

IMPACT OF FISCAL POLICY ON THE REAL EXCHANGE RATE: ANECDOTAL EVIDENCE FROM TANZANIA

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In macroeconomic theory of open economies, it is argued that an adverse fiscal imbalance results into a higher real interest rate. In turn the higher real interest rate reduces net foreign investment and that this leads to an appreciation of the domestic currency. This study is a preliminary empirical investigation of the extent to which the budget deficit in Tanzania has had any relationship with the real interest rate and the real exchange rate.

After analysing relevant data covering almost three decades beginning in 1968, the study finds no evidence to support the above theory. Further empirical work remains to be done in order to establish the link between a budget deficit and movements in the real exchange rate for a small but open economy such as Tanzania. Only in this way can one justify the prevailing concerns among policy makers in Tanzania over the need to eliminate the budget deficit due to its alleged adverse effect on other macro-economic indicators.

INTRODUCTION

The real exchange rate in Tanzania, as measured against the US dollar, appreciated from 1968 to 1985 when it began its downturn trend until it reached its record low in 1993 (see Table 1). On the other hand, for nearly three decades (between 1970 and 1997) the Tanzania Government has had an unfavourable fiscal balance annually except during fiscal year 1996/97. This unfavourable balance has so much been fluctuating during the period under consideration. For example in 1980, the budget deficit as a percentage of GDP amounted to 13.5 whereas in 1996 it amounted to only 0.5 percent of GDP.

A budget deficit can be shown to force up the interest rate, and in this way result into the often-talked about 'crowding out' effects.² But there is another adverse effect of a budget deficit. By raising the interest rate a budget deficit may cause an unfavourable change in the real exchange rate. Rising domestic interest rates cause foreigners to increase their demand for domestic assets. Since these have to be bought using the domestic currency, an appreciation of the domestic currency may result. On the other hand, a budget deficit that is financed through money creation does also have an impact on the real exchange rate through increasing the supply of the domestic currency. In short, budget

deficits are generally thought of as having a major influence on economic performance (see Burdekin and Langdama, 1992). It is thus not uncommon for international financial institutions to advise governments in the third world against deficit financing of public expenditure. Sound macroeconomic management is in this sense equated to the ability of a given government to limit public spending to levels that can be supported by non-borrowing revenue sources.

This paper examines the long-trend in the real exchange rate in Tanzania, with particular reference to the relationship between the US dollar and the Tanzanian shilling. In so doing it seeks to test empirically the relationship between movements in the budget deficit and those in the real exchange rate in Tanzania during an almost three-decade period spanning between 1970 and 1997.

The paper begins with an exposition of the theoretical link between movements in the real exchange rate and an adverse fiscal imbalance. Then it briefly surveys the empirical studies conducted on the relationship between budget deficits and exchange rates, before explaining the method of calculating the real exchange rate. Then it explains the statistical manipulations carried out on the available data, presents the results of those manipulations and makes some inferences on the basis of the results. A brief concluding note ends the paper while movements in the fiscal balance in Tanzania as well as the necessary variables for the calculation of the real exchange rate such as interest and inflation rates are documented in the Appendices.

Theoretical Framework

The conceptual relationship that exists between the real exchange rate and an adverse fiscal

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² A detailed discussion of the contentious issue of the relationship between interest rates and budget deficits is given in Gupta and Mozzani (1996: chapter 6).

imbalance has been articulated in the literature. Mankiw (1997), for example (to whom this paper owes a lot) brings out clearly and simply the gist of the theoretical link between the two. He argues that one needs to look at two markets simultaneously. The market for loanable funds where supply comes from national savings (S); and demand comes from domestic investment (I), as well as net foreign investment (NFI). Net foreign investment is in this sense a part of demand because a person who invests abroad needs to borrow from the market for loanable funds. Equilibrium in this market is represented by equation (1), with the interest rate balancing supply and demand.

$$S = I + NFI \dots \dots \dots (1)$$

The second market is that for foreign currency. In this market supply comes from net foreign investment (NFI) in that anyone wanting to buy a foreign asset must first supply the domestic currency in exchange for foreign currency. Demand comes from net exports (NX) since non-residents wanting to buy domestic assets must first acquire the domestic currency. In this second market, the exchange rate balances supply and demand, with equilibrium being represented by equation (2).

