	70.5	30.9	35.3	220.0	42.1	85.1	121.3	40.5	95.9	15.3	70.3
Overall surplus/deficit	-18.6	-19.8	1.5	-65.4	-5.4	42.8	-120.1	-89.1	-218.4	66.8	-231.9	-149.0	-134.6	-144.2	-79.7	-191.6
Long term financing (net)																
External	)	)	7.7)	53.6	19.6	8.6	31.8	18.9	113.3	26.8	39.5	17.2	9.0	8.5	49.1	87.5
Internal	)13.2	) -1.2	10.7)		11.9	16.0	14.2	28.2	25.7	10.9	14.0	20.0	6.5	6.2	5.3	12.9
Short term borrowing	5.5	21.0	-19.9	11.8	-26.1	-67.4	74.2	41.9	79.4	-104.5	178.5	111.8	119.1	129.5	25.2	91.3

Notes: (a) Deflated by implicit price index of total domestic final expenditure (calculated from Table S.1.1)
(b) For explanation of variables and aggregates see Table S.7.1
(c) Eighteen month figure reduced pro rata to twelve month equivalent.
(d) Constitutional and Statutory expenditure

Source: Calculated from Table S.7.1

Table S.7.3 Central government current revenue by source 1965-81

(Million kwacha)

	1964/65	1965/66	1966/67(e)	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980(f)	1981(f)
Current revenue	157.1	217.4	277.5	306.1	400.7	432.4	309.0	315.2	385.2	649.6	448.2	443.0	499.0	549.9	592.7	718.9	824.6
Mineral revenue	...	141.5	163.8	176.2	235.1	251.1	114.1	55.7	107.6	314.7	59.4	11.6	-1.2	0.1	-9.8	41.0	2.0
Company income tax	...	59.1	52.5	42.2	49.5	79.6	86.9	28.0	16.3	60.5	61.0	9.7	--	0.1	-9.0	18.0	1.0
Royalties	42.3	82.4	58.1	65.8	88.7	34.2	--	--	--	--	--	--	--	--	--	--	--
Mineral tax	--	--	--	--	--	56.4	27.2	27.7	91.3	203.2	-9.3	1.9	-1.2	--	-0.8	22.0	1.0
Other	--	--	53.2 a	68.1 a	96.9 a	80.9 a	--	--	--	51.0 b	7.8 b	--	--	--	--	1.0	--
Income taxes	67.1 c	21.2	32.9	44.1	64.3	70.0	80.1	91.2	116.0	134.9	142.6	159.1	199.9	217.7	223.2	237.5	318.2
Personal		11.3	15.4	21.0	24.6	30.6	34.3	41.3	52.6	55.0	58.0	74.0	88.9	96.7	98.4	115.0	128.8
Companies		7.6	12.9	17.6	31.0	32.9	38.5	39.4	44.3	46.2	64.7	61.9	77.5	82.9	86.8	85.5	134.1
Other		2.3	4.6	5.5	8.7	6.5	7.3	10.5	19.1	33.7	19.9	23.2	33.5	38.1	38.0	37.0	55.3
Taxes on international Trade	15.5	16.6	17.4	21.2	31.0	32.5	36.7	41.8	32.7	37.8	56.5	58.6	61.5	50.7	68.4	73.4	115.4
Customs duty	15.5	16.6	17.4	21.2	31.0	32.5	36.7	41.8	32.7	37.8	36.8	29.0	29.6	27.2	34.9	36.6	52.0
Sales tax (imports)	--	--	--	...	--	--	--	--	--	--	19.7 d	29.6 d	31.9	23.5	33.5	36.8	63.4
Sales tax (domestic)	--	--	--	...	--	--	--	--	3.5	10.0	14.6 d	19.6 d	25.6	31.7	34.2	35.8	46.9
Excise duties/surtax	6.8	8.6	15.6	26.7	29.8	35.0	36.8	55.7	72.1	98.4	115.9	132.6	152.5	177.1	211.5	242.8	276.1
Cigarettes	--	2.6	4.8	8.3	9.2	9.4	8.5	10.0	11.5	12.2	17.9	15.9	18.7	22.2	23.6	29.0	31.8
Clear beer	--	3.2	5.4	11.1	14.5	19.9	22.6	31.0	34.3	37.1	46.2	54.8	59.5	75.6	73.9	85.9	108.6
Petrol, oil lubricants	--	1.0	2.8	3.2	--	--	--	--	5.1	16.4	24.1	35.3	47.8	54.3	75.3	79.1	89.2
Other	25.4	29.4	47.8	37.9	40.5	43.8	41.4	70.8	53.2	53.8	59.1	61.5	60.7	72.6	65.2	88.3	66.0
Memorandum item																	
Total non-mineral revenue...		75.9	113.7	129.9	165.6	181.3	194.9	259.5	277.6	334.9	388.8	431.4	500.2	549.8	602.5	677.9	822.6

