Exchange rate regimes and inflation in Tanzania

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BOT	Bank of Tanzania
ERP	Economic Recovery Programme
ESAP	Economic and Social Action Programme
IFEM	Inter-bank foreign exchange market
IFIs	International financial institutions – especially IMF and World Bank
IMF	International Monetary Fund
NESP	National Economic Survival Programme
NPC	National Price Commission
OGL	Open general licence
PRS	Poverty reduction strategy
SAP	Structural adjustment programme
UNECA	United Nations Economic Commission for Africa
URT	United Republic of Tanzania

Acknowledgements

Abstract

The study examines the influence of the major determinants of inflation with a particular focus on the role of exchange rate policy changes. The gradual change in policy orientation from "controls" to "market" in Tanzania is associated with a change from a highly controlled exchange rate (until 1985) to a more liberalized regime from 1986 to the present (2002). The parallel exchange rate dominated price changes from the late 1970s to 1985; the parallel premium tapered off gradually from 1986, almost disappearing by 1992. The problem of inflation cuts across both regimes despite improvements in the past four to five years. The model estimations using quarterly data for 1967–1995 show that the parallel rate had a stronger influence on inflation up until the early 1990s compared with the official rate. Continued macroeconomic (tighter monetary and fiscal), trade and exchange rate reforms, and slow but steady improvements in the growth rates of GDP, may explain the recent (1993–2002) fall in inflation and a more "stable" market for foreign exchange in the inter-bank foreign exchange market (IFEM) arrangement. The charged debates of the 1980s about devaluation are no longer fashionable, but the exchange rate remains potentially sensitive to exogenous shocks and certainly any policy reversal or similar lapse.

1. Introduction

Inflation and exchange rates are two of the key "barometers" of economic performance, indicating growth (output), demand conditions, and the levels and trends in monetary and fiscal policy stance. Exchange rate policy emerged as one of the controversial policy instruments in developing countries in the 1980s, with vehement opposition to devaluation for fear of its inflationary impact, among other effects. Tanzania faced such a situation and there has been interest, therefore, in inflation performance and the role of the exchange rate in the process. At all times, even when the rate of inflation seems to be low, authorities have to keep an eye on the different factors that may easily trigger a rise in inflation and erode the value of money holdings, trade flows, investor confidence, etc.

Tanzania recorded single-digit annual rates of inflation for a few years in the 1960s and early 1970s. Towards the end of the 1970s, however, the economy, pursuing socialist principles (since 1967), experienced severe economic strains – including acute shortages of foreign exchange and goods, rising inflation, and strong parallel markets in goods and foreign exchange. The severity of Tanzania's inflation can be seen from the unbroken sequence of annual rates ranging from 21% to 36% between 1980 and 1995. At 21% in 1996, the annual inflation rate was well above the targeted low of 5%. For most of the period until the late 1980s, economic management was oriented towards "controls" by the state. The controls covered prices (including wages, goods prices, interest rates and exchange rates) and allocation of domestic credit and foreign exchange. Amidst the ensuing control-related tensions, the exchange rate became prominent in the policy debate on the internal and external imbalances that the country experienced from the end of the 1970s. It was noted that despite these imbalances (rising inflation, shortages, dwindling foreign exchange reserves and pressure on the exchange rate), action on the exchange rate was resisted or only sparsely adopted.

From the mid 1980s the state initiated macroeconomic reforms including devaluations. The official exchange rate depreciated fast and the parallel premium fell, but by 1994 inflation still stood at 33.1%. Although inflation continued to fall during the second half of the 1990s, reaching single digits in 1999 (at 7.9%) and 4.6% in 2002, authorities have to keep a close watch over the related policies so as to avert a possible slip back. In any case, the inflation rate is still above that of major (mainly Western European) trading partners.

This study set out to examine the influence of the major determinants of inflation with a particular focus on the role of the exchange rate and related macroeconomic policies. The motivation for the study derives from the marked change in macroeconomic policy orientation – from "controls" to "market" – on the one hand, and the controversy

about the relative role of exchange rates in the discussions of structural adjustment and stabilization in the developing countries in the 1980s and 1990s, on the other. In Tanzania, the parallel market for foreign exchange (and the parallel exchange rate) continued to be a notorious menace to macroeconomic management. A series of exchange rate actions and monetary and fiscal policy adjustments led to exchange rate unification (in 1993). Until then, the parallel exchange rate had an upper hand on the rate of inflation compared with the official exchange rate, explained by the existence of controls. However, the model estimations, using quarterly data between 1967 and 1995, indicate that across the period of model estimations the official exchange rate had a slight edge over the parallel rate.