$$NFI = NX \dots \dots \dots (2)$$

A budget deficit reduces national savings in the first market i.e. market for loanable funds. It follows that a budget deficit must push the interest rate up in order to equate demand and supply in this particular market. Apart from the reduction of investments due to an increased interest rate, in an open economy, there is another effect. As domestic assets yield more than foreign assets due to an increase in the interest rate, investors tend to invest domestically rather than abroad thus causing a reduction in net foreign investment. Since in the second market, i.e. the market for foreign currency, the source of supply (for the domestic currency) is net foreign investment, its reduction results into an appreciation of the domestic currency so as to clear the market (see also Langdana, 1990).

Budget Deficits and the Exchange Rate

In line with the above theoretical intuitions, one should expect the existence of an unambiguous

relationship between movements in the real exchange rate and changes in the level of the budget deficit in a given country. This means that fiscal policies can affect the real exchange rate to the extent that such policies are either financed through money creation or have an impact on the demand for money. The case of hyperinflation in the Germany of the 1920s is often cited as an illustration of the former. As the government printed more money to finance its deficit, the increase in money supply led to a hike led to in the price level and at the same time the mark depreciated considerably (see for example, Mussa, 1978).

As another example, the overvaluation of the US dollar in the early 1980s is considered to have had a strong correlation with the fiscal policy of the time i.e. low taxation and unrestrained public spending (see Bergsten, 1982 and Williamson, 1985). Frankel (1993) attributes this phenomenon to the increase in the US real interest rate relative to foreign real interest rates. He holds that two reasons explain this real interest rate differential one of them being 'the emergence of record federal budget deficits that were a source of growing concern' at the period. As regards to this, Mankiw (1997) points out that the model expressed by equation (1) and equation (2) is consistent with what happened in the US during the early 1980s. As budget deficits became the norm, national savings were reduced resulting into a fall in net foreign investment of 2.0 GDP percentage points. Statistics for the period show that between 1981 and 1993, net foreign investment in the US fell from 12.3 percent of GDP to negative 8.8 percent of GDP. As per equation (2) negative foreign investment implies a trade deficit and this is actually what happened in the US then, with the expression 'twin deficits' becoming commonly associated with the US economy.

On what transpired in the US, Feldstein (1986) presents empirical evidence in support of the theory that the budget deficits resulted into a strengthening of the dollar. He uses data for the period between 1973 and 1984 to regress the real exchange rate between the dollar and the German mark and finds a strong and robust effect of the budget deficit on the real exchange rate.

Nakibullah (1993) too finds evidence to support the above conventional view. He uses four different measures of the budget deficit in

the US between 1974 and 1989 and finds each to be positively correlated with the real exchange rate.³ However he builds an alternative model to explain this correlation. He shows that both phenomena i.e. the occurrence of huge budget deficits and the appreciation of the dollar, could as well be explained by some other underlying economic shocks such as monetary and/or output shock.

In Tanzania, the government has for years tried to eliminate its fiscal imbalance as one way of achieving macroeconomic stability. According to BOT (1997: p. 55), stability in the value of the Tanzanian shilling is 'the foundation stone for a sustained high quality and broad based economic progress.' In this regard, the target is to pursue tight monetary policies that will reduce inflation to a single digit without at the same time causing a very high increase in the interest rate. This can only be achieved if the fiscal policy stance of eliminating the budget deficit is maintained. Thus for several years now, the Tanzania Government has been vigorously undertaking measures geared at reducing public expenditure and increasing tax revenues. For several fiscal years now, for example, the Government has been struggling to try and limit the level of the budget deficit at a maximum of a given percentage of GDP. Is this serious concern over the level of the budget deficit really warranted, and is the size of the budget deficit *per se*, such a useful guide to macro-economic policy making? To our knowledge, no work has so far been done to test the empirical validity of this theoretical link between the budget deficit and other macro-economic variables such as the real value of the shilling and the level of real interest rates.