Notes: (a) Mainly export tax.
(b) Dividends and withholding tax may be higher in 1974 because of failure to distinguish withholding tax on mining company dividends in that year
(c) Includes mining companies.
(d) Sales tax on imports was introduced in 1975 but not distinguished in the accounts until 1977. Estimates of domestic sales tax were made by interpolating for 1975 and 1976 based on a linear trend line fitted by least squares. Sales tax (imports) was then obtained as a residual
(e) Eighteen months figures reduced pro rata to twelve month equivalent.
(f) Budget estimates

Sources: Republic of Zambia, Financial Reports 1965-79, Lusaka: Government Printer and Estimates of Revenue and Expenditure 1981

Table S.7.4 Central government current revenue by source in constant prices and structure, 1965-81

	1964/65	1965/66	1966/67	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Expressed in constant (1970) prices								(Million Kwacha)									
Current revenue	209.2	269.1	324.2	330.9	421.8	432.4	330.3	274.8	316.0	476.6	301.4	254.4	240.1	230.5	211.8	230.3	240.1
Mineral revenue	...	175.1	191.4	190.5	247.5	251.1	104.5	48.6	88.3	230.9	39.9	6.7	-0.6	--	-3.5	13.1	0.6
Direct (c)	...	73.1	61.3	45.6	52.1	136.0	104.5	48.6	88.3	193.5	34.8	6.7	-0.6	--	3.5	12.8	0.6
Indirect (d)	56.3	102.0	130.0	144.8	195.4	115.1	--	--	--	37.4	5.2	--	--	--	--	0.3	--
Income taxes	[89.3]	26.2	38.4	47.7	67.7	70.0	73.4	79.5	95.2	99.0	95.9	91.3	96.2	91.2	79.8	76.1	92.7
Personal	...	2.8	18.0	22.7	25.9	30.6	31.4	36.4	43.2	40.3	39.0	42.4	42.8	40.5	35.2	36.8	37.5
Company		9.4	15.1	19.0	32.6	32.9	35.3	34.3	36.3	33.9	43.5	35.5	37.3	34.7	31.0	27.4	39.0
Taxes on international trade	20.6	20.5	20.3	22.9	32.6	32.5	33.6	36.4	26.8	27.7	38.0	33.6	29.6	21.2	24.4	23.5	33.6
Sales tax (domestic)	...	--	--	--	--	--	--	--	2.9	7.3	9.8	11.2	12.3	13.3	12.2	11.5	13.7
Excise duties	9.0	10.6	18.2	28.9	31.4	35.0	33.7	48.6	59.1	72.2	77.9	76.1	73.4	74.2	75.6	77.8	80.4
Other	33.8	36.4	55.8	41.0	42.6	43.8	37.9	61.7	43.6	39.5	39.7	35.3	29.2	30.4	23.5	28.3	19.2
Non-mineral revenue	...	93.9	132.8	140.4	174.3	181.3	225.8	226.2	227.7	245.7	261.5	247.5	240.7	230.4	215.3	217.1	239.5
Principal aggregates as percentage of total current revenue								(Percentages)									
Mineral revenue	...	65.1	59.0	57.6	58.7	58.1	36.9	17.7	27.9	48.4	13.3	2.6	-0.2	-	-1.7	5.7	0.2
Income taxes	...	9.8	11.9	14.4	16.0	16.2	25.9	28.9	30.1	20.8	31.8	35.9	40.1	39.6	37.7	33.0	38.6
Taxes on international trade	...	7.6	6.3	6.9	7.7	7.5	11.9	13.3	8.5	5.8	12.6	13.2	12.3	9.2	11.5	10.2	14.0
Sales tax	...	...	...	...	...	...	...	...	0.9	1.5	3.3	4.4	5.1	5.8	5.8	5.0	5.7
Excise duties	...	4.0	5.6	8.7	7.4	8.1	11.9	17.7	18.7	15.1	25.9	29.9	30.6	32.2	35.7	33.8	33.5
Other	...	13.5	17.2	12.4	10.1	10.1	13.4	22.5	13.8	8.3	13.2	13.9	12.2	13.2	11.1	12.3	8.0
Non-mineral revenue	...	34.9	41.0	42.4	41.3	41.9	63.1	82.4	72.1	51 5	86.7	97.4	100.2	100.0	101.7	94.3	99.8

Notes: (a) Eighteen months figures reduced pro rata to twelve month equivalent.
(b) Budget estimates; 1980 includes supplementary budget
(c) Company tax and mineral tax.
(d) Export taxes, royalties and witholding tax.