As regards the exchange rates, the break around 1985/86 indicates that two major exchange rate regimes can be identified and associated with the macroeconomic policy phases. Up to 1985 the exchange rate was highly controlled. From 1986 to 1995 (to the present),[2] the gradual exchange rate and trade liberalization resulted in diminishing parallel markets and a relatively more "stable" market for foreign exchange.

Ongoing policy initiatives for more efficient revenue collection, prudent cuts in government spending and the development of the Treasury Bills market are considered to be right steps towards reduction in the fiscal deficits and control of money supply. Slow but steady improvements in growth rates of GDP also contributed to slowdown of inflation in the second half of the 1990s. The spread between the official (IFEM) and mean bureau rates (officially recognized since April 1992) shrank significantly over most of the 1990s, signifying reduction in the illegal parallel market. It is proposed that the current institutional arrangements for a liberalized exchange rate regime be strengthened.

The structure of the report is as follows: Section 2 briefly picks from literature issues on the role of exchange rates in structural adjustment and stabilization in the developing countries and in Tanzania. Section 3 presents a macroeconomic background to the problem and outlines the model. Section 4 presents estimation procedures and results, while Section 5 discusses the results and Section 6 draws conclusions and policy implications.

2. Literature review

Afew issues are prominent from literature about the relative roles of exchange rate regimes in the wake of structural adjustment and stabilization in developing countries. The first centres on the problem of assigning weight between two apparently conflicting functions of the exchange rate:
* Its effect on the international competitiveness of a country's tradeables (adjustment), usually linked to a flexible, pro-export exchange rate regime; and
* Its function as a nominal anchor for low inflation (stabilization), often linked to a fixed exchange rate regime (Kiguel, 1992; Edwards, 1993).

Second, there is a view that the primary cause of inflation in developing countries is the recourse to money creation in the face of limited borrowing to finance large fiscal deficits – the "public finance view" of inflation (Agenor and Montiel, 1996; Rebelo and Vegh, 1995). Contrasting with this is yet another view that currency devaluations associated with structural adjustment in the 1980s constituted one of the major causes of inflation (see, for example, UNECA, 1989, 1993).This latter view barely admits to the effects of varying degrees of price controls, parallel markets, financial repression and macroeconomic imbalances arising from fiscal deficits.

Empirical results regarding the inflationary effect of official exchange rate depreciation in cross-country and individual country studies are also conflicting. For example, Canetti and Greene (1992), studying a number of African countries, report a failure in their attempt to identify which between exchange rate depreciation and monetary growth is a more important cause of inflation. Chhibber and Shaffik (1992) do not find a direct relationship between official exchange rate changes and inflation in Ghana. According to them, official devaluations had a positive effect on the budget and were therefore anti-inflationary. Their study found that the parallel market exchange rate had a stronger influence on inflation compared with the official exchange rate. However, Sowa and Kwakye (1993) claim that Chhibber and Shafik (1992) emphasize monetary factors at the expense of supply factors in Ghana and conclude that the supply constraint (output) was the main force behind inflation. Hyuha (1992) found that the devaluations of the official exchange rate had a push on domestic prices in Uganda (1985.1–1991.1). The parallel rate was also a significant determinant of inflation. Kasekende and Ssemogerere (1994) reached a similar conclusion for the period 1987–1992, using monthly data.

Such controversies have not been widely explored in the case of Tanzania. Until the mid 1980s, studies on inflation focused largely on structural factors constraining output and macroeconomic policies. Heavy dependence of domestic production on imported

inputs, including oil, contributed to imported and cost-induced inflation (e.g., D. Rwegasira,1974; K. Rwegasira and Kanneworff, 1982). Fiscal deficits as a cause of inflation have been noted (Collier and Gunning, 1991; Kilindo, 1992). A weak tax base, government overspending, parastatal inefficiencies and a large public bureaucracy amplified the deficits in Tanzania (Lipumba, 1984). Ndulu and Hyuha (1990) analyse the effects of the 1986 devaluation, concluding that the parallel exchange rate was making a considerable impact on domestic prices. Camen (1994) investigates the determinants of inflation, among which the respective roles of official and parallel exchange rates are examined. Covering the period 1971–1992, Camen finds that the official exchange rate had less influence on inflation than the parallel rate.

