Monetary Variables in Macmod

A note concerning the introduction of monetary variables in the Tanzanian macro economic model: Macmod

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Summary

This paper discusses the relationship between money supply and production in Tanzania, wit special reference to Macmod, the macroeconomic model for Tanzania.

The relationship between money supply and production is seen as being neither direct nor simple in nature: the paper argues that the money supply does not impact production directly, but via inflation. Other things being equal, one may consequently expect money supply to influence inflation, and inflation to affect production.

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I : Introduction

This paper reports on some observations and reflections made about the relationship between the aggregate supply of money on the one hand, and the total volume of production on the other. The reflections refer to the Tanzanian setting, and were made in connection with the ongoing revision of Macmod, the macroeconomic model for Tanzania constructed with technical assistance from the Chr. Michelsen Institute.

The concrete background for focusing on this particular model and topic is set out in the following documents:

- "Macroeconomic and budgetary modelling for medium term planning (Phase II)" (undated document in respect of the Macmod-model, written by H. K. Nordås, CMI), where the chapter: The Money Market reads as follows:

  > As explained in the MACMOD documentation, it appears that monetary policy in the past has been the most effective policy instrument in controlling aggregate demand. The transmission mechanisms have, however, not been the traditional Keynesian via the interest rate and investment demand. In order to improve the money market block of the MACMOD, we suggest an assessment of recent developments of the financial sector and the instruments used by the Bank of Tanzania. The objective of this assessment is to incorporate in the most realistic manner the transmission mechanisms of monetary policy in the economy.
  > In accordance with the recommendations from the recent technical session it will be explored whether using M3 as the monetary aggregate improves the model projections.

- "Macmod, a macroeconomic model for the Tanzanian economy" (Hildegunn Kyvik Nordås with Arild angelsen. CMI Report R1998:5), where a section of chapter 3.3 reads as follows:

  > Before closing this section, it is useful to look at how monetary and fiscal policy have influenced aggregate demand in the past. To get a very rough idea, we have computed the correlation coefficients between various components of total expenditure and money supply and government final consumption respectively for the period 1987-1996. The results are presented in table 3.3.

  Table 3.3 Correlation between money supply and GDP and its expenditure categories

	M2
GDPmp	0.92
Private consumption	0.93
Investment	-0.1

  > As can be seen from this table, the correlation coefficients between money supply and GDP and consumption are exceptionally high. The correlation between money supply and investment is, however, negligible and, if anything, slightly negative. This suggests that the transmission mechanism for monetary policy in the not been the traditional Keynesian transmission via the interest rates and investment. It appears that money supply has rather had a direct effect on private consumption and GDP through net wealth effects. This is probably because a large share of the money demand has been for working capital in parastatals and cooperatives and for credit to government, which in turn has increased the purchasing power in the economy. In future, however, the Keynesian transmission mechanism should be expected to be more prominent as capital markets are deregulated, and government monetize the budget deficit to a much lesser extent.

Summing up, the assignment drawn up in the two documents cited above is consequently:

- to look at the financial instruments used by the Bank of Tanzania,
- in order to identify the way in which monetary variables impact production,
- for the ultimate purpose of introducing relevant model structures into Macmod.

II : Monetary matters

Monetary policy objectives and instruments

The Bank of Tanzania (BOT) operates a web site (www.bot-tz.org) containing a lot of valuable information about monetary matters etc in Tanzania. According to the statements made in that web site:

- *The primary objective of the Bank of Tanzania is price stability. The Bank therefore has the responsibility of ensuring that it establishes monetary conditions that are consistent with low and stable inflation.*
- *However, inflation control is not an end in itself, but rather, the means by which monetary policy contributes to solid economic performance.*
- *Low inflation allows the economy to function more effectively, thereby contributing to better economic performance over time.*
- *Inflation control by the Central Bank is done by controlling money supply. The Bank of Tanzania targets extended broad money, M3, which is defined as total deposit liabilities held by commercial banks, including foreign currency deposits, because it is the monetary aggregate estimated to have closest relationship with the rate of inflation.*
- *To influence the chosen monetary aggregate, i.e. M3, the Central Bank normally controls the base money (reserve money, or central bank money) which is directly related to money supply.*

The above statements, (together which other statements in the BOT web site), make it abundantly clear that the monetary policy of Tanzania has *one* primary objective: to maintain low and stable inflation. The importance attached to this target is indicated by the fact that this is also stated (in the web site) as *the primary* objective of the Bank itself, and of all its activities.

The focus on inflation does not, however, imply that price stability is seen as an end in itself. Rather it is seen as the way in which monetary policy may contribute to economic development. Stable and low inflation is seen as an essential *precondition* for sustainable economic growth.

The control of the money supply is the main policy instrument used by the Bank in control controlling inflation. In so doing, BOT uses its direct control over base money (reserve money, or central bank money) to influence the extended broad money aggregate (M3). BOT targets M3 because it sees it as the monetary aggregate with the closest relationship to the rate of inflation.

Base money control is not the only weapon in BOT's arsenal. The Bank also makes use of a number of additional monetary instruments in the fight to ensure price stability. Thus, according to the BOT web site, the Bank engages in Open Market Operations, through which it sells and buys government securities (e.g. Treasury bills) in the

open market. Other BOT instruments include the discount and Lombard rate, the statutory reserve requirements, moral inducement and gentlemen's agreements. The characteristics of the various instruments are described in considerable detail in the said web site (to which the interested reader is referred).

The interest rate

The interest rate is of specific concern to the present paper, given that it is a central variable in the Keynesian transmission mechanism referred to earlier. The interest rate (or rather: the average or typical interest rate) of Tanzanian is market oriented; it reflects the prevailing conditions in the financial market (i.e. the relative shortage or surplus of liquidity etc.) Even so, BOT plays a crucial role in "setting" the interest rate; it is a major "force" behind the said market conditions. Thus, BOT determines the "leading" (or "signal") interest-rates "underpinning" the financial market, it control the supply of base money etc.

The "signal" rates[1] are policy instruments in their own right. BOT describes them as independent variables that it may use to *control* the supply of money (as defined in terms of M3), not as dependent variable *controlled* by it. This, however, does not imply that BOT can impose them on the rest of the economy in the sense that it can set them entirely at will and expect the market to "follow suite". In setting these rates BOT has to take due account of other relevant factors and conditions, and of the overall policy objective of controlling inflation.

This may possibly have been different in earlier years. The financial sector was then under heavy government control, and credit allocated largely by administrative means (rather than through the market). BOT was consequently in command of the financial market. The government, in its turn, was in command of BOT. At the same time, government budget discipline was weak, and government "borrowing in the central bank" the order of the day. BOT was consequently relied on to provide government with a steady supply of credits.

This scenario may possibly serve to throw some light upon a point raised in the earlier cited CMI Report (R1998:5). It is recalled that the correlation coefficient between money supply and investments was found to be negative (-0.1), apparently to the surprise of the authors of the report. Instead, they appear to have expected a positive correlation coefficient on the assumption that:

- an increase in the money supply will tend to lower the interest rate,
- which will reduce the "cost of borrowing",
- which will increase the demand for investment products (because investments tend to be credit financed).

A correlation coefficient of -0.1 repudiates this hypothesis. It corresponds to a coefficient of determination of almost zero, indicating the absence of a causal relationship of any kind between money supply and investments.[2] This situation may possibly arise because the first part of the above hypothesis is incorrect. In other words:

---

[1] The "signal" rates in question are the discount rate, which is used when BOT buys financial securities from the banks, and the Lombard rate, which is used when BOT gives loans to the private banks.

[2] See Appendix I for a note about the interpretation of the coefficient of determination, correlation coefficient etc.

changes in money supply did *not* impact the interest rate, because both were set administratively and independently.[3]

Monetary survey

Table II,1 portrays the various elements of money supply in (mainland) Tanzania for the period 1985-98. The rapid growth in the variables concerned is readily seen in the upper section of the table. Thus, narrow money (M1) grew by a factor of 22, from 25 billion shillings in 1985 to 546 billion in 1998. Broad money (M2) also grew by a factor of 22, from 39 to 845 billion, while extended broad money (M3) grew by a factor of 26, from 39 to 1,027 billion. The additional growth in M3 is due to the spectacular growth in foreign currency deposits, which has grown from virtually zero in the 1980s, to 182 billion shillings in 1998.

Table II,1 Monetary Survey for mainland Tanzania (TZS'Billion)

Year	Currency in circulation	Plus: Demand deposits	Equals: Narrow money (M1)	Plus: Time & savings deposits	Equals: Broad money (M2)	Plus: Foreign currency deposits	Equals: Extended broad money (M3)
1985*)	12,7	12,6	25,3	13,7	38,9	0,2	39,0
1986	18,3	17,5	35,8	14,4	50,2	0,1	50,4
...	...	...	...	...	...	...	...
1997	287,9	206,0	493,9	266,5	760,4	166,7	927,1
1998	307,8	237,7	545,5	299,4	844,9	182,1	1 027,0
Annual averages for selected periods:							
1985-88	21,8	21,6	43,4	17,8	61,2	0,3	61,4
1989-93	76,0	76,4	152,5	74,7	227,2	16,3	243,4
1994-98	254,8	194,5	449,3	228,8	678,1	140,9	819,0

cont.

Year	Extended broad money (M3)	of which:			
		Net foreign assets	Net claims on government	Lending to private & parastatals	Other items, net
1985*)	39,0	-10,8	32,3	17,4	-6,9
1986	50,4	-12,9	32,6	27,6	3,1
...	...	...	...	...	...
1997	927,1	398,9	239,5	183,0	105,7
1998	1 027,0	458,0	276,6	248,3	44,1
Annual averages for selected periods:					
1985-88	61,4	-16,7	38,0	43,4	-5,0
1989-93	243,4	15,9	82,2	177,1	-31,7
1994-98	819,0	285,9	254,4	220,1	58,5

*) The 1985 entries do not balance.
Source: Table A1 of Annex II.