Source: Calculated from Table S.7.3

Table S.7.5 Covenment expenditure by economic type: Selected years

(Million kwacha)

	1964/65	1969	1973	1974	1975	1976	1977	1978	1979	1980	1981
Normal Recurrent expenditure	...	...	305.2	314.7	408.9	443.9	475.6	462.0	604.8	812.2	780.4
Personal emoluments	33.6	61.5	95.7	100.8	118.8	142.8	148.9	154.3	170.2	204.6	238.7
Goods and services	26.5	65.0	88.5	96.5	112.9	126.1	129.7	124.3	160.7	193.4	197.7
Subsidies	)	20.7	37.0	47.4	82.8	59.8	66.2	42.1	105.3	206.4	124.7
Grants, other, special expenditure	)19.8	29.0	21.5	19.9	31.8	37.9	36.3	33.5	44.6	61.0	62.6
Pensions	8.7	4.4	5.7	5.4	4.8	16.2(b)	17.6	17.7	20.5	20.0	62.6
Emergency and contingency	--	--	26.0	5.0	15.0	--	--	--	0.3	--	--
Debt interest	) ...	44.6	31.3	39.7	42.8	61.1	76.9	90.1	103.2	126.8	136.1
Other Constitutional and Statutory	) 16.5	44.6	64.3	89.0	138.2	124.6	119.6	118.1	163.5	194.6	87.0
Capital expenditure	19.0	101.1	97.5	112.9	131.0	122.9	114.5	91.7	88.6	121.4	149.5
Net lending (incl. s-t)	7.5(a)	41.1(a)	268.2	57.4	126.5	211.4	84.7	228.8	42.8	212.2	56.3(a)
Debt amortization	6.4	10.2	24.1	35.1	62.5	46.3	65.4	67.0	68.9	62.4	89.7
Total expenditure	138.0	377.6	759.3	609.1	867.1	949.1	859.8	967.6	968.6	1402.8	1162.9
Memorandum items											
Recurrent	105.1	225.2	369.5	403.7	547.1	568.5	595.2	580.1	768.3	1006.8	867.4
Non-current	32.9	152.4	389.8	204.4	320.0	380.6	264.6	387.5	200.3	396.0	295.5

Notes: (a) Excludes short term lending
(b) Expenditure on some pensions previously classified under Constitutional and Statutory expenditure included in this category from 1976.
(c) Excluding debt amortization

Source: Government of Zambia Estimates of Revenue and Expenditure 1981, Lusaka: Government Printer (page vii) and Table S.7.1

Table S.7.6 Government expenditure by economic type in constant (1970) prices (a): selected years

(Million kwacha)

	1964/65	1969	1974	1975	1976	1977	1978	1979
Normal recurrent expenditure	...	...	230.9	275.0	254.5	228.9	193.6	216.2
Personal emoluments	44.7	64.7	73.9	79.9	81.9	71.6	64.7	60.8
Goods and services	35.3	68.4	70.8	75.9	72.3	62.4	52.1	57.4
Subsidies	26.4	21.8	34.8	55.7	34.3	31.9	17.6	37.6
Grants other and special expenditure	26.4	30.5	14.6	21.4	21.7	17.5	14.0	15.9
Pensions	11.6	4.6	4.0	3.2	9.3	8.5	7.4	7.3
Emergency/contingency expenditure	--	--	3.7	10.1	--	--	--	0.1
Debt interest))	22.0))	46.9	29.1	28.8	35.0	37.0	37.8	36.9
Other constitutional and statutory)	)		65.3	92.9	71.5	57.6	49.5	58.4
Total recurrent expenditure	140.0	236.9	296.2	367.9	326.0	286.5	243.1	274.4
Capital expenditure	25.3	106.4	82.8	88.1	70.5	55.1	38.4	31.7
Net lending	10.0	43.3	42.1	85.1	121.3	40.8	95.9	15.3
Debt amortization	8.5	10.7	25.7	42.0	26.6	31.5	28.1	24.6
Total non-current expenditure	43.8	160.4	150.6	215.2	218.4	127.4	162.4	71.6
Total expenditure	183.7	397.3	446.8	583.1	544.4	413.9	405.5	346.2

Note: (a) Deflated with implicit deflator of total domestic final expenditure (from Table S.1.1)

Source: Calculated from Table S.7.5

Table S.7.7 Source of financing for central government borrowing requirement, by type of debt, and by holder: 1965-79