It may be inferred that the impact of the exchange rates – official or unofficial (parallel/black) – depends on the level and application of other macroeconomic policies and the pace of institutional reforms. In the case of Tanzania, most of the studies on inflation cover the period before 1985, which was largely dominated by "controls". Although structural adjustment started in the early 1980s, a big departure from controls began mainly in the 1984/85 budget year. Exchange rate adjustment and ideas of trade liberalization were already generating heated opposition. The few studies that cover the post 1985 period use annual data and emphasize monetary, fiscal and structural factors. While Camen (1994) alludes to the question of exchange rate regime shift, and Ndulu and Hyuha (1990) examine the inflationary impact of the 1986 devaluation (that is, shortly after the launching of the Economic Recovery Programme), no other studies particularly examine regime changes in respect of exchange rate.

The contribution of the present study, therefore, is its analysis of a period long enough into the reform period (since 1985/1986 to 2002) with a view to empirically investigating the inflationary impact of the regime changes and implications for the longer-term objectives of instituting a market-determined exchange rate regime, consistent with price stability and growth. Despite initial resistance, exchange rate policy has been one of the key pillars of adjustment. The study estimated a model of inflation using quarterly data for the period 1967–1995 to show, inter alia, the relative roles of the parallel and official exchange rates over the regime change.

3. Macroeconomic background

The his section outlines a background review of major macroeconomic policies and performance. The study period is broadly divided into two major macroeconomic policy phases: the pre-1985 period and the period from (around) 1986 to the present (2002).

Control regime 1967–1985

The 1967–1985 phase is characterized by the dominance of a state resolved to set up a planned, socialist economy through directive controls – "the control regime" . It also marked by a recession. During the first six years of independence (since 1961), economic policy aimed at higher growth of income through import substitution industrialization (ISI).[4] Private and foreign investment ventures were forthcoming as government offered tariff protection and guarantees against nationalization (Rweyemamu, 1973). This commitment was soon reversed with the launch of the 1967 Arusha Declaration, the socialist blueprint. The control regime began in earnest at this time with nationalizations, expansion of the public sector and use of administrative allocation of resources. Although the economy remained "mixed", the private sector was severely curtailed. Other control instruments designed to foster the public sector in resource allocation included the annual Finance and Credit Plan (begun in 1971/72) and the Foreign Exchange Plan. These were designed to administratively allocate credit and foreign exchange, respectively, thus rendering interest rates and exchange rates less relevant as policy tools.

In the 1960s and up to 1978 there was modest growth of an average annual rate of about 5.4% (Singh, 1986; Bagachwa, 1992). Annual rates of inflation were below 10%, permitting positive increases in real per capita income. But signs of a weakening economy showed up towards the end of the 1970s. The overall annual growth of real GDP declined to an average of 1.3% during 1979–1985, with growth of -0.5% in 1981 and -2.4% in 1983. This compares unfavourably with 3.9% between 1966 and 1975. During this subperiod (1979–1985) real export earnings, already declining from the mid 1960s, fell by 8.4%. although adverse external terms of trade played a role, Lipumba and Ndulu (1989) show that declining volumes of agricultural exports largely caused this poor export performance. Thus, domestic supply constraints played a role in the decline of exports, leading to external debt areas and the lowest foreign reserves during 1980–1985 (Hanak, 1982).

The major policy initiatives to grapple with economic decline between 1979 and 1985 aimed, with little success, to among other things, reduce inflation. In the meantime, a few small exchange rate devaluations were carried out prior to 1986. Exchange rate adjustment may not have been a big issue in the 1960s and early 1970s as there were sufficient foreign reserves. As the external payments increased and government sought external support, however, a call to devalue was made by the International Monetary Fund (IMF); but the government preferred to keep the exchange rate "fixed" or just make small adjustments, relying on administrative, central allocation of foreign exchange. Maintaining an over-valued exchange rate favoured the import substitution industrialization (ISI) strategy at the expense of the agricultural sector and led to a strong rise in the parallel market for foreign exchange. By the mid 1980s, the foreign exchange market proliferated into a number of "windows", a de facto multiple exchange rate system, allowing access to scarce foreign exchange at different effective rates (Table 1).