[3] Investment demand will of course also depend on a number of other factors, besides the money supply and the interest rate. Thus, it will depend on the "general investment climate", i.e. on such factors as the situation with respect to "red tape", the secure supply of required production inputs, the expectations about the future etc. Factors of this nature have probably been of considerable importance, especially in the past, given that the Tanzanian economy has suffered significant inefficiencies, inequilibria, bottlenecks etc.

Looking at the lower section of table II,1 we find that M3 was mainly associated with lending to the private and parastatal sector, as well as with net claims on government, during the 1980s, and early 1990s. The prominence of these factors has weakened considerably during the later 1990s, with foreign assets becoming the major M3 item in recent years.

The rapid growth in the various money supply components is illustrated in table II,2. The table shows that the foreign currency deposits increased at an average rate of 88 % pa during the period 1985-98, while extended broad money (M3) grew at an average rate of 29 % pa. The corresponding figure for M1 and M2 is 27 % pa (in both cases). Breaking the 1985-98 period down into two sub-periods (1985-91 and 1992-98) we find that the average growth rates were decidedly higher in the first sub-period than in the second. This is the case for all the three money aggregates, and also for their various sub-components, with the exception of foreign currency deposits.

Table II,2 Average growth rates for selected periods (geometric, % pa) *)

Period	Currency in circulation	Demand deposits	Narrow money (M1)	Time & savings deposits	Broad money (M2)	Foreign currency deposits	Ext. broad money (M3)
1985-88	36 %	39 %	37 %	21 %	32 %	24 %	32 %
1989-93	24 %	25 %	25 %	30 %	26 %	105 %	29 %
1994-98	20 %	14 %	17 %	20 %	18 %	28 %	20 %

cont.

Period	Extended broad money (M3)	of which:			
		Net foreign assets	Net claims on government	Lending to private & parastatals	Other items, net
1985-88	32 %	29 %	17 %	62 %	20 %
1989-93	29 %	-204 %	25 %	18 %	5 %
1994-98	20 %	76 %	8 %	0 %	-204 %

*) Based on the data of table A1.

Decomposing the overall growth rate

Table II,3 shows the annual (year on year) growth rates for M1, M2 and M3 during each year of the period 1986-98. The growth rates are, as expected, seen to vary with respect to both years and variables. On the whole, however, the picture is one of fairly substantial variations between years, and relatively modest variations within year. The variation between years is particularly striking when comparing the rates of the last few years to the rates of earlier years. In comparison, the variation between the three variables (M1, M2 and M3) within each year is relatively small. With some exceptions, the three aggregates seem to have moved fairly well in step over the years.

It is recalled that the question of whether to use M2 or M3 for the modelling effort was raised in the Macmod report "Macroeconomic and budgetary modelling for medium term planning (Phase II)". The above observation may possibly serve to suggest that the choice between the two is not all that important.[4]

[4] Note, however, that the above finding refers to annual data. A proper analysis of the question ought preferable to employ monthly data. According to present plans, this will be done in another paper. We will therefore not venture further along this road here.

Table II,3 Annual growth rates for M1, M2 and M3 (% pa)

Year	Narrow money (M1)	Broad money (M2)	Ext. broad money (M3)
1986	42 %	29 %	29 %
1987	32 %	32 %	32 %
1988	39 %	35 %	35 %
1989	26 %	29 %	29 %
1990	35 %	42 %	43 %
1991	22 %	26 %	27 %
1992	37 %	38 %	43 %
1993	33 %	29 %	39 %
1994	33 %	33 %	35 %
1995	30 %	26 %	32 %
1996	5 %	12 %	9 %
1997	10 %	11 %	13 %
1998	10 %	11 %	11 %
Annual (geometric) averages, selected periods:			
1985-88	37 %	32 %	32 %
1989-93	25 %	26 %	29 %
1994-98	17 %	18 %	20 %

Table II,3 refers to the aggregate M1, M2 and M3 levels. It may be of some interest to analyse how the various components of these aggregates have contributed to the overall growth in money supply. Table II,4 breaks the annual growth in the M3 aggregate down into its various components.

The components of table II,4 are additive within years, i.e. they add up to the M3-total when summed row-wise. Section A presents the percentage shares of the annual (year on year) growth in the value of M3. Section B gives the same shares, but this time expressed in terms of the annual M3 (% pa) growth rate. Figures in bold (in section A) are "local maxima" while the underlined figures are the corresponding minima.

Inspecting the table (section A) it is seen that currency in circulation, and lending to the private and parastatal sector, were the main M3 components in the 1980s and early 1990s. The picture, however, is not entirely "one-sided". Thus, in 1988 the demand deposits contributed much more to the overall growth in M3 than did the currency in circulation.

Later years have seen considerable variations in this "pattern". All kinds of deposits, including foreign currency deposits, have become important contributors to the growth of M3, as have net foreign assets. No single variable among them is however able to dominate the picture in the way as currency in circulation and lending to the private and parastatal sector dominated the picture in the early years.

All in all the picture presented by table II,4 is therefore one of significant change during the 1990s, from an initial situation rather heavily dominated by the two factors: currency in circulation and lending to the private and parastatal sector, to a situation which is much more balanced in the sense that more factors have come into play.

Table II,4 Components of growth in M3 [5]

Section A: Percentage shares of the annual (year on year) growth in M3 value

Year	Currency in circulation	Demand deposits	Narrow money (M1)	Time & savings deposits	Broad money (M2)	Foreign currency deposits	Extend. broad money (M3)	of which: Net foreign assets	Net claims on gov.	Lending to priv.etc	Other items, net
1986	**49 %**	43 %	93 %	7 %	99 %	-1 %	100 %	-18 %	2 %	**89 %**	88 %
1987	**39 %**	31 %	70 %	28 %	99 %	1 %	100 %	-44 %	19 %	**170 %**	-45 %
1988	31 %	**48 %**	78 %	21 %	100 %	1 %	100 %	-14 %	69 %	**79 %**	-34 %
1989	**35 %**	29 %	64 %	32 %	96 %	4 %	100 %	5 %	32 %	**126 %**	-62 %
1990	**33 %**	24 %	57 %	39 %	96 %	4 %	100 %	57 %	-12 %	**77 %**	-22 %
1991	13 %	**43 %**	55 %	40 %	95 %	5 %	100 %	30 %	-32 %	**117 %**	-16 %
1992	**35 %**	20 %	55 %	32 %	88 %	12 %	100 %	31 %	37 %	-10 %	**42 %**
1993	23 %	29 %	52 %	18 %	69 %	**31 %**	100 %	-18 %	**94 %**	48 %	-24 %
1994	**36 %**	19 %	55 %	25 %	80 %	20 %	100 %	**60 %**	-2 %	23 %	19 %
1995	**37 %**	17 %	54 %	16 %	69 %	31 %	100 %	27 %	**54 %**	-18 %	37 %
1996	20 %	12 %	32 %	**77 %**	109 %	-9 %	100 %	**191 %**	25 %	-163 %	47 %
1997	28 %	13 %	41 %	28 %	69 %	**31 %**	100 %	**100 %**	-52 %	38 %	14 %
1998	20 %	**32 %**	52 %	33 %	85 %	15 %	100 %	59 %	37 %	**65 %**	-62 %
Annual (geometric) averages for selected periods:											
1985-88	37 %	**42 %**	79 %	20 %	99 %	0 %	100 %	-25 %	38 %	**110 %**	-10 %
1989-93	27 %	28 %	55 %	**29 %**	84 %	16 %	100 %	15 %	40 %	**52 %**	-7 %
1994-98	**31 %**	19 %	49 %	30 %	79 %	21 %	100 %	**71 %**	15 %	0 %	13 %

Section B: Same as above, but expressed in terms of the % pa M3 growth rates

Year	Currency in circulation	Demand deposits	Narrow money (M1)	Time & savings deposits	Broad money (M2)	Foreign currency deposits	Extend. broad money (M3)	of which: Net foreign assets	Net claims on gov.	Lending to priv.etc	Other items, net
1986	14 %	13 %	27 %	2 %	29 %	0 %	29 %	-5 %	1 %	26 %	26 %
1987	12 %	10 %	22 %	9 %	32 %	0 %	32 %	-14 %	6 %	54 %	-14 %
1988	11 %	17 %	27 %	7 %	35 %	0 %	35 %	-5 %	24 %	28 %	-12 %
1989	10 %	8 %	19 %	9 %	28 %	1 %	29 %	1 %	9 %	37 %	-18 %
1990	14 %	10 %	25 %	17 %	42 %	2 %	43 %	24 %	-5 %	33 %	-9 %
1991	3 %	11 %	15 %	11 %	26 %	1 %	27 %	8 %	-9 %	32 %	-4 %
1992	15 %	9 %	24 %	14 %	37 %	5 %	43 %	13 %	16 %	-4 %	18 %
1993	9 %	11 %	20 %	7 %	27 %	12 %	39 %	-7 %	37 %	19 %	-9 %
1994	13 %	7 %	20 %	9 %	28 %	7 %	35 %	21 %	-1 %	8 %	7 %
1995	12 %	5 %	17 %	5 %	22 %	10 %	32 %	9 %	17 %	-6 %	12 %
1996	2 %	1 %	3 %	7 %	9 %	-1 %	9 %	17 %	2 %	-14 %	4 %
1997	4 %	2 %	5 %	4 %	9 %	4 %	13 %	13 %	-7 %	5 %	2 %
1998	2 %	3 %	6 %	4 %	9 %	2 %	11 %	6 %	4 %	7 %	-7 %
Annual (geometric) averages for selected periods:											
1985-88	36 %	39 %	37 %	21 %	32 %	24 %	32 %	29 %	17 %	62 %	20 %
1989-93	24 %	25 %	25 %	30 %	26 %	105 %	29 %	-204 %	25 %	18 %	5 %
1994-98	20 %	14 %	17 %	20 %	18 %	28 %	20 %	76 %	8 %	0 %	-204 %

[5] Note that the various components are directly additive. Thus, for each year they add up to the M3 growth rate.