	Central government borrowing (CGBR)	Long term borrowing (net)				Short term borrowing requirement (STBR)					
							Treasury bills held by:				
		External	Internal	Banks	Total	Total	Bank of Zambia	Commercial Banks	Other holders	Other Short-term (a)	Total
	(Million kwacha)										
1964/65	14.0		9.9	...	9.9	5.6	...	...	...	-1.5	4.1
1965/66	14.9		-0.9	...	-0.9	11.9	...	...	...	3.9	15.8
1966/67	-1.9		23.9	...	23.7	-6.9	...	...	...	-18.7	-25.6
1968	60.5		49.6	...	49.6	19.1	...	...	...	-8.2	10.9
1969	5.1	18.6	11.3	...	29.9	3.8	...	...	...	-28.6	-24.8
1970	-42.8	8.6	16.0	(6.3)	24.6	11.6	8.0	-16.0	-3.6	-55.8	-67.4
1971	131.2	34.7	15.5	(16.8)	50.2	-6.3	5.9	-9.7	-2.5	87.3	81.0
1972	102.2	21.7	32.4	(26.7)	54.1	39.4	0.4	41.2	-3.2	8.7	48.1
1973	266.2	138.1	31.3	(14.1)	169.4	46.5	-2.6	25.9	24.2	50.3	96.8
1974	-91.1	36.5	14.8	(-3.2)	51.3	-93.9	2.4	-76.1	-20.2	-48.5	-142.4
1975	344.9	58.7	20.8	(1.9)	79.5	148.0	52.2	97.1	-1.3	117.4	265.4
1976	259.8	30.0	34.9	(-1.6)	64.9	222.0	88.1	137.2	-3.3	-27.1	194.9
1977	279.7	18.8	13.5	(-15.6)	32.3	266.0	34.3	230.8	0.9	-18.6	247.4
1978	344.1	20.2	14.9	(-11.4)	35.1	163.0	541.2	-381.8	3.5	146.0	309.0
1979	222.9	137.5	14.8	(-7.6)	152.3	72.3	-78.4	147.8	2.8	-1.7	70.6

Notes: (a) Mainly Bank of Zambia advances and overdrawn accounts

Sources: (CGBR and STBR) Table S.7.1
Holding of government stocks and Treasury bills Bank of Zambia, Report and Statement of Accounts 1976 and 1980, Lusaka: Bank of Zambia Tables 10 and 11

Tables S.7.8 Central Government Debt: quantity outstanding and service costs; 1965-82

(Million kwacha)

	1964/65	1965/66	1966/67	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981(b)	1982(b)
I Debt outstanding (a)	212.7	229.1	253.0	289.5	318.1	346.2	402.3	495.7	758.2	670.6	1011.6	1390.1	1659.3	2050.5	2284.1	2871.9	3097.8	3461.0
Long term	190.7	195.2	226.0	245.4	270.2	309.9	372.3	426.3	581.5	636.4	712.0	895.6	917.4	999.5	1162.6	1474.8	1545.0	1778.2
External	76.5	73.0	90.5	99.6	111.0	132.2	176.8	195.8	317.2	345.3	406.4	551.7	556.9	621.0	766.2	1036.7	1070.2	1274.6
Internal	114.1	122.2	135.5	145.8	159.2	177.7	195.5	230.5	264.3	282.1	305.6	343.9	360.5	378.5	396.4	438.1	474.8	503.6
Short term	22.0	33.9	27.0	44.1	47.9	36.3	30.0	69.4	176.7	34.2	299.6	494.5	741.9	1051.0	1121.5	1397.1	1552.8	1682.8
II Debt service costs	16.2	...	...	...	...	33.9	41.8	57.5	55.4	74.8	105.3	107.4	142.3	157.1	172.1	189.2	267.7	291.3
Interest	9.8	...	...	...	...	16.1	18.7	23.5	31.3	39.7	42.8	61.1	76.9	90.1	103.2	126.8	171.8	190.7
Long term	...	...	...	...	...	15.0	17.3	20.9	26.7	36.2	36.9	45.3	51.7	59.3	72.0	94.0	122.9	136.4
External	...	...	...	...	...	5.8	7.5	8.7	12.5	19.8	18.4	24.0	27.3	33.7	43.8	62.6	88.3	98.9
(of which IMF)	...	...	...	...	...	...	...	...	...	...	...	4.2	5.3	9.4	12.1	23.6	35.4	44.3
Internal	...	...	...	...	...	9.2	9.8	12.2	14.2	16.4	18.5	21.3	24.4	25.6	28.2	31.4	34.6	37.5
Short term	...	...	...	...	...	1.1	1.4	2.6	4.6	3.5	5.9	15.8	25.2	30.8	31.2	32.8	48.9	54.3
2. Amortization(c) (incl., S.F.)	6.4	15.3	14.3	13.8	10.2	18.9	23.1	34.0	24.1	35.1	62.5	46.3	65.4	67.0	68.9	62.4	95.9	100.6
Long term																		
External	...	8.6	3.9	5.7	5.2	11.3	8.4	26.2	10.6	21.7	42.1	22.8	38.9	39.9	42.7	36.2	65.3	67.4
Internal	...	6.7	10.4	8.1	5.0	7.6	14.7	7.8	13.5	13.4	20.4	23.5	26.5	27.1	26.2	26.2	30.6	33.2

Notes: (a) At year-end.
(b) Estimates.
(c) Includes sinking fund contributions.