Table 1: Foreign exchange windows by mid 1980s

Window	Source of foreign exchange	Degree of control	Rate applying
Central Bank free resources	Official export earnings surrendered to Bank of Tanzania, and limited commercial loans	High; by Bank of Tanzania	Official
Import support	Bilateral donor support	High;Treasury with donors.	Official
OGL	World Bank and bilateral donors	Less control, more leaning towards market forces	Official
Export retention	Export proceeds retained by exporters	Low; exporte's own decision	Mainly parallel rate
Own funded imports	Unofficial exports and foreign exchange transactions and private external capital	Low; market forces, dominated by private business	Parallel rate
Project loans and grants	Various commodity exports	High; government with foreign banks	Mainly official
Suppliers' credits	Supplier	Low; involving suppliers and private business	Higher than the parallel rate to cover risk premium

Source: compiled by author from different sources.

On the other hand, there was a marked failure of government to control its spending. The budget deficits that cropped up more prominently beginning 1978/79 continued to deepen.[6] The poor performance of the finance and credit plans was due to lack of financial discipline in the parastatal and government departments.

Reform and recovery: Mid 1980s to the present

The reform period is notable for the economic recovery programmes supported by international financial institutions (IFIs) and donors aiming at raising output growth, bringing down the rate of inflation, restoring external balance and improving social services.[7] Together with these were trade and exchange rate liberalization. These gradually led to a rapid depreciation of the Tanzanian shilling. The ultimate aim was to eliminate the multiplicity of exchange rates (i.e., to unify the foreign exchange market) so as to evolve a market-based exchange rate and thus overcome inefficiencies associated with administrative allocation of foreign exchange. These reforms were backed by institutional reforms, particularly in the area of finance and banking, progressive reduction of quantitative restrictions, and simplification (and compression) of tariff schedules. The "own funded import" scheme (initiated in 1984) and open general licence (OGL); (initiated 1972 and reformed in 1988) were instrumental in the gradual import liberalization. Requirements to surrender foreign exchange earnings of exports were dropped.

Foreign exchange shops (*bureaux de change*), most of them private, were allowed to operate beginning in April 1992. Foreign exchange auctions were established in June 1993 to prepare grounds for an inter-bank market. Exchange rate unification was achieved by August 1993 and implied converging formerly multiple exchange rates into a market-based competitive rate and minimizing allocative distortions and rent-seeking activities. The accompanying liberalization of trade and payment regimes reduced administrative restrictions on current account transactions, cost, time and uncertainty related to external transactions.

After unification, the premium on the unofficial (illegal) parallel exchange rate virtually disappeared. In June 1994 the Inter-bank Foreign Exchange Market (IFEM) replaced the weekly auctions. It comprises Bank of Tanzania, commercial banks and foreign exchange bureaux, and non-bank financial institutions.[8] Though the Tanzania shilling exchange rate is freely determined in the IFEM, the Bank of Tanzania may occasionally intervene (e.g., in 1999/2000) to build up foreign exchange reserves to reduce exchange rate volatility. The IFEM and forex bureau rates continued to narrow, reflecting unification and market efficiency. The foreign reserves position reached 5.6 and 6.1 "weeks of imports" in 2000 and 2001, respectively, compared with less than one week of imports in the early 1980s.

Another notable step relating to financial reforms and fiscal performance is the attempt to make interest rates market-determined by the treasury bill market. In tandem, government has struggled to lessen reliance on bank borrowing by raising some of its resource requirements from the T-bill market. Such a step has an effect of lessening inflation pressure, particularly from that portion of fiscal deficit that should be covered by bank borrowing.

Table 2 shows period averages of a few macroeconomic indicators for two major subperiods across the 1967 to 2002 period (although, as indicated earlier, model estimations used quarterly data up to 1995). Despite the most recent of improved

macroeconomic performance in terms of GDP growth rates, fall in inflation and reduced exchange rate variability especially in the 1993–2002 period, the problem of inflation cuts across both regimes (see also Appendix figures A1–A4).