Measuring the Real Exchange Rate

The nominal exchange rate is the rate at which one person can trade the currency of one country for the currency of another. For the purpose of this paper, this is the rate at which one can exchange Tanzanian shillings for on US dollar. On the other hand the real exchange rate is that rate at which one person can trade goods and services of one country for those of another. In this case it is the rate at which Tanzania commodities can be exchanged for US commodities.

If, for example, a can of Tanzanian beer sells at TZS 500, and a can of American beer sells at \$ 0.8, the real exchange rate between Tanzanian beer and American beer can be easily computed assuming perfect substitutability of the two beers.

$$\begin{aligned} \text{American beer} &= \$ 0.8 \\ \text{Tanzanian beer} &= \text{TZS } 500 \end{aligned}$$

Since we are assuming American beer to be equivalent to Tanzanian beer, TZS 500 must also be equivalent to \$ 0.8. This gives a real exchange rate of TZS 625 per dollar.

The nominal and the real exchange rates are very closely related. Supposing that the nominal exchange rate is TZS 700 per \$ 1, the real exchange rate of TZS 625 per one dollar can be arrived at as follows. First convert the prices of the two beers into one currency, say the shilling, and then multiply the nominal exchange rate by the domestic price divided by the foreign price as per equation (3).

$$\psi \frac{(e \times P)}{P^*} \dots\dots\dots (3)$$

Where ψ and e stand respectively for the real and the nominal exchange rates, and P and P^* represent the domestic and the foreign prices of beer respectively. From macroeconomic viewpoint however, P and P^* must represent the prices of whole baskets of commodities in the domestic and the foreign country. It is thus common to use some price index when computing the real exchange rate of a country.⁴

In this paper, one of the simplest economic models for the determination of the real exchange rate is used. This model is known as purchasing-power parity (PPP), and it is based on the logic that a unit of any given currency should be able to buy the same quantity of commodities in all countries. In case a unit of one currency bought more in one country than in another, through arbitrage, the price of the commodity in question in the former country would go up whereas in the latter, such price

³ An increase in budget deficit increases the value of domestic currency and vice versa.

⁴ It is important to recognise that there is a body of literature on the merits and demerits of one price index against another. Whereas some works suggest the use of the consumer price index, others prefer the whole sale price index. Yet others favour the GNP deflator (see for example Wood, 1988).

would go down, until equilibrium is attained. Despite some limitations of this model,⁵ many economists believe that purchasing-power parity describes the forces that determine exchange rates in the long run (see Mankiw, 1997). In this case therefore, the nominal exchange rate between the currencies of two countries is supposed to reflect the price levels in those countries.

Trends in Exchange Rate, Interest Rate and Fiscal Balances

Table 1 shows movements in the real exchange rate between the US dollar and the shilling as well as the fiscal balance in Tanzania as a percentage of GDP during 1970 to 1998. The real exchange rate has ranged from TZS 28.5 per one US dollar to TZS 141.4 per one US dollar within the period in question. As for the budget deficit expressed as a proportion of GDP, the lowest in this period was achieved in 1996 at 0.4 percent, with the highest in 1980 at 13.4 percent.

b) Figures for GDP for up to 1994 are as reported by the Bureau of Statistics. This same source does also provide fiscal balances, which are computed as being equal to the amount of government borrowing. GDP and fiscal balance figures are those reported by the Bank of Tanzania.

Table 2 documents side by side the changes in the two economic variables of the interest rate and the fiscal balance during the 20 years for which data is available. During this period the highest interest rate in real occurred in 1995 when it reached 13 percent. The real interest rate was lowest at -23.3 in 1984.

Table 1: *The Real Exchange Rate and the Fiscal Balance as a Percentage of GDP*

Year	Fiscal Balance	Exchange Rate	Year	Fiscal Balance	Exchange Rate	Year	Fiscal Balance	Exchange Rate
1968	N/A	N/A	1979	-12.4	44.0	1990	-6.2	113.4
1969	N/A	N/A	1980	-13.4	38.1	1991	-7.1	108.6
1970	-4.3	55.2	1981	-9.3	34.0	1992	-8.3	124.5
1971	-5.9	54.9	1982	-9.0	31.3	1993	-8.2	141.4
1972	-6.0	52.3	1983	-9.5	30.4	1994	-7.4	136.1
1973	-6.4	49.8	1984	6.2	32.1	1995	-3.5	121.6
1974	-8.4	46.7	1985	-5.1	28.5	1996	-0.4	107.4
1975	-10.9	42.2	1986	-5.0	40.9	1997	2.4	97.9
1976	-6.6	47.3	1987	-2.4	64.3			
1977	-8.1	44.7	1988	-6.7	78.7			
1978	-5.4	41.7	1989	-7.7	94.7			