III : Transmission mechanisms

Implicit assumptions

The assignment drawn up in the introduction may at first glance seem clear enough. On closer consideration, however, the picture becomes less lucid. This is because the assignment implicitly builds upon certain underlying presumption about the nature of the Tanzanian economy. These presumptions are of fundamental importance to the question put before us, and they seem far from self-evident to the present author. We shall therefore take a closer look at them.

The texts cited in chapter I seem to have accepted without much qualm that monetary policy has so far been "most effective" in influencing local demand, and hence local production. Splitting this argument into its separate components, we get the following two statements:

- Typically speaking, the economy of Tanzania is (or, rather: has been) demand-driven (as opposed to supply-driven).
- The use of monetary variables is (or, rather: has been) the most effective way of controlling aggregate demand.

The first of these statements implies that demand is the critical factor determining the volume of activity attained by the country's producers. Supply, on the other hand, is assumed merely to "follow" demand. Producers are consequently presumed able, willing and compelled to meet any variations in demand for their products. Given such a structure, slow economic growth may be seen as caused by weak aggregate demand, not by supply-side constraints or similar. In order to achieve higher economic growth one must therefore try to increase demand, rather than production capacity.

Assumptions of this nature is often adopted in the case of rich, industrialised countries, especially for the short-term perspective, or when faced with an economic downturn or depression.[6] The assumption seems more doubtful in the case of a poor, agricultural country like Tanzania, where significant supply constraints in all probability are the order of the day.

Expressing this differently we may note that the fundamental problem of countries like Tanzania is poverty. The predicament is therefore not one of insufficient demand as such, in the sense that consumers etc are "holding back" and have to be stimulated so as to spend more. Rather, it is one of insufficient income and purchasing power, allowing them to satisfy their many unsatisfied needs. The insufficient income, in its turn, reflects insufficient means of production, insufficient labour productivity etc., i.e. insufficient capacity to produce and supply.

The second of the above statements (about total demand being governed mainly by the money supply) also seems a bit doubtful. In order to discuss this statement we draw on the macro budget identity which equates total demand to total supply, and

[6] I.e. when affected by a slow or otherwise unsatisfactory economic performance, despite spare production capacity.

breaks both down into their various components. Thus: Total Supply, which is equal to: GDP + Imports, must be equal to Total Demand, which is equal to: Private and Government Consumption + Private and Government Capital Formation + Exports + Changes in Inventories.

It is readily seen that one of the above demand variables (exports) represents foreigners' procurement of Tanzanian products. Such demand seems likely to depend on conditions abroad, and equally unlikely to depend on the monetary situation in Tanzania.[7]

Among the local demand components private consumption accounts for the lion's share of all demand. Thus, as seen from table III,1 it accounts for around 6/10 of total demand, some 3-4 times the share of the next largest demand components (government consumption and private investments).

Table III,1: The macro budget [8]

Year	Supply components		Total supply (& demand)	Demand components						Errors and omissions
	GDP at market price	Imports		Private consumpt.	Gov. consumpt.	Private investments	Gov. investments	Exports	Change in stocks	
A : Absolute values, at constant 1992 prices, TZS'billion										
1987	1 154	481	1 635	952	229	302	23	120	3	6
1988	1 201	477	1 678	987	250	230	21	131	3	56
...	...	...	...	...	...	...	...	...	...	...
1996	1 525	561	2 086	1 278	169	264	10	329	4	32
1997	1 578	403	1 981	1 310	135	252	23	247	4	10
B : Percentage distribution										
1987	71 %	29 %	100 %	58 %	14 %	18 %	1 %	7 %	0 %	0 %
1988	72 %	28 %	100 %	59 %	15 %	14 %	1 %	8 %	0 %	3 %
...	...	...	...	...	...	...	...	...	...	...
1996	73 %	27 %	100 %	61 %	8 %	13 %	0 %	16 %	0 %	2 %
1997	80 %	20 %	100 %	66 %	7 %	13 %	1 %	12 %	0 %	0 %

Private consumption may possibly be affected by monetary variables, for instance via the credit market, via the inflation rate or similar. On the whole, however, these impacts are likely to be indirect and marginal in nature. This is especially so given the fact that a large part of private consumption is non-monetary in nature. Thus, as table A3 of Annex II demonstrates, a large part of Tanzania's GDP is of the non-monetary kind. Almost all of this ends up as private consumption.[9]

What then, is the decisive factor behind private consumption demand? The obvious answer to this question is that consumer demand is "driven" by consumer income.

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[7] Note that this statement concerns the *demand* side of exports. It does not rule out the possibility that the *supply* of exports may be influenced by local monetary variables, either in terms of volume or price.

[8] From table A5 of Annex II.

[9] A minor part of non-monetary GDP is usually ascribed to private investments (hut construction etc).

Consumption incurs expenditure, which the consumer has to cover. The necessary "consumer purchasing power" is largely acquired through "incomes earned" (as modified by assets held, taxes paid, savings (positive or negative) made, gifts/transfers given or received etc).

The incomes in question are primarily those earned as labour rewards (inclusive of incomes-in-kind, incomes from self-employment, "incomes" in non-monetary activity etc.), but capital returns in small and medium scale activities are probably also of relevance. Given that returns to labour and capital are the major components of GDP, "incomes earned" are therefore closely associated with the latter, which may serve as a "shadow variable" for the former.

The case of private investments provides more scope for the monetary dimension, at least in principle. Like consumption, investments have to be financed. This will often be from the investors' own assets or incomes, but credit finance is also common (provided that the country in question has the required credit facilities). The average private investment project may therefore be dependent upon the credit market, which in its turn presumably reflect monetary and credit policies. Investment decisions, however, reflect many and complex factors, not merely the "ease or squeeze" in the credit market. Investments may therefore be low even though credit conditions seem favourable (and *vice versa*), denying the effective role of money and credit also for this variable.[10]

Government demand (consumption and investments) ought in principle to be financed by government incomes (tax revenues, grants etc.), by drawing on existing assets, or by borrowing from the non-government sector. In other words, the resources used by government ought to be "balanced" against a parallel reduction in the "disposable resources" of the rest of the economy.

However, governments are often inclined to spend "beyond their means", "borrowing in the central bank" to cover the extra expenditures. In most cases this is a euphemism for "printing money", i.e. for injecting additional money into the economy. So also in Tanzania, where poor budget discipline and extensive deficit spending used to be a common occurrence in government organisations. In this particular sense, therefore, money supply and government demand went hand in hand.

This, however, was no receipt for economic development. The result of such monetary expansion was all to often found to be demand pressure and inflation, rather than real-term economic growth.[11] In recognition of this fact, the Tanzanian authorities have curtailed the use of such deficit financing in recent years. The close relationship between money supply and government demand described above is therefore unlikely to persist today.

Summing up, there consequently seems quite limited scope for a *direct* monetary impact on economic demand categories. This, however, is not to deny the possibility that

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[10] Thus, it is recalled from the earlier quoted CMI Report (R1998:5) that the investments were found to be negatively correlated to the money supply.

[11] Note, however, that a certain degree of monetary expansion, reflecting (and "servicing") the growth of the (monetary) economy, may nevertheless be required as part of proper macro-economic management.

demand may be *in*directly linked to money supply via production, i.e. via the supply variable: GDP. Thus, it is recalled that private consumption, which constitutes the lion's share of demand, is closely associated with GDP. In the following chapter we shall look at the relationship between production and money supply.

Aggregate money and production

It is recalled from CMI Report R1998:5) that the Tanzanian correlation coefficient for money supply and production was found to be "exceptionally high", suggesting a strong bond between these two variables. However, as explained in Annex I, the correlation coefficient in itself is but a measure of statistical association; it does not imply any form of causality between the variables concerned.

Rectifying this "deficiency", by formulating a feasible hypothesis of causality, however, may seem a fairly straightforward matter in the present case. Thus, we may for instance put forward the hypothesis implied in the said CMI Report, i.e. that production is a function of the money supply. Spelling this out in further detail, we hypothesise that the level of total GDP (as measured in real terms, i.e. constant prices) in any given year may be treated as a linear function of the corresponding (nominal) level of the monetary aggregate M2 in the same year.

Putting this hypothesis to the test, by running the available data through a simple regression analysis, we get a coefficient of determination of 0.85, implying that 85% of the variation in the dependent variable (GDP) is caused by the variation in the independent variable (M2). This may at first glance appear to constitute conclusive evidence of causality. After all, how could such a high coefficient of determination possibly mirror anything *but* a fairly clear and strong causal link between these variables?

To answer this question we simply need to take note of the obvious. The problem of creating economic growth would be easily overcome if mere increases in the money supply were capable of inducing the kind of production responses suggested above. If this had been the case, why bother with other economic growth factors than the money supply, and why not use it more expansionary, in the safe knowledge that the result is stronger economic growth? The answer, of course, is that experience has shown that monetary variables can produce little economic growth in and by themselves; flushing the economy with money is likely to result in inflation rather than in real term economic growth.