Table 2: Period averages of selected macroeconomic indicators 1967–2002 (annual data)

Indicator	Entire period and two subperiods			Subperiods of (2)	
		(1)	(2)		
	1967–2002	1967–1985	1986–2002	1986–1992	1993–2002
GDP growth rate (%)	3.7	3.3	4.2	4.6	3.8
Domestic inflation (%	18.4	15.3	21.8	30.0	16.1
Official exchange rate (Tsh/US$1)	231.2	8.99	479.7	173.8	693.8
Parallel exchange rate (Tsh/US$1)	259.5	25.9	520.6	275.8	691.9
Annual rate of official exchange rate depreciation (%)	18.3	5.1	32.9	63.3	11.7
Annual rate of parallel exchange rate depreciation (%)	16.5	19.9	15.1	23.2	9.4
Parallel exchange premium (%)	100.5	159.1	35.1	84.9	0.3
Annual change in broad money M2 (%)	24.5	20.1	25.1	34.6	18.4
Annual change in domestic credit expansion (%)	35.1	27.0	23.1	27.3	30.0

Source: Computed from annual data from Bank of Tanzania, National Bureau of Statistics.

The model in the next section covers exchange rates, foreign prices, real output, wages and measures of excess demand. Attempts are also made to include and examine the influence of price controls on the rate of inflation. Estimations cover the period 1967 to 1995.

4. Modelling inflation and exchange rates

This section introduces the model used to investigate the problem. Using quarterly time series data, the model examines the determinants of inflation and the relative role of exchange rates – both official and (illegal) parallel rates. It is constructed on the basis of different previous models of inflation, particularly those studying the problem in the developing countries.

Different studies place varying weights on different sources of inflation. Monetarist models emphasize monetary growth, while structuralist models emphasize cost– push or supply-related factors such as wage costs, interest rates output, and, for an open economy, external factors, foreign prices and exchange rates. Still others incorporate, with varying emphasis, both demand (monetarist) and supply factors. Examples of previous works on which elements of this model are drawn include Corbo (1985), Agenor (1991), Chhibber and Shaffik (1992), and Camen (1994). An attempt is made to get a controlled price component of the consumer price index (CPI). Derivation of the model is made in equations 1–5 below:

$$P_t = a_1 P_t^{co} + a_2 P_t^f \qquad a_t + a_2 = 1 \tag{1}$$

$$P_t^f = b_1 P_{T,t} + b_2 P_{N,t} \qquad b_t + b_2 = 1 \tag{2}$$

$$P_{T,t} = c_1 P_t^* + c_2 E_t \qquad c_1 > 0, c_2 > 0 \tag{3}$$

$$P_{N,t} = d_1 w_t + d_2 y_t + d_3 z_t \qquad d_1 > 0, d_2 < 0, d_3 > 0 \tag{4}$$

$$P_t = \gamma_1 P_t^* + \gamma_2 E_t + \gamma_3 w_t + \gamma_4 \gamma_t + a_1 P^{co} \tag{5}$$

where $\gamma_1 = (a_2 b_1 c_1) > 0$, $\gamma_2 = (a_2 b_1 c_2) > 0$, $\gamma_3 = (a_2 b_2 d_1) > 0$, $\gamma_4 = (a_2 b_2 d_2) < 0$, $\gamma_5 = (a_2 b_2 d_3) > 0$, and $a_1 < 0$

The variable P is the domestic price level, P^f is the free market price level, P^{co} is the price level of goods whose prices are controlled, and a_1 and a_2 are respective weights for controlled and free (uncontrolled) commodities in the total. P_T is the price level of

tradeables, P_N is price level of non-tradeables, $P*$ is the foreign price level standing for the import price level, E is the official exchange rate (alternately, B for the parallel or black market exchange rate) in domestic units per unit of foreign currency, W is the wage rate, Y is real GDP and z is a measure of excess demand, proxied here by either money supply broadly defined or domestic credit. The cap ("^") denotes rates of change in the variable and t stands for the time period (or here the tth quarter).

In Equation 1, the change in the domestic price level (P) is assumed to be a weighted average of changes in the "uncontrolled" (or free) prices (P^f) and those that are controlled (P^{co}). Equation 2 represents the assumption that the free price level (P^f) is a weighted average of the price level of the tradeables (P_T) and that of non-tradeables (P_N). Inflation in the traded goods sector P_T is given by the foreign inflation rate ($P*$) and the rate of change in the applying exchange rate (Equation 3), either the official or the parallel market rate.[9]

In Equation 4, the change in the non-traded goods price level is modelled as a function of changes in labour costs (wages), changes in real output and excess market demand. Corbo (1985) considers employer contributions to pension funds, labour productivity and prices of imported intermediate inputs. Data limitations on these variables preclude reasonable coverage of these factors. It has not been possible to model the wage function, largely for lack of data (and even definition) on the unemployment rate in Tanzania.