Source: Appendices I and III

The above variables were obtained as follows:

a) Nominal exchange rates and figures for the Consumer Price Index, CPI, are taken from World Bank Data Series 1995, except those for after 1993, which come from various sources as indicated in the Appendix I.

⁵ The existence of non-tradable commodities is one such serious limitations of purchasing-power parity. For such commodities consumers in one country have to move to the country where they are cheaper and this is in most cases impracticable. Even in the case of those commodities that are tradable, it may so happen that they are not perfect substitutes with their foreign counterparts.

Table 2: *The Real Interest Rate and the Fiscal Balance as a Percentage of GDP*

Year	Fiscal Balance	Interest Rate	Year	Fiscal Balance	Interest Rate
1980	-13.4	-19.6	1990	-6.2	10.3
1981	-9.3	-13.0	1991	-7.1	7.7
1982	-9.0	-17.2	1992	-8.3	7.9
1983	-9.5	-16.6	1993	-8.2	7.5
1984	-6.2	-23.3	1994	-7.4	4.9
1985	-5.1	-21.0	1995	-3.5	13.0
1986	-5.0	-14.0	1996	-0.4	17.6
1987	-2.4	-2.4	1997	2.4	9.1
1988	-6.7	-2.5			
1989	-7.7	-5.2			

Source: appendix ii

Results and Inferences

Chart 1 is a scatter diagram that compares, for the period between 1968 and 1999, the real exchange rate with the fiscal balance as a percentage of GDP. It shows visual evidence of the lack of correlation between the real exchange rate and the size of the fiscal balance.

In order to confirm the lack of visual correlation some more formal statistical analysis was carried out. The sample correlation, r , and the coefficient of determination, R^2 , were calculated in order to assess the strength of the correlation between the real exchange rate and the fiscal balance (see Appendix IV). The numerical values for the above statistics turned out to be:

$$r = 0.02748; \text{ and } R^2 = 0.04\%$$

It can be inferred from the above results that, for the time under review, no linear relationship exists between the two macro-economic variables. The fact that the sample correlation is fairly close to zero implies lack of evidence to support the theory of a direct relationship between the exchange rate and the budget deficit. This conclusion is corroborated by the very low figure for the coefficient of determination, implying the inappropriateness of a least squares line for these empirical data.

As confirmation of the above contradiction between theory and reality, similar statistical analyses were undertaken for the real interest rate and the fiscal balance.

Chart 1: Fiscal Balance as % age of GDP and the Real Exchange Rate

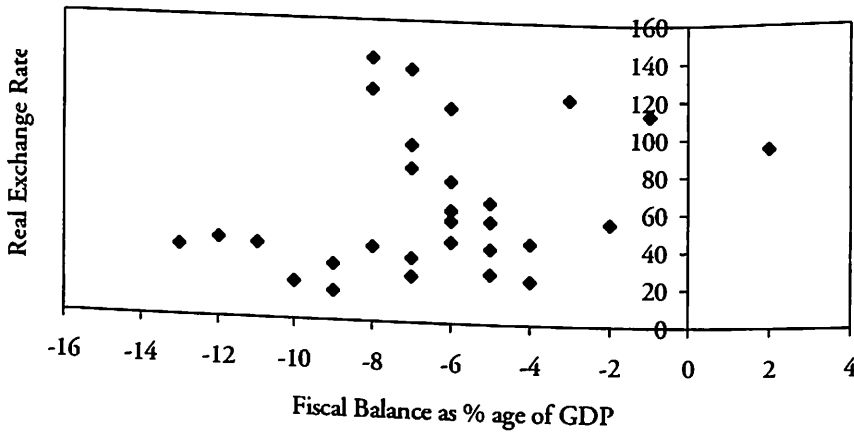
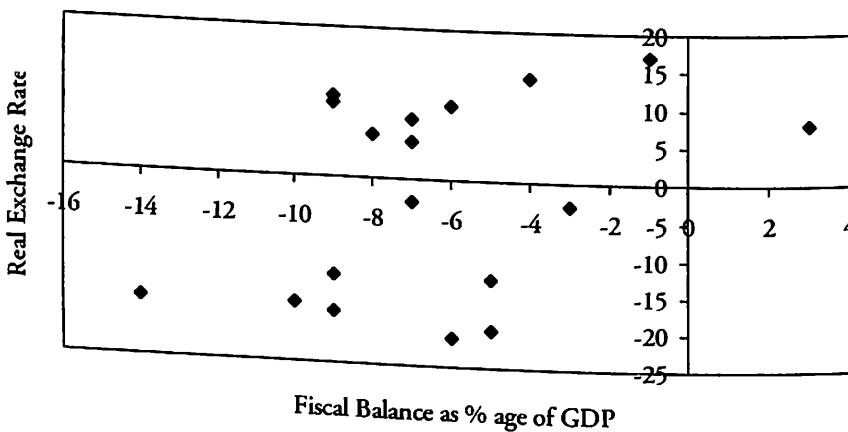