Sources: Republic of Zambia, Financial Reports, 1965-80, Lusaka: Government Printer (Appendix 5-long term; Statement K-short term) and author's estimates

Table S.7.9 Central government debt: principal aggregates expressed in constant (1970) prices (a), 1965-80

(Million kwacha)

	1964/65	1965/66	1966/67	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Debt outstanding	283.2	283.5	305.8	313.0	347.3	346.2	368.4	432.2	622.0	492.0	680.3	797.5	798.5	859.4	816.3	951.9
Long term	253.9	241.6	274.3	265.3	296.8	309.9	340.9	371.7	477.0	466.9	478.8	513.8	441.5	418.9	415.5	488.8
External	101.9	90.3	116.0	107.7	129.3	132.2	161.9	170.7	260.2	259.9	273.3	316.5	268.0	260.3	273.8	343.6
Internal	151.9	151.2	158.3	157.6	167.6	177.7	179.0	201:0	216.8	207.0	205.5	197.3	173.5	158.6	141.7	145.2
Short trem	29.3	42.0	31.5	47.7	50.4	36.3	27.5	60.5	145.0	25.1	201.5	283.7	357.0	440.5	400.8	463.1
Debt service costs	21.6	...	...	...	...	33.9	38.3	50.1	45.4	54.9	70.8	61.6	68.5	65.8	61.5	62.7
Interest	13.0	...	...	...	...	16.1	17.1	20.5	25.7	29.1	28.8	35.0	37.0	37.8	36.9	42.0
Long term	...	...	...	...	...	15.0	15.8	18.2	21.9	26.6	24.8	26.0	24.9	24.8	25.7	31.2
External	...	...	...	...	...	5.8	6.9	7.6	10.2	14.5	12.4	13.8	13.1	14.1	15.6	20.7
Internal	...	...	...	...	...	9.2	9.0	10.6	11.6	12.0	12.4	12.2	11.7	10.7	10.1	10.4
Short term	...	...	...	...	...	1.1	1.3	2.3	3.8	2.6	4.0	9.1	12.1	12.9	11.1	10.9
Amortization	8.5	18.9	16.7	14.9	10.7	18.9	21.2	29.6	19.8	25.8	42.0	26.6	31.5	28.1	24.6	20.7
External	...	10.6	4.6	6.2	5.5	11.3	7.7	22.8	8.7	15.9	28.3	13.1	18.7	16.7	15.3	14.2
Internal	...	8.3	12.1	8.8	5.3	7.6	13.5	6.8	11.1	9.8	13.7	13.5	12.8	11.4	9.4	8.7

Notes: (a) Deflated by implicit price deflator of total domestic expenditure.

Souce: Calculated from Table S.7.8

Table S.7.10 Comparative data: Central Government Operations, 1978 World,

(As a percentage of total expenditure and net lending)

	World Total Company	Industrial countries	Oil-exporting countries	Non-oil developing countries						
				Africa	Asia	Europe	Middle East	Western Hemisphere	Overall	Zambia
Overall deficit/surplus	-12.7	-12.2	-15.8	-22.3	-20.9	-9.0	-23.0	-9.4	-14.4	-36.1
financed by:										
Financing abroad	3.2	2.9	8.2	5.0	4.7	0.5	6.9	2.8	3.7	2.4
Domestic financing	9.9	9.2	12.3	17.3	16.2	10.2	13.2	10.4	13.5	33.7
Monetary authorities	1.7	1.3	0.3	3.9	0.9	3.4	1.9	13.3	5.5	75.1
Deposit banks	0.8	0.8	-1.7	-0.3	2.5	1.2	7.1	0.62	1.6	-42.6
Debt outstanding:										
Domestic	92.0	92.7	-	111.7	128.6	73.0	142.5	52.8	113.1	161.8
Foreign	21.9	17.5	97.1	34.4	52.3	16.2	110.0		44.6	70.5

Source: Compiled from International Monetary Fund Government Finance Statistics Yearbook, 1981, Washington: International Monetary Fund

Table S.7.11 Comparative data: Principal source of government revenue, 1978.