By substitution, the general price level (P) Equation 5 specifies the price control component, along with other determinants – foreign prices, exchange rate, wages and monetary factors, and growth rate of real output.

In Equation 5, the expected signs on the specified determinants are as indicated. But the sign for the controlled price component is not straightforward. In Equation 1, a_1 is the proportion that is price controlled. It is by assumption a constant, though in reality this need not be the case. (To our knowledge the coverage of price controls on commodities in the CPI, though not all inclusive, had been high for a long time until the end of the 1980s, when it started to decline sharply to less than 0.16 by 1995). During estimation an idea of using a dummy variable (considered to be simpler than the exogenous controlled-price component) was tried. 1989 was considered to be the year when at least more than half of the prices were decontrolled. DU was expected to have an indirect effect denoting the fact that controls put a limit to the possible higher rise in the prices. A value of one (DU=1) was assigned to observations from 1967 to 1989. The year 1989 was chosen because by that time the majority of prices had been decontrolled by nearly 90%; DU=0 for the rest of the years, when the controls lost ground.

Excess demand in the economy z has been measured in different ways. Chhibber and Shafik (1992), Blejer (1977), and Agenor (1991) measure it as ex ante disequilibrium of the money market, that is, excess real money balance. In this case, z depicts the pure role of monetary policy. Edwards (1993) uses the growth rate of domestic credit as a measure of excess demand. The derivative of z is expected to be positive since expansionary monetary policy is inflationary.

Excess aggregate demand, on the one hand, and deficient aggregate supply and/or rising costs of production, on the other hand, are usually the immediate causes of a rise in the price level. In a "controlled" or planned economy, the changes in the prices are

also manipulated to suit the objectives of the planner. But the ideal scenario in a "mixed" economy presents special analytical problems, especially that of quantifying the magnitude of the price control aspect.

Both exchange rates and wages are usually regarded as "cost–push" factors, together with the foreign inflation, entering the domestic price index via imported inputs and imported consumer goods. Measures of excess demand stand for macroeconomic position and are directly related to fiscal performance. Thus, the factors covered are both monetary and structural in nature.

The model is not all-inclusive, nonetheless. Other variables that are macroeconomic in nature that have not been modelled include financial sector reforms and foreign aid. Furthermore, Equation 5 does not cover such other details as extremes of weather (dry spells and floods), usually captured by dummy variables (a dummy here is reserved for price controls). Inasmuch as they affect agricultural output, transport and distribution differently, they may as well be assumed to be reflected already in the output (GDP) variable.

5. Estimation of the model

This section describes the procedures for econometric estimation of the model in the previous section. Justification of the time series estimation procedure is a necessary first step, since most macroeconomic time series data tend to be non-stationary (with moving means and trend).

Equation 5, the main model, is in rates of change (based on first differences). As such, direct estimation of this model would seem to be less prone to the spurious regression problems that befall relations estimated using classical methods such as ordinary least squares (OLS) techniques on (log) levels. Differencing has been suggested since most series become stationary after first differencing, thus removing trend. Even then, not all variables become stationary in first differences. Direct estimation in first differences leads to a loss of long-run information inherent in the relationship (Thomas, 1993). Therefore, although it is recognized that the rates are likely to be stationary, it is important to ascertain their orders of integration. Then OLS can be applied to series integrated of order 0, that is, stationary series.

Furthermore, in its present form, Equation 5 does not allow for an estimation of the effects of past values of the price level on the current price level. Thus, it is important also to investigate the lag structure of this relationship so as to get an idea of the time it may take for a change in the explanatory variable to have an impact on the dependent variable.

This investigative approach is done in stages. First, definitions and measurement of the variables are given and the quality of the data is assessed. This is followed by a summary of descriptive statistics of the time series data and unit root tests showing the order of integration of each variable. Since most of the variables are found to be stationary, an investigation of inter-variable cointegration is not pursued. Instead, an autoregressive form of Equation 5 is estimated by OLS by starting from a more "general" form, testing down to a more preferred form.