The idea that the authorities can use the money supply to "drive" the economic growth process on a simple "pro-rata" basis is consequently untenable. And yet that is what our regression results seem to imply. This suggests that the relationship between these variables is spurious, despite the high coefficient of determination. This problem may for instance have arisen because the relationship is incorrectly specified in respect of the problem studied.

To investigate this possibility we take a closer look at the data yielding the 0.85 coefficient of determination. Table III,3 contains the data in question, as well as their implied % pa growth rates. It is noted that the 0.85 coefficient refers to the specific "total dimension" of the variables analysed (see Section A of the table), and that this is not the only "dimension" possible (see, for instance, Section B of the table).

We consequently need to ask ourselves if our use of the "total dimension" represents an appropriate choice. In other words: should the presumed relationship between money and production variables really be defined in terms of the absolute GDP- and M2-*levels*? Isn't it more appropriate to define it as a relationship between the *changes* in these levels?

Table: III,3: Aggregate Money and Production, 1986-97 [12]

Year	Section A Absolute values (TZS'billion)		Section B Annual increases (% pa)	
	Aggregate Money (M2)	Production (Total GDP)	Aggregate Money (M2)	Production (Total GDP)
1986	50	1 001	NA	NA
1987	66	1 072	31.7 %	7.0 %
1988	89	1 119	35.1 %	4.4 %
1989	115	1 148	28.5 %	2.6 %
1990	163	1 219	42.1 %	6.2 %
1991	206	1 253	26.1 %	2.8 %
1992	285	1 276	38.5 %	1.8 %
1993	367	1 281	28.8 %	0.4 %
1994	486	1 299	32.5 %	1.4 %
1995	614	1 345	26.1 %	3.6 %
1996	685	1 402	11.6 %	4.2 %
1997	760	1 448	11.0 %	3.3 %

In suggesting the existence of a causal link between M2 and GDP, we undoubtedly mean to imply that the absolute aggregate GDP-values somehow reflect the corresponding aggregate M2-values. But that does not tell the whole story; in addition, we mean to imply that this correlation at the aggregate level has arisen because given *changes* in M2 give rise to corresponding *changes* in GDP.

We may "test" the validity of the latter postulate by reformulating our regression hypothesis in terms of the annual changes in the two variables in question. Table III,4 summarises the result of alternative postulates. Section A of the table confirms that the coefficient of determination between the absolute levels is 0.85 (for the variables TotGDP and M2). Section B shows that a reformulation of the hypothesis in terms of the *absolute* annual changes of the variables (i.e. in terms of dTotGDP and dM2) yields a coefficient of determination of no more than 0.07. Finally, section C shows that a reformulation of the hypothesis in terms of the *relative* annual changes of the variables (i.e. in terms of d%TotGDP and d%M2) yields a coefficient of determination as low as -0.10 (which we may interpret as 0.00).

In both of the latter cases, therefore, the coefficient of determination implies that the variables involved grew independently of one another, even though they appear to have followed each other fairly closely at the "accumulated" level. The table also shows that this apparent paradox is not unique to the specific variables here discussed

[12] The monetary aggregate in question is: M2, and the GDP aggregate: total GDP at factor cost, in constant 1992 prices.

(TotGDP & M2 etc). It is equally the case for other specifications of the monetary and production variables. No matter which of the monetary variables we pick, and which of the production variables, the picture is the same: a very high coefficient of determination wrt to the absolute level of the variables, and a very low wrt the increase in this level.[13]

Table III,4 Coef. of determination (adj.R^2) for alternative data combinations [14]

A : Adjusted R square wrt *absolute level* (of annual money and production volumes). Unit of measurement: TZShilling			
Independent variable:	$M1_t$	$M2_t$	$M3_t$
Dependent variable:			
Total GDP ($TotGDP_t$)	0.84	0.85	0.82
ow: Monetary ($MonGDP_t$)	0.79	0.80	0.77
Non-Mon. ($NmonGDP_t$)	0.94	0.94	0.93
B : Adjusted R square wrt *absolute increase* (in annual money and production volumes)[15]. Unit of measurement: TZShilling			
Independent variable:	$dM1_t$	$dM2_t$	$dM3_t$
Dependent variable:			
$dTotGDP_t$	0.12	0.07	0.09
$dMonGDP_t$	0.18	0.12	0.15
$dNmonGDP_t$	-0.05*)	-0.06*)	0.01
C : Adjusted R square wrt *relative increase* (in annual money and production volumes)[16]. Unit of measurement: % pa.			
Independent variable:	$d\%M1_t$	$d\%M2_t$	$d\%M3_t$
Dependent variable:			
$d\%TotGDP_t$	-0.11*)	-0.10*)	-0.10*)
$d\%MonGDP_t$	-0.11*)	-0.09*)	-0.10*)
$d\%NmonGDP_t$	-0.10*)	-0.09*)	-0.10*)

*) Note that the value of the Adjusted R Square may turn out negative. These may be interpreted in the same way as regular zero values, i.e. as evidence of non-association between the variables in question.

It is recalled from the document: "Macroeconomic and budgetary modelling for medium term planning (Phase II)" that: "it will be explored whether using M3 as the monetary aggregate improves the model projections". It follows from the above result that no significant advantage is to be gained by choosing M3 (or any other monetary aggregates), as long as we focus on the direct relationship between money and production. Thus, a feasible interpretation of the results of table III,4 may be to deny the existence of an "operational" relationship between these variables, implying that the

[13] Table III,4 reveals a somewhat odd point concerning monetary and non-monetary GDP. Inspecting section A of the table it is seen that the coefficient of determination (between money and GDP) is higher in the case of non-monetary GDP than in the case of monetary GDP. Inspecting section B of the table, moreover, the situation is seen to be just the opposite in terms of increases in these variables.

[14] I.e. alternative combinations of aggregate money supply and aggregate production. The latter is measured by GDP at factor cost at constant 1992 prices (for the period 1986-97).

[15] Thus: $dM1_t = M1_{t-1} - M1_t$, and similar for the other variables.

[16] Thus: $d\%M1_t = (M1_{t-1} - M1_t) / M1_t$, and similar for the other variables.

authorities can not rely on given changes in monetary aggregates to induce given GDP reactions.

Admittedly, this negative conclusion may reflect shortcomings in our analysis or hypothesis. Thus, we have used a simple regression technique to calculate the above coefficients, assuming simple linearity between the dependent and independent variables. We have also disallowed any possible time-lags between the variables. The latter may well be important; it seems reasonable to expect the monetary impact on production to materialise gradually and after a certain time-lag, rather than immediately.

A proper lag-analysis would require the use of monthly or quarterly data. Such data exist for the monetary aggregates, but not for GDP. We are consequently not in a position to undertake such an assignment. A number of crude lag-analyses, introducing alternative lag periods, have nevertheless been made, based on the annual data at hand. The result of this exercise was negative; none of the lag alternatives attempted gave any indication whatsoever of causality between money (M2) and production (GDP). [17]

Admittedly, this conclusion refers to a few simple lag-alternatives only. Our analysis is far from exhaustive; there are numerous other lag structures and relationships that we could have analysed in our quest for the "truth" about the relation between money and production. We shall not try to do so; in all probability this would only involve us in an "endless" exercise, which would be unlikely to succeed in "proving or disproving" the existence of a certain relationship between money and production.

Instead we shall look at the issue from "the other end", and demonstrate that it is indeed quite possible for a set of non-correlated growth impulses to produce trends that are highly correlated. To do so we construct a set of hypothetical cases, in which we *a priori* ensure that the annual changes in GDP and M2 are unrelated. We do so simply by substituting the actual % pa increases in GDP and M2 (given in table III,3) by a set of randomly chosen growth-rates.

In order to keep the calculation example reasonably close to the actual case investigated, however, we define the feasible range of variation for the two variables. Thus, the annual percentage changes in GDP and M2 are allowed to vary freely in all respects, but only within broad ranges suggested by the data of table III,3. Inspecting these data we find that the ranges in question are 0–7 %pa for GDP and 11-42 %pa for M2.

Twenty alternative data sets were put through the same regression analysis as used for the actual data. The results of this exercise are given in table III,5. Column A of the table gives the coefficient of determination for the regression between the % pa trend

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[17] Alternative lag-periods between 1 and 18 months were used. The GDP-variable ($d\%TotGDP_t$ or $d\%MonGDP_t$) was defined as a linear function of the lag-variable $LM2_t$. The latter was defined as a function of the $d\%M2_t$ variables, calculated as the following weighted average: $LM2_t = (m_{(-1)}*d\%M2_{t-1} + m_{(0)}*d\%M2_t) / (m_{(-1)} + m_{(0)})$, where: $m_{(r)}$ was the number of months for year: t-r applicable to the average. The sum: $m_{(-1)} + m_{(0)}$ was kept equal to 12 throughout the present analysis. (NB: In the formula used for lags exceeding 12 months the lag-variable $LM2_t$ was calculated as: $(m_{(-2)}*d\%M2_{t-2} + m_{(-1)}*d\%M2_{t-1})/12$, where: $m_{(-2)} + m_{(-1)} = 12$.)

increases. Given that these data are all randomly generated we should expect them to be non-correlated, i.e. we would expect the coefficient of determination to be zero (or very close to zero). Most of the results given in column A are of this nature. However, column A also demonstrates that the coefficient of determination for randomly generated data may occasionally become quite substantial. This reflects the fact that each of our samples contain rather few observations. In such small samples even completely randomly generated data may occasionally turn out in such a way that they appear to be correlated.