Chart 2: Fiscal Balance as % age of GDP and the Real Exchange Rate



After all, it is through its impact on the interest rate that the budget deficit is supposed to affect the exchange rate. From the scatter diagram shown as chart 2, it is difficult to visualise a linear relationship between the fiscal balances and the real interest rate over the 20-year period for which data is available. In this case the sample correlation, r , and the coefficient of determination, R^2 , according to Appendix IV becomes:

$$r = 0.473657; \text{ and } R^2 = 25\%$$

CONCLUSION

It has been shown that no linear relationship existed between the real exchange rate and the budget deficit in Tanzania during the past three decades. Data for nearly two decades suggest the existence of a very weak relationship between the real interest rate and the fiscal balance. In practice, however, a deficit is said to raise borrowing costs i.e. the interest rate. The effect of a higher interest rate is a reduction in net foreign investment through the attraction of investors, both foreign and domestic, who seek to exploit the higher yield resulting from the domestic-foreign interest rate differential.

This kind of framework for analysis presupposes a number of other factors that may be non-existent in Tanzania. First, if deficit financing is to raise the domestic interest rate, the deficit must also be financed domestically. In the case where the deficit is financed through external borrowing, the results of this investigation should not be so surprising. When one speaks against deficit financing of government expenditure on the basis of adverse effects on the real exchange rate, it is important to distinguish between external and internal financing. In this regard, more work remains in order to identify the extent to which the deficit in Tanzania has been internally financed.

Secondly, there is a need to acknowledge the limitations of purchasing power parity as a theory for exchange rate determination. In this study, the exchange rate between the Tanzanian shilling and the US dollar was equated to the Tanzania foreign exchange rate. However, it can be shown that baskets of goods that are used to measure the Consumer Price Index, (CPI), in Tanzania and that used in the US contain some goods that are not internationally traded. In addition, even some traded goods cannot be said to be perfect substitutes. There is thus the possibility that the real exchange rate computed in this work could

turn out to be far from the actual real exchange rate between the dollar and the shilling.

In view of the above one definite conclusion is obvious. The direct theoretical linkage between fiscal policy and the real exchange rate through the real interest rate may not be so direct after all. Despite Tanzania running deficits for almost three decades, there is no clear-cut pattern to suggest co-movements of these macroeconomic indicator. Deficit financing should thus not always be construed negatively, purely on the basis of its impact on the exchange and interest rates. Further empirical work remains to be done to determine the conditions under which a budget deficit in Tanzania may adversely affect these other two macro-economic aggregates.