Definition and measurement of variables

Quarterly observations of the domestic consumer price index (P) were obtained from the Bureau of Statistics. For the foreign price level (P^*), a linear interpolation was made to the annual wholesale price index of the industrial countries. Both indexes are set to 1985 as base year. The quarterly rates of change of these are taken as measures of domestic inflation rate, P_t, and foreign inflation rate, P_t^*.

Official and parallel exchange rates (E) and (B), both in quarterly observations, are measured as the number of Tanzanian shillings to US$1. E is taken from Bank of Tanzania, while B is taken from various sources and own surveys. Rates of change of these are denoted as E_t and B_t. Linear interpolation was also made to Tanzaniaís GDP in 1985 prices (y) and the real minimum wage (w), also in 1985 prices. The CPI was used to deflate the nominal wage series. For output, the quarterly growth rate in the estimations is denoted by y_t. The per month real minimum wage is recorded as a monthly average for each year. The quarterly rate of change of w is denoted as w_t.

Two alternative measures of z, a measure of excess demand in Equation 5, were used. Money supply *(M)* is broad money, *M2,* in million Tanzanian shillings. (Note also that in July 2000, Bank of Tanzania shifted from extended broad money *(M3)* to broad money *(M2)* as a monetary policy intermediate target (BOT, 2001). M2 is deflated by the price index (1985=100). An alternate measure of excess demand was taken to be total domestic credit *(DC)* in million Tanzanian shillings in 1985 prices. *DC* is claims on (or bank lending to) government plus claims on the rest of domestic sectors, on quarterly basis. The quarterly rate of change in real money is denoted by m_t and that for total real credit by c_t.

While there is a good measure of reliability of the financial data (official exchange rates, money stocks and credit on quarterly basis), the quality of the data set may be lowered by the interpolation of the foreign inflation, real GDP and real minimum wage.

GDP data are available on annual basis, with frequent revisions. Sometimes figures from different sources differ, although the trend is by and large maintained. The minimum monthly average wage was the only systematically available data on wages (1967–1995), also compiled on an annual basis. This being a statutory minimum, the fact of wage controls is evident in that over years the announced raises by government were not systematic. No national average wage is available. Despite its non-representativeness, the official minimum wage rate was taken on the grounds that often it was the minimum wage scale that got the largest nominal percentage rise. Lastly, foreign prices are available even on quarterly basis, but there were many gaps from the sources that could be reached.

Although quarterly observations allow more degrees of freedom in estimations involving many variables and lags as in the present case, the quality of some of the series and interpolation (three variables may be too many) may have been a source of difficulties in the estimation.

Descriptive statistics

The sample period runs from 1967.1 to 1995.1 for all variables (see Appendix tables A1 and A2 for the main summary characteristics of the data). Most variables do not follow a normal distribution. They show a high level of skewness and kurtosis. A check was made on the density and histograms of these variables (charts not included). From the preliminary inspection of the plots of each variable over the entire period, most

variables do not look to be stationary in their levels. But plots of their rates of change seem to be stationary. The rates of change involve first differencing. If the rate of change becomes stationary I(0), then the value in its level is I(1). Since the model in Equation 5 is in rates of change, however, it matters if all the series in the regression are I(0) and/or can be transformed to become and be used in I(0). From the graphs, doubts remain as to the order of integration of such variables as foreign price, output (growth rate of GDP) and growth rate of the real minimum wage. Conclusive results are next sought from formal unit root tests.

Augmented Dickey Fuller and Dickey Fuller (ADF and DF) and the Sargan–Bhargava Durbin–Watson (SBDW) unit tests indicate that the null of non-stationarity cannot be rejected.[10] This is especially true of domestic inflation (P_t), rates of change of official and foreign exchange rates (E_t, B_t), real money (m_t), and real domestic credit (c_t). In all these variables the trend was significant at critical value -3.451 at the 5% level.

All tests suggest that the foreign price P_t^* is non-stationary. For γ_t, the DF and SBDW do not support stationarity of this variable although the ADF rejects the null of non-stationarity (in the test equations for this variable the trend was dropped as it was not significant, hence a different critical value -2.89 at the 5% level). The growth rate of real minimum wage does not pass the DF and SBDW tests: only the ADF (critical value of 2.89 at 5%) suggests the variable is stationary. For the SBDW test, the critical value is 0.39. In the case of this test, however, the null hypothesis of the SBDW test is that the series is stationary, i.e., I(0)[11] – the alternative hypothesis of the DF class of tests. Using both tests together provides a cross-check for the test (Adams, 1992).