Table III,5: Results of random data calculations [18]

Data set no:	Coefficient of determination for:	
	A : Regression between %pa trend *increases*	B : Regression between absolute trend *levels*
1	0,24	0,89
2	-0,01	0,86
3	-0,10	0,88
4	-0,06	0,99
5	-0,07	0,71
6	0,16	0,90
7	-0,10	0,97
8	-0,01	0,92
9	0,01	0,95
10	0,44	0,96
11	0,17	0,96
12	0,37	0,93
13	0,12	0,86
14	-0,09	0,92
15	0,24	0,85
16	-0,10	0,80
17	-0,11	0,89
18	-0,11	0,91
19	0,12	0,86
20	-0,08	0,90
Lowest result	-0,11	0,71
Highest result	0,44	0,99
Average result	0,05	0,90

Column B of table III,5 gives the coefficient of determination for the regression between the absolute trend *levels*, i.e. between the total accumulated values corresponding to the % pa increases analysed in column A. Despite their randomly generated origin, these trends are all seen to have very high coefficients of determination. Thus, the coefficient varies between 0.71 and 0.99 within the sample. The average coefficient is 0.90, significantly higher than the 0.85 calculated for our actual data set.

[18] Results of the regression analysis of twenty different data sets. Each data set contains 11 subsets of data. These represent the % pa increase and the corresponding total value, of two different variables (for instance GDP and M2). All the % pa increases have been randomly chose (within broad limits).

We have consequently demonstrated that non-correlated growth impulses may produce highly correlated trends at the aggregate level. The underlying factor producing this apparent paradox may be described as "trend behaviour". There will often be a tendency for variables to be statistically correlated at the aggregate level if they show such behaviour, implying that each of them tends to move relatively steadily in a given direction.

Hence, if this is the case, the variables do not need to move "in perfect harmony", or in the same direction, to produce statistically correlated trends at the aggregate level. Economic variables like money supply, commodity prices and production will often exhibit such "trend behaviour". On the whole, they all tend to grow over time, although at very different rates. Such "conformity of movement" may of course reflect that the variables in question are after all linked to each other, although not directly and simply. Thus, they may for instance often turn out to be linked indirectly through yet other (underlying) factors. Such indirect relationships, however, are beyond our present simple regression analysis.

Money supply and inflation

In the above chapter we rejected the idea of a simple, powerful and direct relationship between money supply and economic growth. This, however, does not mean that money supply is irrelevant to economic progress. On the contrary, proper management of the money supply *is* an important condition for economic development. But it is not alone in being so; other measures are also vital. These, however, need to be supported by appropriate monetary measures in their turn.

The most direct and obvious relevance of the money supply variables concerns the area of inflation. Other things being equal, rapid growth in the overall money supply may be expected to fuel inflation, while slow growth in the money supply may serve to hold inflation in check. This will in its turn have implications for the production side of the economy. Thus, the rate of inflation may harm the economic development prospects of the nation if it is too high.[19]

This, as we have already seen, is also the view of the monetary authorities of Tanzania. Thus, it is recalled from above that the Bank of Tanzania has made it quite clear in its web site (www.bot-tz.org) that:

- Price stability is the primary objective of the Bank.
- BOT employs the money supply principally to control inflation.
- Inflation control, however, is not an end in itself, but the means by which monetary policy is expected to contribute to economic growth.
- In other words: low inflation is expected to allow the economy to function more effectively, thereby contributing to better economic performance over time.

In order to study the relationship between money and price variables we have calculated regression results parallel to those presented in the preceding chapter. The results are reported in table III,6. A notable degree of accord is seen to exist between money supply and inflation. The accord is extremely strong at the absolute level (see

[19] Arguably, the rate of inflation may also harm the economic development prospects of the nation if it is too low, for instance negative.

Section A), with coefficients of determination very close to 1.00. As explained in the previous chapter, however, this does not necessarily prove causality. It may, at least in theory, merely imply that the two variables in question both show "typical trend behaviour".

In order to analyse causality we should therefore focus on the *changes* in these trends. Sections B and C of table III,6 contain the coefficients of determination obtained from analysing the annual absolute and relative changes. It is readily apparent that these results are quite different from those calculated in the previous chapter. Thus, the present coefficients of determination go as high as 0.72 for the absolute changes, and as high as 0.58 for the relative ones, indicating a significant degree of causality between the variables in question.

Table III,6 Coefficient of determination (adjusted R square) for alternative data combinations wrt aggregate money supply and inflation [20]

A : Adjusted R square wrt *absolute level*			
Independent variable:	$M1_t$	$M2_t$	$M3_t$
Dependent variable: The absolute value of the price index for:			
:Total GDP ($PTGDP_t$)	0,98	0,99	0,99
:Monetary GDP ($PMGDP_t$)	0,98	0,99	0,99
:Non-Mon. GDP ($PNGDP_t$)	0,96	0,97	0,97
B : Adjusted R square wrt *absolute annual increase*[21]			
Independent variable:	$dM1_t$	$dM2_t$	$dM3_t$
Dependent variable: The absolute increase in the price index for:			
:Total GDP ($dPTGDP_t$)	0,39	0,63	0,61
:Monetary GDP ($dPMGDP_t$)	0,50	0,71	0,72
:Non-Mon. GDP ($dPNGDP_t$)	0,17	0,42	0,37
C : Adjusted R square wrt *relative annual increase*[22]			
Independent variable:	$d\%M1_t$	$d\%M2_t$	$d\%M3_t$
Dependent variable: The relative increase in the price index for:			
:Total GDP ($d\%PTGDP_t$)	0,31	0,12	0,07
:Monetary GDP ($d\%PMGDP_t$)	0,58	0,35	0,30
:Non-Mon. GDP ($d\%PNGDP_t$)	0,00	-0,08*)	-0,10*)

*) Note that the value of the Adjusted R Square may turn out negative. These may be interpreted in the same way as regular zero values, i.e. as evidence of non-association between the variables in question.

This description, however, does not apply to all alternatives. The two coefficients cited above represent the absolute maxima of table III,6. The corresponding minima go as low as 0.17 and -0.10 respectively. This is comparable to the coefficients found wrt GDP (see previous chapter). It is recalled that we concluded that no causality was indicated in that case. The results of table III,6 may therefore appear to be somewhat conflicting, indicating both the presence and absence of causality.

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[20] Inflation is measured by the GDP price deflator of table III,6.

[21] $dM1_t = M1_{t-1} - M1_t$, and similar for the other variables.

[22] $d\%M1_t = (M1_{t-1} - M1_t) / M1_t$, and similar for the other variables.

This is easily explained by the fact that the economy of Tanzania is both monetary and non-monetary in character. The difference between the two is easily seen in table III,6. The low coefficients of determination relate to the price movements of non-monetary production, while the high coefficients relate to the price movements of monetary production. The medium size coefficients relate to the price movements of their aggregate (i.e. of total monetary and non-monetary production).

This corresponds to what one would *a priori* expect. The close relationship between money and price movements will presumably apply primarily for products that are traded at market price. The imputed accounting prices used to value non-monetary production fall into a different category (as do government regulated prices). They should not be expected to exhibit the same relationship to the monetary variables as the market prices, even when they are said to reflect general trends in market prices.

The coefficients of determination given in table III,6 all refer to a rather crude underlying hypothesis implying that the inflation experienced in a given year is treated as a simple linear function of the money supply in that same year. Thus, it is presumed that variations in money supply are directly and immediately translated into corresponding variations in inflation. This is unlikely to be the case. In real life, changes in the money supply are likely to translate into price variations only gradually and over time.

Lag analyses, based on monthly or quarterly price and money data, are required to examine the "translation process" involved properly. Monthly data for monetary aggregates and inflation trends are available for Tanzania[23]. Time constraint does however not allow us to undertake such an analysis as part of the present paper.[24] Instead we merely reiterate that we have obtained rather convincing results from our analysis even without introducing any kind of lags or refinements. The introduction of such features ought (logically) to improve the results further (provided that the *relevant* features can be identified).

We next turn to the question of the "best" monetary variable for policy modelling purposes. Other things being equal, the "choice" variable should obviously be the monetary aggregate with the strongest link to the inflation rate (and hence indirectly to the rate of GDP growth).

Before proceeding we take note of the official view. BOT's opinion about inflation control is given in the earlier cited web site, where the Bank states that:

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[23] The data on inflation, however, refer to the consumer price index, rather than to the type of "all-embracing" GDP deflator used in the present analysis.

[24] A quick and crude lag analysis, covering the variables d%M1 and d%PMGDP (both of which are defined in table III,6), was in fact undertaken. It was however not based on monthly data, but on the annual data presented in this paper. The analysis was similar in form to that undertaken for money and production in the previous chapter. It produced no significant improvements in the coefficient of determination, but it did indicate that the said "translation process" may possibly drag on for as much as half a year or more.

The issue obviously calls for a proper investigation, based on monthly data, and allowing for a range of alternative lag-structures. An in-dept examine of this nature, however, taking into consideration the many potential possibilities of non-linear relationships, multi-period lag structures etc, may prove quite a large job.

- BOT controls inflation by controlling the money supply. In so doing, BOT targets M3 (extended broad money), that it regards as the monetary aggregate with the closest relationship to the inflation rate.
- To *influence* the targeted M3 aggregate, however, the BOT normally controls the base money (reserve money, or central bank money) which is directly related to money supply.

BOT consequently regards M3 as the monetary aggregate with the closest relationship to the inflation rate. Inspecting table III,6, however, we find scant support for this view. True, the table does provide some slight support for the BOT view, but in the main it presents a different picture.