REFERENCE

- Bank of Tanzania, (1997)
Economic and Operations Report for the Year Ended 30th June, 1997.
- Bergsten, Fred, et al. (1982)
From Rambouillet to Versailles: A Symposium. Essays in International Finance no. 149. Princeton, N.J.: Princeton University.
- Burdekin, Richard C.K. and Farrokh K. Langdana (1992)
Budget Deficits and Economic Performance, London: Routledge.
- Feldstein, Martin (1968)
"The Budget Deficit and the Dollar," in *NBER Macroeconomics Annual*, edited by Stanley Fischer. Cambridge, MA: MIT Press, pp. 355-92.
- Frankel, Jeffrey (1993)
On Exchange Rates. Massachusetts: MIT Press.
- Gupta, Kanhaya L. and Bakhtiar Moazzani (1996)
Interest Rates and Budget Deficits. London: Routledge.
- Landana, Farrokh K. (1990)
Sustaining Budget Deficits in Open Economies. London: Routledge.
- Mankiw, Gregory (1997)
Principles of Macroeconomics. Orlando: The Dryden Press.
- Mussa, Michael (1978)
"The Exchange Rate, the Balance of Payments, and Monetary and Fiscal Policy under a regime of Controlled Floating" in Frankel, J. and H. Johnson (eds.), *The Economics of Exchange Rates: Selected Studies*. Massachusetts: Addison-Wesley.
- Nakibullah, Ashraf (1993)
"Comovements of Budget Deficits, Exchange Rates and Outputs of Traded and Non-traded Goods," *Economic Inquiry* 31(2), pp. 298-313.
- Williamson, John (1985)
The Exchange Rate System. Policy Analyses in International Economics no. 5 Washington, D.C.: Institute for International Economics.
- Wood, Adrian (1988)
Global Trends in Real Exchange Rates, 1960 to 1984. World Bank Discussion Papers no. 35. Washington D.C.: The World Bank.

Appendix I: Computation Of The Real Exchange Rate (1987 = 100)

Year	Nominal Exchange Rate	CPI in Tanzania	CPI in US	Real Exchange Rate
1968	7.1	3.7	30.6	58.7
1969	7.1	4.3	32.2	53.2
1970	7.1	4.4	34.2	55.2
1971	7.1	4.6	35.6	54.9
1972	7.1	5.0	36.8	52.3
1973	7.0	5.5	39.1	49.8
1974	7.1	6.6	43.4	46.7
1975	7.4	8.3	47.3	42.2
1976	8.4	8.9	50.1	47.3
1977	8.3	9.9	53.3	44.7
1978	7.7	10.6	57.4	41.7
1979	8.2	11.9	63.8	44.0
1980	8.2	15.6	72.5	38.1
1981	8.3	19.5	79.9	34.0
1982	9.3	25.2	84.9	31.3
1983	11.1	32.0	87.6	30.4
1984	15.3	43.6	91.4	32.1
1985	17.5	58.1	94.6	28.5
1986	32.7	77.0	96.4	40.9
1987	64.3	100.0	100.0	64.3
1988	99.3	131.2	104.0	78.7
1989	143.4	165.1	109.0	94.7
1990	195.1	197.6	114.9	113.4
1991	219.2	241.7	119.8	108.6
1992	297.7	295.0	123.4	124.5
1993	405.3	364.3	127.1	141.4
1994	510.0	488.5	130.4	136.1
1995	575.0	634.1	134.1	121.6
1996	590.0	758.4	138.0	107.4
1997	617.0	894.9	142.0	97.9

* Figures after 1993 are calculated from the Economist Intelligence Unit, various reports. All other figures are from the World Bank Data Series 1995.

Appendix II: Calculation of the Real Interest Rate

Year	Nominal Interest Rate	Inflation Rate	Real Interest Rate
1980	11.5	31.1	-19.6
1981	12.0	25.0	-13.0
1982	12.0	29.2	-17.2
1983	10.4	27.0	-16.6
1984	13.0	36.3	-23.3
1985	12.3	33.3	-21.0
1986	18.5	32.5	-14.0
1987	27.5	29.9	-2.4
1988	29.6	32.1	-2.5
1989	31.0	25.8	5.2
1990	30.0*	19.7	10.3
1991	30.0*	22.3	7.7
1992	30.0*	22.1	7.9
1993	31.0	23.5	7.5
1994	39.0	34.1	4.9
1995	42.8	29.8	13.0
1996	37.2	19.6	17.6
1997	27.1*	18.0	9.1

SOURCE: Figures for nominal interest rates are from International Financial Statistics Yearbooks (various years); The inflation rate is computed from CPI figures in Appendix A.