(As a percentage of total expenditure and net lending)

	World Total Company	Industrial countries	Oil-exporting countries	Non-oil developing countries						
				Africa	Asia	Europe	Middle East	Western Hemisphere	Overall	Zambia
Taxes on income/profit	38.8	41.7	42.5	35.9	20.4	25.7	21.7	21.3	23.5	36.1
Social security contributions	30.8	32.7	6.4	3.3	0.9	33.1	10.4	25.5	21.7	- -
Domestic taxes on goods/services	17.8	15.8	5.4	25.3	17.5	24.3	17.8	30.2	30.4	42.7
Taxes on international trade	4.4	1.8	10.0	20.2	21.6	13.6	19.2	10.9	15.5	5.9
Non-tax revenue	9.4	7.0	40.9	12.3	16.3	19.3	23.8	8.9	13.5	10.8
Grants	1.2	0.8	0.6	3.8	2.6	0.4	16.8	0.6	2.6	3.5

Source: Compiled from International Monetary Fund Government Finance Statistics Yearbook, 1981, Washington: International Monetary Fund.

Table S.7.12 Comparative data: central government expenditure by function 1978

	World Total Company	Industrial countries	Oil-exporting countries	Non-oil developing countries						
				Africa	Asia	Europe	Middle East	Western Hemisphere	Overall	Zambia
Defence	14.4	14.4	20.0	12.0	21.1	14.1	34.9	6.2	13.1	--
Social security and welfare	34.4	38.2	5.2	5.3	4.4	18.5	11.4	27.0	19.3	0.2
Education	6.0	4.8	12.6	14.9	8.5	13.2	9.6	11.6	11.1	16.8
Health	9.9	11.0	4.8	5.4	3.1	9.7	3.5	5.9	5.6	7.7
Housing	2.5	2.5	3.2	1.4	2.3	2.4	3.5	5.9	1.9	1.9
Economic services:	14.1	11.0	31.5	28.9	27.9	32.9	20.6	22.5	26.0	24.4
Agriculture	2.8	2.2	4.3	9.2	6.8	2.5	3.9	6.5	6.1	12.2
Electricity	1.0	0.5	6.8	2.4	2.8	6.8	2.5	2.1	2.8	0.8
Roads	2.2	1.6	5.9	4.4	5.8	11.3	1.2	4.7	5.4	3.1
Communications	2.6	2.5	4.5	5.1	2.9	0.9	1.0	2.7	2.6	3.7
Other	5.5	4.2	10.0	7.8	9.6	11.4	12.0	6.5	9.1	4.6
Other	18.7	18.1	22.7	32.1	32.7	9.2	16.5	20.9	23.0	49.0

Source: International Monetary Fund, Government Finance Statistics Yearbook 1981, Washington, DC: International Monetary Fund.

Table S.7.13 Comparative data: central government expenditure by economic type, 1978

	World Total Company	Industrial countries	Oil-exporting countries	Non-oil developing countries						
				Africa	Asia	Europe	Middle East	Western Hemisphere	Overall	Zambia
Purchases of goods and services	29.2	27.5	41.5	44.2	33.9	48.4	37.2	29.8	35.1	44.7
of which: wages and salaries	(14.7)	(13.3)	(24.3)	(28.5)	(15.6)	(36.2)	(16.3)	(20.9)	(21.4)	(24.4)
Subsidies and other transfers	50.4	55.9	13.0	20.2	24.5	25.3	30.2	38.5	30.6	10.6
of which: to other levels of government	(13.8)	(14.1)	(13.4)	(16.3)	(19.1)	(0.5)	(-)	(7.3)	(12.0)	(-)
Interest	6.5	6.4	2.5	6.2	8.0	3.0	9.0	10.0	8.2	8.7
Capital	9.3	6.7	34.2	20.5	15.8	17.8	10.4	17.2	17.1	10.3
Net lending	4.8	3.8	11.0	8.9	16.8	5.5	13.3	4.9	9.0	25.7

Source: International Monetary Fund, Government Finance Statistics Yearbook 1981, Washington: International Monetary Fund.

Table S.8.1 Monetary survey, 1965-80

(Million kwacha)

	Banking sector assets			Banking sector liabilities				
	NET FOREIGN ASSETS(a)	CLAIMS ON GOVERNMENT (NET)(b)	CLAIMS ON PRIVATE SECTOR(c)	TOTAL ASSETS/ LIABILITIES	MONEY SUPPLY(NARROW)	QUASI-MONEY (e)	OTHER ITEMS (f)	MONEY SUPPLY (BROAD) (g)
1965	148.6	-88.7	42.3	102.2	76.5	31.0	-5.3	107.5
1966	158.0	-86.1	66.9	138.8	105.2	40.1	-6.5	145.3
1967	134.6	-68.4	96.0	162.2	121.9	47.5	-7.3	169.4
1968	140.2	-37.3	90.7	193.6	160.7	58.5	-25.0	218.7
1969	267.8	-118.5	112.3	261.6	181.3	100.2	-19.9	281.5
1970	381.6	-163.8	136.9	354.7	186.0	169.6	-0.8	355.6
1971	186.2	18.6	182.7	387.5	198.6	119.9	69.1	318.5
1972	78.6	147.2	165.0	390.8	201.3	139.7	49.6	341.0
1973	67.2	205.0	174.8	447.0	242.9	172.6	31.6	415.5
1974	76.7	78.1	335.8	490.5	265.7	175.0	49.5	440.7
1975	-75.0	317.8	392.9	635.7	322.1	170.8	142.8	492.9
1976	-114.7	571.1	399.5	855.9	376.7	246.7	232.5	623.4
1977	-183.5	791.1	470.3	1077.9	386.5	312.2	379.2	698.7
1978	-311.6	1061.8	422.2	1172.4	391.7	247.7	533.0	639.4
1979	-283.1	1121.6	483.0	1321.5	513.3	318.9	489.4	832.2
1980	-387.9	1354.5	505.3	1417.9	509.4	397.7	546.7	907.1