Focusing on the relationship between the alternative money supply variables and the price of monetary GDP prices we find that M3 does indeed have the highest coefficient of determination when the variables are measured in terms of absolute annual changes (see section B). Even so, however, M2 does have almost as high a coefficient as M3, only that of M1 is significantly lower.

Section C of the table, however, indicates that M1 is far superior to the other two variables when they are measured in terms of relative annual changes (% pa). This is the data-format most commonly employed for expressing changes in the variables concerned. It consequently seems that our results contradict the BOT stance in this matter.[25]

Inflation and economic growth

In the above chapter we noted that there is an upper limit to how quickly the money supply should be allowed to grow. Exceeding this limit will hurt the prospects for economic development. There is also a limit to how slow the money supply ought to grow. Both an insufficient and an excessive supply of money will be detrimental to the economy concerned, harming the prospects of real term growth derived from investments etc. An appropriate supply of money, on the other hand, may allow the investments etc to bear fruits. The role of money in the economy may therefore be compared to that of a lubricant in an engine. The lubricant is essential to the smooth running of the engine, yet it can not drive the engine on its own.[26]

Thus, the prospects for economic growth may be at risk if the rate of inflation becomes "too high". High inflation may give rise to sub-optimal saving and investment behaviour. Such inflation may for instance encourage immediate consumption at the cost of saving for the future. The utilisation of funds saved may also change; invest-

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[25] It should be noted, however, that the inflation concept used by BOT is somewhat different from the one used above. Thus, BOT refers to a price index for certain types of consumption, rather than the overall GDP price index. BOT measures inflation by the non-food sub-index of the National Consumer Price Index (NCPI). The GDP price index, covering the whole range of (monetary) production in Tanzania (but ignoring final-use imports) might arguably have been a better measure of overall local inflation. Even if this should be the case, however, the GDP index represents no practical option for the bank. The NPCI has to be employed because it alone provides the bank with up-to-date estimates on a monthly basis. The food component is excluded because food prices are very sensitive to factors totally unrelated to the money supply (typically: weather conditions).

[26] Translating this into more technical terms we may say that appropriate monetary policies represent *necessary but insufficient* conditions for economic development.

ment "portfolios" are likely to become "biased" towards the more "inflation-safe" alternatives, rather than towards the more productive ones. This reflect a tendency for resource allocation in general to become sub-optimal, as economic actors try to protect their incomes and assets from inflation-losses, as opposed to employing them to maximum effect in the wider macro-economic perspective.

The prospects for economic growth may also be at risk if the rate of inflation is "too low", for instance negative. This is because the real-term value of existing debts are affected by inflation, unless their nominal value is adjusted in step with the inflation rate, something that is seldom the case. A negative rate of inflation will consequently tend to lead to an increase in the real value of existing debts and loans. This is important because the average producer will typically be a credit user; i.e. he will typically have borrowed money to financed at least some of his past investments etc, and he has typically done so at interest rates reflecting expectations of positive inflation. Such a producer may be hard hit by a spell of deflation.[27]

Commentators on the topic of economic policy often seem to regard zero inflation as something of an ideal. This may be understandable given recent economic history. Following years of rapid inflation during the 1970s and 1980s, the fight against inflation was put high on the political agenda. Economic policy makers, especially in the industrialised countries, turned their attention decisively to the fight against inflation. The fight was to most intents and purposes won already some years ago, but even so, the rhetoric and fear of inflation may linger on.

Looking at the economic development record over a longer period and a broader span, however, the picture may possibly turn out a little different. Economic growth and inflation have tended to be "fellow travellers"; periods of economic growth have often also been periods of (positive) inflation. This may be explained as a concrete expression of the tendency for the economic growth process to create its own inflationary pressures.

Fighting back these pressures completely may require harsh remedies, which may jeopardise the growth itself. Besides, it may be argued that a mild degree of inflation, for instance around 3-4 % pa, may in fact be beneficial for a country's overall growth prospects. Hence, drawing on the arguments used above, it may be noted that a mild dose of inflation will lighten real-term debt burdens[28], while at the same time it may be hoped that the tendency towards sub-optimal resource allocation is kept to a minimum. If so, a certain (mild) degree of inflation may consequently be seen to "oil the wheels of economic growth".

It may seem that the BOT shares this view. Thus, it is recalled from above that BOT is responsible for "ensuring monetary conditions that are consistent with low and stable inflation", and that "low inflation allows the economy to function more effectively, thereby contributing to better economic performance over time." In other words, the bank tries to promote economic development, not by eradicating inflation, but by keeping it *reasonably low and predictable.*

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[27] Deflation (negative inflation) is often associated with periods of economic crisis, both because the crisis may lead to deflation, and because the latter may serve to strengthen the crisis.

[28] I.e. it will have the same effect as a reduction in the interest rate, which (ceteris paribus) may be expected to "fuel the economy", through increase borrowing, investments etc.

IV : Model structures

General format

Summing up the findings of the above chapters we may conclude that the relationship between money supply and production is neither direct nor simple in nature. The money supply does not impact production directly, but via inflation. Other things being equal, we may consequently expect money supply to influence inflation, and inflation to affect production.

Focusing on the latter relationship, it appears that a favourable rate of inflation is a necessary condition for economic growth. It is not, however, a sufficient condition for such growth. In other words: inflation can not create economic progress in and by itself, but it can help or harm the prospects for such progress.

A favourable rate of inflation is synonymous with a reasonably low and predictable rate. Inflation should not be allowed to "skyrocket", but neither should it be allowed to "drop through the floor". Most countries, however, are seldom at any risk of experiencing the latter.

When "translating" these conclusions into concrete mathematical model-structures it is evident that the relationship between money supply and economic growth should *not* be portrayed as a simple and linear one. Instead, we may need to break it down into the two separate relationships described above, i.e. one portraying the relationship between money supply and inflation, and another portraying the relationship between inflation and production.

The first of these relationships may possibly be portrayed using some kind of simple near-linear type of (absolute or logarithmic) formula, in which given variations in money supply are assumed to impact the inflation rate in given ways, and after given time lags. This may suffice, (provided that the degree of sophistication aimed at in the model is not too high), given that the coefficient of determination between these variables is relatively high.[29]

The second relationship may need to be treated with more circumstance. The relationship between inflation and economic growth ought *not* to be portrayed by way of a simple and linear function, according to which x % of inflation may be relied on to produce y % of GDP "no matter what". Inflation, after all, is only one among several GDP-driving factors (and in many cases it may not even be the most important one). Inflation should therefore be seen as a determinant for production, but in no way as the only or main one.

Moreover, linearity does not apply even when focusing on the relationship between inflation and production in a specific and partial sense. The relation between the two should ideally be expressed as some kind of inverted U-form or similar, reflecting the

[29] In a more ambitious set-up, however, one should seek to introduce also other inflation-driving factor, such as for instance import-price driven inflation. The latter will depend on inflation abroad, and the exchange rate between local and foreign currencies. The latter will in its turn probably (over time) reflect the difference in local and foreign inflation rates in the "near past" or similar.

argument that high and low inflation "extremes" are both detrimental to economic growth, while more "reasonable" rates of inflation tend to promote the prospects for such growth.

Towards concrete formulas

In trying to identify the concrete formulas and parameters of the functions outlined above, it may seem obvious that one should follow the usual procedure of relying on the "statistical evidence" at hand, i.e. of investigating what can be inferred from the historical record of the variables concerned. In most cases this will be preferable to the alternative of relying on "proxy- information" (referring to "corresponding" variables covering "similar" institutions elsewhere), unsubstantiated assumptions or similar.

To undertake a proper econometric investigation of this nature promises to become a substantial task. It has consequently not been attempted as part of the present very limited effort. The job therefore remains to be done. However, before deciding to launch such an investigation one should first address a few pertinent questions.

The first question concerns the risk of duplicating work already done by others. In the present case it appears that the BOT may already have done the job in question. Thus, a mission statement for the Bank's Directorate of Economic Policy, given in the earlier mentioned BOT web site, informs us that:

> *"Econometric studies carried out by the Bank of Tanzania have indicated that there is a relatively significant relationship over the longer term between changes in M3, Prices (National Consumer Price Index, NCPI), and nominal GDP (Gross Domestic Product)."*

The Macmod team should obviously look carefully into the feasibility of employing the results of the BOT studies also for the current Macmod purpose, before deciding whether or not there is a need to launch any new studies of the econometric relationship between money supply, inflation and production.

The second question concerns the issue of relevance. When considering the likely benefits of employing econometric evidence or similar to identify the monetary functions of Macmod one should not take it for granted that such evidence is in fact capable of providing the answers we are looking for.

In other words: we should not overlook the possible that econometric evidence reflecting Tanzania's past economic record may be unsuitable for our purpose. Even if given econometric results or similar should prove impressive in respect of past events, they do not necessarily provide us with a valid guide to the future. Our effort to "capture the future" may in some cases be better served by our own best guesses than by the "evidence of the past".

Relevance of historical evidence

The above possibility seems particular relevant in the present case. The existing data on inflation and production are limited in scope, in the sense that they are incapable of illustrating the complete form of the relationship between these variables. Thus, no

data will be on hand to illustrate the effect of negative inflation. Admittedly, this may not be too serious; negative inflation does not seem a likely alternative given present Tanzanian realities. What is decidedly worse is the fact that that the existing data are also unlikely to be capable of showing the effects of an "appropriately" low rate of inflation, i.e. of relating more precisely to the stated objective of present monetary policies.