* Author's estimate as no actual figures could be obtained.
* Average short-term lending interest rate in June, 1997 {as per BOT, 1997 (p. 12)}

Note:

Nominal interest rates represent annual average lending rates charged by commercial banks on general purpose loans.

Appendix III: GDP and Budget Deficits

Year	GDP (at factor cost) 000,000 Tshs.	Budget % of GD	Balance Tshs (Milins)
1970	8,215	-4.3	-353
1971	8,857	-5.9	-520
1972	10,032	-6.0	-602
1973	11,490	-6.4	-736
1974	14,010	-8.4	-1,184
1975	16,988	-10.9	-1,857
1976	22,109	-6.6	-1,470
1977	26,146	-8.1	-2,113
1978	29,798	-5.4	-1,595
1979	35,141	-12.4	-4,373
1980	37,564	-13.4	-5,048
1981	46,557	-9.3	-4,310
1982	56,247	-9.0	-5,048
1983	61,621	-9.5	-5,828
1984	74,643	-6.2	-4,607
1985	101,684	-5.1	-5,168
1986	135,493	-5.0	-6,827
1987	186,544	-2.4	-4,429
1988	330,260	-6.7	-22,026
1989	515,825	-7.7	-39,577
1990	671,742	-6.2	-41,807
1991	825,825	-7.1	-58,927
1992	1,007,576	-8.3	-83,830
1993	1,332,813	-8.2	-108,845
1994	1,731,447	-7.4	-127,933
1995	2,130,554	-3.5	-75,120
1996	3,317,634	-0.4	-13,777
1997	3,620,790	2.4	86,290

Source: GDP and fiscal balance figures all come from the Tanzania Bureau of Statistics (BOS, 1995), with the exception of figures for the years after 1994, which come from the Bank of Tanzania (BOT, 1997).

Appendix iv: Statistical Manipulations of Data

1. Correlation between the fiscal balance, X , (as % age of GDP) and the real exchange rate, Y is ρ and here it is assumed that the sample correlation, r , is an estimate of ρ . Using the data of fiscal balances as percentages of GDP given in Appendix C, as X ; and real exchange rates given in Appendix A, as Y ; the following are the results which were obtained.

$$\sum X = -1.746 \quad \sum X^2 = 0.186061 \quad \sum Y = 1.902.7$$

$$\sum Y^2 = 165,048.3 \quad \sum XY = -117.557 \quad (\sum X)^2 = 3.048516$$

$$(\sum Y)^2 = 3,620,267.29 \quad \sum X \sum Y = -3,322.1142 \quad n=28$$

$$S_{xx} = \sum X^2 - (\sum X)^2 / n = 0.077185$$

$$S_{yy} = \sum Y^2 - (\sum Y)^2 / n = 35,753,03964$$

$$S_{xy} = \sum XY - \sum X \sum Y / n = 1.0899357$$

$$r = S_{xy} / S_{xx} S_{yy}$$

$$r = 0.020748$$

$$R^2 = 0.04\%$$

2. Correlation between the fiscal balances, X, (as a % age of GDP) and the real interest rate, i , is ρ and here it is assumed that the sample correlation, r_i , is an estimate of ρ . Using the data of fiscal balances as percentages of GDP in Appendix C, as X; and real interest rates given in Appendix B, as i ; the following results were obtained:

$$\sum X = -1.13 \quad \sum X^2 = 0.09356 \quad \sum i = -0.464$$

$$\sum i^2 = 0.321312 \quad \sum Xi = 0.068751 \quad (\sum X)^2 = 1.2769$$

$$(\sum i)^2 = 0.215296 \quad \sum X \sum i = 0.52432 \quad n = 18$$

$$S_{xx} = \sum X^2 - (\sum X)^2 / n = 0.02262$$

$$S_{ii} = \sum i^2 - (\sum i)^2 / n = 0.309351$$

$$S_{Xi} = \sum Xi - \sum X \sum i / n = 0.039622$$

$$r_i = S_{xi} / \sqrt{S_{xx} S_{ii}}$$

$$r_i = 0.473657$$

$$R_i^2 = 22.44\%$$