Notes: (a) All foreign assets of commercial banks and the monetary authorities (including the government) less all foreign liabilities (covering IMF drawings)

(b) Banking system credit to government less deposits held. (includes treasury bills, loans and government securities

(c) Banking system credit to the non-government non-bank sector (includes parastatals)

(d) Demand deposits plus currency held by non-bank public.

(e) Private sector deposits with the monetary authorities plus savings and time deposits.

(f) Bank deposits at Bank of Zambia plus capital reserves and other liabilities of Bank of Zambia, plus commerical banks liabilities to other parts of the banking system less other banking system assets

(g) "Money" plus "quasi-money"

N.B. It is noted that in the 1980 issue of the Bank of Zambia Report there were numerous errors which have been corrected to the extent possible using also the Bank of Zambia Quarterly Statistical Review, March 1981.

Source: Bank of Zambia, Report and Statement of Accounts 1975 and 1980, Lusaka: Bank of Zambia (Table 3 in each issue)

Table S.9.1 External Public Debt: amounts outstanding and debt service: Zambia, 1965 - 80.

(Million kwacha)

	Debt outstanding (a)		Commitments (b)	Disbursements (b)	Service Payments			Net Transfer (d)	Net Flow	Exports	Imports (e)	Reserves	GDP	Net Debt (f)	Arrears	IMF Drawings	Debt outstanding incl. monetary authority liabilities
	Disbursed	Incl. Undisbursed			Amortization	Interest (c)	Total										
1965	119	125	1	3	3	5	8	-5	--	414.1	352.6	152.8	730.4	54	--	--	119
1966	124	151	28	6	3	5	7	-1	3	485.8	433.1	167.2	852.8	65	--	--	124
1967	149	195	56	36	4	5	9	27	32	528.0	519.6	144.2	922.7	135	--	--	149
1968	163	244	56	19	8	4	11	8	11	559.0	561.9	147.4	1083.2	156	--	--	163
1969	200	278	25	28	9	9	17	11	19	886.7	548.4	273.7	1326.0	63	--	--	200
1970	417	640	396	248	19	14	34	214	229	720.1	643.1	384.8	1277.7	193	--	--	417
1971	421	620	6	27	26	20	47	-20	1	526.8	703.3	210.0	1188.6	387	--	14.7	436
1972	454	659	90	94	48	22	69	25	46	604.0	752.8	125.2	1348.0	517	--	44.2	498
1973	420	717	286	184	174	53	229	-45	10	804.8	711.4	129.6	1591.3	468	--	59.0	479
1974	490	892	209	100	36	24	63	37	64	970.8	960.5	143.8	1892.6	586	--	59.9	550
1975	708	1078	253	269	25	25	50	219	244	584.7	1048.5	100.8	1583.4	869	102.1	71.5	882
1976	985	1425	144	159	36	39	78	81	123	847.8	937.0	89.2	1940.5	1130	205.7	105.3	1296
1977	1067	1418	98	177	91	43	137	40	86	806.0	976.7	63.9	2023.6	1247	362.6	105.3	1535
1978	1144	1731	284	84	111	33	150	-66	-27	771.4	965.0	73.6	2258.7	1312	507.9	269.4	1921
1979	1246	1885	215	167	67	36	112	55	100	1248.7	1112.2	145.9	2566.3	1378	359.1	344.9	1950
1980	1320	...	...	257	183	58	252	5	74	1210(g)	1525(g)	116.3	2970.0	1585	471.7	351.0	2143

Notes: (a) End of period converted from U.S. dollars at year-end exchange rate.
(b) Transactions during period converted from U.S. dollar at average exchange rate.
(c) Includes some service charges
(d) disbursements minus debt service
(e) disbursements minus amortization
(f) Net debt = debt outstanding - reserves + 3 months (1/4 of annual) imports
(g) Author's estimates based on data in Bank of Zambia Annual Report 1980.