The available data are also "structurally" out of date. Economic relationships are not unchangeable entities, given once and all. Their strength and character may alter significantly over time, and in response to changing circumstances. So also in the present case; the character and magnitude of Tanzania's monetary aggregates has changed significantly during the last decade and a half, as has (presumably) the nature of their impact upon the rest of the economy.

During this period, the country saw the introduction of fundamental changes in its economic policies and practices. The "Tanzanian model" was initially a heavily state-controlled one, but has become much more market oriented in recent years. In the past state institutions of various kinds were also, to a significant degree, allowed to "drive" the money supply. This they could do simply by showing poor budget discipline, persistently allowing expenditures to exceed incomes.

The outcome may have been a fairly close association between "material" demand and monetary expansion.[30] This kind of monetary expansion should now be a thing of the past. In future, all institutions will have to show better budget discipline, abiding by their budget limit, and refraining from monetizing their deficits. These developments will be reinforced in the years ahead, and their impact on the overall economy will grow ever more visible. Given this state of affairs, there must be some doubt about the relevance of using the experience of the past as a guide towards the future.

This is not to deny that ambitious economic modelling efforts like Macmod often call for substantial amounts of analysis of past events. Even so, the simple fact should not be overlooked that the justification for constructing these models is rarely the compulsion to analyse the events of the past as such. The analysis of these events is mainly important to the modelling exercise in so far as it discloses how the various structures of the economy operate. But this is normally done as a guide towards the future, on the assumption that the structure etc studied does not change significantly or rapidly over time. If this is the case, a sound understanding of past events will greatly benefit the more "forward-looking" tasks, such as economic planning and prediction tasks.

It is recalled that our present project is derived from a wish to see monetary variables and functions introduce into the Macmod model. The implication of the above observations for this project is evident. The relationships and coefficients introduced should (to the best of our knowledge and ability) reflect the nature of future conditions. They *may* be equated to the parallel ones observed in the past, but *only* if the relevant structures of the future can be relied upon to be reasonably similar in strength and character to those of the past.

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[30] Note that this association between "material" demand and monetary expansion did not come about because the money supply created the "material" demand, but because the latter was financed by "money" created through the issuing of "uncovered" cheques, purchase order etc. The direction of dependence between the two variables is therefore the reversed of what is normally the case.

In the present case there may be serious doubts that this will indeed be the case, given the fundamental changes in Tanzania's economic regime already mentioned. An investigation of the monetary aspects of the Tanzanian economy in the past may consequently prove of rather limited relevance to the model building effort, even if it should come out with relatively clear and convincing conclusions etc in itself.

Concluding remarks

The Macmod practitioners initially referred to have clearly foreseen the possibility that the past may be of limited relevance for the future. Thus, it is recalled from CMI Report R1998:5 that they expect the traditional Keynesian "transmission mechanism"[31] to operated in the future, even though it did obviously not do so in the past.

In support of this expectation they forward the same type of arguments as presented above. Thus, they maintain that past expansions of the Tanzanian money supply probably reflected the credit requirements of the government and its various ancillary institutions. In future, however, they expect things to be different. As the new economic realities take effect they expect the traditional Keynesian transmission mechanism to become more prominent.

The present author agrees that this is a likely development. This does not imply, however, that he expects it to come into absolute or real *prominence* in the near future, only that one should expect it to grow increasingly *more* important over time (relative to an initial situation in which it must have been a very marginal phenomenon indeed). Looking towards the near future, therefore, he expects other factors than the Keynesian to be the primary determinants of the nation's investment decisions. Looking further into the future, however, he expects the Keynesian mechanism to gradually grow in importance, reflecting the development of the economy.

As seen in this perspective the employment of the Kenyesian transmission mechanism is clearly a relevant proposition for the future. It is therefore advisable that the Macmod investment function takes it on board. This it may do already today. Though probably still of relatively minor importance, one should not rule it out completely as a potentially relevant investment determinant.

One should *not*, however, rely on the Keynesian transmission mechanism as the only, or the main, investment determinant. The investment function ought to be "wide" enough to encompass what we consider the main investment factors, even if these can not be properly "internalised" within the Macmod model.

Further works may be needed to pinpoint exactly what "drives" the investment decisions in an economy like Tanzania's (i.e. an economy undergoing rapid changes, not least in terms of overall policy matters). At this stage we will only forward the idea that the presence or absence of what we may term "investors' confidence" is probably of crucial importance.

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[31] I.e. the mechanism through which variations in money supply translates into variations in economic demand (via the interest rate and investment demand), giving rise to parallel variations in production.

This implies that investments will not materialise unless the authorities in question are able to convince the potential investors that their investments are profitable and safe both in the short and long term perspective. This may typically mean that the authorities have to demonstrate, by word and deed, that legal and economic conditions will remain reasonably stable and predictable, that government is earnestly committed to the reform policies initiated, that it is in practice able to maintain a reasonably degree of "good governance", etc.

These factors are unlikely to present themselves as feasible "internal variables" in the model. The above arguments consequently imply that investments are to a significant degree decided by exogenous factors (i.e. exogenous to the model). This being the case, it may perhaps seem that we "allow" the monetary variables and authorities of Tanzania no more than a subordinate role.

This, however, would amount to a misconception. Thus, as already argued elsewhere, the present author agrees with the Bank of Tanzania that the money supply impacts the rate of inflation, and that the latter can "make or break" the country's development prospects. In all probability, "extreme" rates of inflation are effective deterrents to real-economy growth, while more "reasonable" rates are conducive to such growth.

A reasonable degree of price stability and price predictability should consequently be seen as a *necessary* precondition for economic growth. Failing to achieve reasonable success in this arena, the country is unlikely to succeed in creating economic development. But, as emphasised earlier, price stability and predictability is not a *sufficient* condition for economic growth; other factors must also come into play. As seen in this perspective, therefore, the monetary authorities play a crucial *enabling* role in the struggle for economic development.

Annex I : A note about correlation coefficients etc.

It is recalled that a correlation coefficient of 0.92 between aggregate money (M2) and production (GDP) was given in table 3.3 of the CMI Report (R1998:5) cited in the introduction chapter. This may seem an impressively high value, suggesting a strong link between the two variables. However, it would be inappropriate to jump to the conclusion that a given M2 value will definitely give rise to a corresponding GDP value.

This is not to deny that the said correlation coefficient confirms a strong tendency for GDP to grow with aggregate money supply (during the period investigated), and vice-versa. It may be tempting to interpret this in terms of causality, suggesting that the money supply is a driving force behind GDP growth, (or, alternatively, that GDP changes causes changes in money supply). The correlation coefficient, however, does not in itself carry any such suggestion of causality; it simply measures the "statistical association" between the variables in question.

In order to investigate the question of causality we must first formulate a specific hypothesis of causality between the variables in question. This hypothesis should be expressed in terms of a linear function between the dependent and the independent variables (i.e. between the "impact*ed*" and the "impact*ing*" variables).[32]

Having done so, we may employ standard regression tools to estimate the individual coefficients of the prescribed function, and to assess the "goodness of fit" of the whole function. The latter describes how "successful" the function is in explaining the observed variations in the dependent variable, given the observed variations in the independent variables.

The success rate is measured by the coefficient of determination, commonly referred to as: R^2, or (preferably) by its adjusted version[33]. The magnitude of this coefficient indicates how much of the variation in the dependent variable may be "explained" by the variations in the independent variable, given the structural assumption.

Returning to case reported in the CMI Report (R1998:5), the adjusted R^2 is calculated at 0.85. Although significantly below the 0.92 correlation coefficient described above, this is still an impressive result, implying that 85% of the variation in the dependent variable is "explained" by the variations in the independent variable.[34] In other words: the presumed relationship between money and production leaves only 15% of the variations in the dependent variable unexplained.

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[32] Note that the functional relationship should be given a linear form, for instance: $Y_i = A + B*X_i$. Non-linearity of a kind may nevertheless be obtained by "translating" the variables (X and Y) into a log-normal format or similar.

[33] The unadjusted version of R^2 is equal to the square of the correlation coefficient. The latter is calculated as: $R_{xy} = \Sigma x_i y_i / (\sqrt{\Sigma x_i^2}\sqrt{\Sigma y_i^2})$, where: $x_i = X_i - X_{avg}$ and $y_i = Y_i - Y_{avg}$ (i.e. deviations from mean). The adjusted version of R^2 is based on the unadjusted R^2, but adjusted for "degrees of freedom" etc, i.e. as adjusted for possible "data inadequacies" (typically data scarcity).

[34] Note that this R^2 value applies to both regression alternatives; the value of R^2 is the same irrespective of whether GDP is presumed to drive or be driven by M2. (NB: this is the case for R^2 alone, not for any of the other regression coefficients or estimates.)

Annex II : Some basic data

Table A1 Monetary Survey for mainland Tanzania (TZS'Billion)

Year	Currency in circulation	Plus: Demand deposits	Equals: Narrow money (M1)	Plus: Time & savings deposits	Equals: Broad money (M2)	Plus: Foreign currency deposits	Equals: Extended broad money (M3)
1985*)	12,7	12,6	25,3	13,7	38,9	0,2	39,0
1986	18,3	17,5	35,8	14,4	50,2	0,1	50,4
1987	24,6	22,6	47,1	19,0	66,1	0,3	66,5
1988	31,7	33,7	65,4	23,9	89,3	0,5	89,8
1989	41,1	41,3	82,4	32,4	114,8	1,5	116,3
1990	57,9	53,2	111,1	52,1	163,2	3,5	166,7
1991	63,6	72,3	135,9	69,9	205,8	5,8	211,6
1992	95,5	90,4	185,9	99,1	285,0	17,0	301,9
1993	122,2	124,9	247,1	120,0	367,1	53,5	420,6
1994	176,3	153,3	329,6	156,9	486,5	83,3	569,7
1995	244,3	184,0	428,3	185,4	613,7	139,2	752,9
1996	257,7	191,6	449,2	235,8	685,0	133,1	818,1
1997	287,9	206,0	493,9	266,5	760,4	166,7	927,1
1998	307,8	237,7	545,5	299,4	844,9	182,1	1 027,0
Annual averages for selected periods:							
1985-88	21,8	21,6	43,4	17,8	61,2	0,3	61,4
1989-93	76,0	76,4	152,5	74,7	227,2	16,3	243,4
1994-98	254,8	194,5	449,3	228,8	678,1	140,9	819,0

cont.