Sources: Debt: Compiled from data supplied by the World Bank; Exports, Imports: Appendix S Table S 6.1; Reserves and arrears: Appendix S Table S.6.2; GDP: Appendix S Table S.1.1; IMF drawings: Appendix S Table S.6.3 (using exchange rates in Tables S.6.4)

Table S.9.2 Selected ratios and indicators of Zambian external indebtedness, 1965-80.

	DOD/X	DOD/GDP	DOD/R	DS/X	A/X	I/X	DS/DOD	DS/DB	A/DB	NT/M	NF/M	DB/M	NT/DB	NF/DB	ND/GDP	ND/X	GD	GX	GND	DOD/DOU	DODM/X	DODM/GDP
1965	28.7	16.3	77.9	1.9	0.7	1.2	6.7	266.7	100.0	-1.4	--	3.7	-166.7	--	7.4	13.0	...	...	...	95.2	28.7	16.3
1966	25.5	14.5	74.2	1.4	0.6	1.0	5.6	116.7	50.0	-0.2	0.7	1.4	-16.7	50.0	7.6	13.4	4.2	17.3	20.4	82.1	25.5	14.5
1967	28.2	16.1	103.3	1.7	0.8	0.9	6.0	25.0	11.1	5.2	6.2	6.9	75.0	88.9	14.6	25.6	20.2	8.7	107.7	76.4	28.2	16.1
1968	29.2	15.0	110.6	2.0	1.4	0.7	6.7	57.9	42.1	1.4	2.0	3.4	32.1	57.9	14.4	27.9	9.4	5.9	15.6	66.8	29.2	15.0
1969	22.6	15.1	73.1	1.9	1.0	1.0	8.5	60.7	32.1	2.0	3.5	5.1	39.3	67.9	4.7	7.1	22.7	58.6	-59.6	71.9	22.6	15.1
1970	57.9	32.6	108.4	4.7	2.6	1.9	8.2	13.7	7.7	33.3	35.6	38.6	86.3	92.3	15.1	26.8	108.5	-18.8	206.3	65.2	57.9	32.6
1971	79.9	35.4	200.5	8.9	4.9	3.8	11.2	174.1	96.3	-2.8	0.1	3.8	-74.1	3.7	32.6	73.5	1.0	-26.8	100.5	67.9	82.8	36.7
1972	75.2	33.7	362.6	11.4	7.9	3.6	15.2	73.4	51.1	3.3	6.1	12.5	26.6	48.9	38.4	85.6	7.8	14.7	33.6	68.9	82.4	36.9
1973	52.2	26.4	324.1	28.4	21.6	6.6	54.5	124.5	94.6	-6.3	1.4	25.9	-24.5	5.4	29.4	58.2	-7.5	33.2	-9.5	58.6	59.5	30.1
1974	50.5	25.9	340.7	6.5	3.7	2.5	12.9	63.0	36.0	3.8	6.7	10.4	37.0	64.0	31.0	60.4	16.7	20.6	25.2	54.9	56.7	29.1
1975	121.1	44.7	702.4	8.6	4.3	4.3	7.1	18.6	9.3	20.9	23.2	25.7	81.4	90.7	54.9	148.6	44.5	-39.8	48.3	65.7	150.8	55.7
1976	116.2	50.8	1104.3	9.2	4.2	4.6	7.9	49.1	22.6	8.6	13.1	17.0	50.9	77.4	58.2	133.3	39.1	45.0	30.0	69.1	152.9	66.8
1977	132.4	52.7	1669.8	17.0	11.3	5.3	12.8	77.4	51.4	4.1	8.8	18.1	22.6	48.6	61.6	154.7	8.3	-4.9	10.4	75.2	190.4	75.9
1978	148.3	50.6	1554.3	19.4	14.4	4.3	13.1	178.6	132.1	-6.8	-2.8	8.7	-78.6	-32.1	58.1	170.1	7.2	-4.3	5.2	66.1	249.0	85.0
1979	99.8	48.6	854.0	9.0	5.4	2.9	9.0	67.1	40.1	4.9	9.0	15.0	32.9	59.9	53.7	110.4	8.9	61.9	5.0	66.1	156.2	76.0
1980	109.1	44.4	1135.0	20.8	15.1	4.8	19.1	98.1	71.2	3.3	4.8	16.8	1.9	28.8	53.4	131.0	5.9	-3.1	15.0	...	177.1	72.2

Note: Definitions of symbols

DOD - Debt outstanding (disbursed only)
DB - Disbursements during year
DS - Debt service
A - Amortization
I - Interest payments
DOU - Debt outstanding (including undisbursed)
NT - Net transfer
NF - Net flow
ND - Net debt outstanding
X - Exports
M - Imports
R - Reserves
GDP - Gross domestic product
GD - growth of debt outstanding
GX - growth of export
GND - growth of net debt outstanding

Source: Calculated from Table S.9.1

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