Year	Extended broad money (M3)	of which:			
		Net foreign assets	Net claims on government	Lending to private & parastatals	Other items, net
1985*)	39,0	-10,8	32,3	17,4	-6,9
1986	50,4	-12,9	32,6	27,6	3,1
1987	66,5	-19,9	35,6	55,0	-4,1
1988	89,8	-23,3	51,6	73,5	-12,0
1989	116,3	-22,1	60,1	106,8	-28,4
1990	166,7	6,4	54,2	145,5	-39,4
1991	211,6	20,1	39,7	198,2	-46,3
1992	301,9	47,9	72,9	189,3	-8,2
1993	420,6	27,1	184,1	245,8	-36,3
1994	569,7	116,4	181,1	280,2	-7,9
1995	752,9	165,8	279,3	247,8	60,0
1996	818,1	290,3	295,8	141,3	90,6
1997	927,1	398,9	239,5	183,0	105,7
1998	1 027,0	458,0	276,6	248,3	44,1
Annual averages for selected periods:					
1985-88	61,4	-16,7	38,0	43,4	-5,0
1989-93	243,4	15,9	82,2	177,1	-31,7
1994-98	819,0	285,9	254,4	220,1	58,5

*) The 1985 entries do not balance.

Source: Macmod data file and Bank of Tanzania web site.

NB: Estimates refer to end of December.

Table A2: Monetary and production aggregates

	Monetary Aggregates			Production Aggregates		
Year	M1	M2	M3	Monetary GDP*)	Non-Mon. GDP*)	Total GDP*)
A : Absolute values (TZS'mill.)						
1986	35 810	50 235	50 353	720 430	280 839	1 001 269
1987	47 131	66 137	66 495	780 765	290 775	1 071 540
1988	65 401	89 339	89 809	818 260	300 758	1 119 018
1989	82 419	114 807	116 295	835 927	311 818	1 147 745
1990	111 085	163 153	166 669	895 674	323 562	1 219 236
1991	135 926	205 818	211 579	920 422	332 712	1 253 134
1992	185 876	284 968	301 926	935 248	340 669	1 275 917
1993	247 091	367 095	420 636	929 623	351 383	1 281 006
1994	329 625	486 489	569 743	940 529	358 413	1 298 942
1995	428 285	613 695	752 912	970 604	374 642	1 345 246
1996	449 213	684 991	818 063	1 015 509	386 202	1 401 711
1997	493 869	760 353	927 069	1 048 168	399 922	1 448 090
B : Annual increases (% pa)						
1986	NA	NA	NA	NA	NA	NA
1987	31,6 %	31,7 %	32,1 %	8,4 %	3,5 %	7,0 %
1988	38,8 %	35,1 %	35,1 %	4,8 %	3,4 %	4,4 %
1989	26,0 %	28,5 %	29,5 %	2,2 %	3,7 %	2,6 %
1990	34,8 %	42,1 %	43,3 %	7,1 %	3,8 %	6,2 %
1991	22,4 %	26,1 %	26,9 %	2,8 %	2,8 %	2,8 %
1992	36,7 %	38,5 %	42,7 %	1,6 %	2,4 %	1,8 %
1993	32,9 %	28,8 %	39,3 %	-0,6 %	3,1 %	0,4 %
1994	33,4 %	32,5 %	35,4 %	1,2 %	2,0 %	1,4 %
1995	29,9 %	26,1 %	32,1 %	3,2 %	4,5 %	3,6 %
1996	4,9 %	11,6 %	8,7 %	4,6 %	3,1 %	4,2 %
1997	9,9 %	11,0 %	13,3 %	3,2 %	3,6 %	3,3 %

*) GDP at factor cost, measured in constant 1992 prices.
Source: Macmod data file and Bank of Tanzania web site.

Table A3: GDP at Factor Cost, by Monetary and Non-Monetary component

	At Current Prices			At Constant 1992 Prices		
	Monetary	Non-Monetary	Total	Monetary	Non-Monetary	Total
A : Absolute Values (TZS'billion)						
1986	157	67	224	720	281	1 001
1987	217	86	303	781	291	1 072
1988	323	145	468	818	301	1 119
1989	415	167	582	836	312	1 148
1990	562	198	760	896	324	1 219
1991	730	260	990	920	333	1 253
1992	935	341	1 276	935	341	1 276
1993	1 180	428	1 608	930	351	1 281
1994	1 523	603	2 125	941	358	1 299
1995	2 015	781	2 797	971	375	1 345
1996	2 451	1 001	3 453	1 016	386	1 402
1997	3 003	1 278	4 282	1 048	400	1 448
B : Percentage breakdown						
1986	70 %	30 %	100 %	72 %	28 %	100 %
1987	72 %	28 %	100 %	73 %	27 %	100 %
1988	69 %	31 %	100 %	73 %	27 %	100 %
1989	71 %	29 %	100 %	73 %	27 %	100 %
1990	74 %	26 %	100 %	73 %	27 %	100 %
1991	74 %	26 %	100 %	73 %	27 %	100 %
1992	73 %	27 %	100 %	73 %	27 %	100 %
1993	73 %	27 %	100 %	73 %	27 %	100 %
1994	72 %	28 %	100 %	72 %	28 %	100 %
1995	72 %	28 %	100 %	72 %	28 %	100 %
1996	71 %	29 %	100 %	72 %	28 %	100 %
1997	70 %	30 %	100 %	72 %	28 %	100 %

Source: Macmod data file and Bank of Tanzania web site.

Table A4 Implied GDP price deflators

Year	Index value (Base 1992 = 100)			Annual % pa price increases		
	Monetary	Non-Mon.	Total	Monetary	Non-Mon.	Total
1986	0,218	0,240	0,224	NA	NA	NA
1987	0,278	0,295	0,282	27,3 %	23,1 %	26,0 %
1988	0,395	0,481	0,418	42,2 %	63,1 %	48,1 %
1989	0,496	0,537	0,507	25,6 %	11,6 %	21,3 %
1990	0,627	0,613	0,623	26,4 %	14,2 %	22,9 %
1991	0,793	0,780	0,790	26,5 %	27,2 %	26,7 %
1992	1,000	1,000	1,000	26,1 %	28,2 %	26,6 %
1993	1,270	1,217	1,255	27,0 %	21,7 %	25,5 %
1994	1,619	1,681	1,636	27,5 %	38,2 %	30,4 %
1995	2,076	2,086	2,079	28,2 %	24,0 %	27,1 %
1996	2,414	2,593	2,463	16,2 %	24,3 %	18,5 %
1997	2,865	3,196	2,957	18,7 %	23,3 %	20,0 %

Source: Based on the data of table A3.

Table A5: The macro budget

Year	Supply components		Total supply (& demand)	Demand components						Errors and omissions
	GDP at market price	Imports		Private consumpt.	Gov. consumpt.	Private investments	Gov. investments	Exports	Change in stocks	
	A : Absolute values, at constant 1992 prices, TZS'billion									
1987	1 154	481	1 635	952	229	302	23	120	3	6
1988	1 201	477	1 678	987	250	230	21	131	3	56
1989	1 246	491	1 737	1 032	224	237	13	140	4	89
1990	1 334	507	1 841	1 110	237	324	12	155	4	-1
1991	1 362	517	1 879	1 131	273	354	23	139	4	-44
1992	1 370	539	1 909	1 133	269	335	34	170	4	-37
1993	1 386	601	1 988	1 154	239	286	42	221	4	43
1994	1 408	575	1 983	1 172	220	294	37	247	4	9
1995	1 458	610	2 069	1 223	203	269	13	328	4	30
1996	1 525	561	2 086	1 278	169	264	10	329	4	32
1997	1 578	403	1 981	1 310	135	252	23	247	4	10
	B : Percentage distribution									
1987	71 %	29 %	100 %	58 %	14 %	18 %	1 %	7 %	0 %	0 %
1988	72 %	28 %	100 %	59 %	15 %	14 %	1 %	8 %	0 %	3 %
1989	72 %	28 %	100 %	59 %	13 %	14 %	1 %	8 %	0 %	5 %
1990	72 %	28 %	100 %	60 %	13 %	18 %	1 %	8 %	0 %	0 %
1991	72 %	28 %	100 %	60 %	15 %	19 %	1 %	7 %	0 %	-2 %
1992	72 %	28 %	100 %	59 %	14 %	18 %	2 %	9 %	0 %	-2 %
1993	70 %	30 %	100 %	58 %	12 %	14 %	2 %	11 %	0 %	2 %
1994	71 %	29 %	100 %	59 %	11 %	15 %	2 %	12 %	0 %	0 %
1995	71 %	29 %	100 %	59 %	10 %	13 %	1 %	16 %	0 %	1 %
1996	73 %	27 %	100 %	61 %	8 %	13 %	0 %	16 %	0 %	2 %
1997	80 %	20 %	100 %	66 %	7 %	13 %	1 %	12 %	0 %	0 %

Source: Macmod data file