Lags in relation to the ADF test indicate the j th lag in the ADF testing equation at which autocorrelation in the error term is judged to have been removed – reached by monitoring the equation's Durbin–Watson statistic as the number of lags is changed. P_t^* and γ_t were further differenced. The tests show that ΔP_t^* and $\Delta \gamma_t$ are stationary. Hence, it can be concluded that they are integrated of order two in their levels: but their rates of change are I(1). Conclusive results were not obtained on real wage so it was left in its rate of change (w_t).

Since most of the variables in rates of change are I(0), except for the foreign price and output, there does not seem to be ground for analysis of cointegration using these variables. In principle, cointegration can hold (where it does) between two non-stationary series that are of the same order – for example, both being I(1) with a resulting combination of them being of a lower order of integration, in this case, I(0). It is possible therefore to proceed and use OLS provided the foreign inflation and real output are differenced once to make them also I(0).

6. Estimation results

This section presents and discusses results of the OLS estimation of the model (Equation 5).[12] In running this regression, up to five lags were imposed and the estimation proceeded by dropping those variables with low t-values. Two final "preferred" equations are in tables 3 and 4.

Table 3: Modelling P_t by OLS

With official exchange rate and broad money: 1968.4 to 1995.4

Variable	Coefficient	Std. Error	t-value	HCSE
P_t_4	0.604	0.076	7.915	0.079
$P_t^*\_3$	2.688	0.773	3.477	1.288
E_t_1	0.068	0.024	2.815	0.033
m_t_3	0.003	0.027	0.127	0.034
$\Delta\gamma_t\_4$	-0.045	1.019	-0.044	0.798
w_t_5	-0.271	0.105	-2.579	0.099
DU	1.335	0.560	2.382	0.444
CSeason	-0.276	1.071	-0.258	1.054
CSeason_1	-1.420	1.152	-1.233	0.944
CSeason_2	-1.460	1.104	-1.322	1.130

R^2 = 0.70 s = 3.927 DW = 2.00; AR 1- 5F(5, 94) =3.4307 [0.007] **; ARCH 4 F(4, 91) = 0.681[0.6066]
Normality Chi^2 (2)=5.5522 [0.0623]; RESET F(1, 98) = 11.054 [0.0012] **
RSS = 1526.417 for 10 variables, n=109; Information criteria: SC = 3.07; HQ = 2.92; FPE = 16.83

Moving from the "general" specification, testing down to the most "preferred equation" improves the information criteria (Shwart Criterion [SC], Hannan and Quinn [HQ], and the forecast prediction error [HPE]). These decline as the less significant variables and lags are dropped on the basis of low t-values. At the same time, the equation standard errors (sigma) rise. Some variables are retained even if their t-values are low, however. These are variables that are being particularly investigated. The tests of significance of each variable for estimations in tables 3 and 4 are shown, respectively, in tables 5 and 6. These are tests for significance of each variable considering its current and all its lags jointly.

Table 4: Modelling P_t by OLS

With parallel exchange rate and domestic credit: 1969.3 to 1995.4

Variable	Coefficient	Std. Error	t-value	HCSE
P_t_4	0.616	0.080	7.724	0.088
ΔP_t^*-3	2.747	0.800	3.435	1.316
B_t	0.030	0.020	1.520	0.019
c_t_3	0.005	0.036	0.132	0.032
$\Delta\gamma_{t}\_5$	-0.901	1.079	-0.835	0.979
w_t_5	-0.320	0.107	-2.984	0.107
DU	1.410	0.614	2.298	0.515
CSeason	-0.255	1.141	-0.223	1.170
CSeason_1	-1.472	1.173	-1.254	1.061
CSeason_2	1.167	1.201	-0.971	1.266

R^2 = 0.69 s = 4.04654 DW = 2.11; AR 1- 5F(5, 91) =4.60 [0.0009] **; ARCH 4 F(4, 88) = 1.10 [0.3634]
Normality Chi^2(2)= 2.74 [0.2539]; RESET F(1, 95) = 9.06 [0.0033] **
RSS = 1571.95 for 10 variables, n= 106; Information criteria: SC = 3.14; HQ = 2.99; FPE = 17.92

Table 5: Tests of significance of model variables (w.r.t. Table 3)

Variable	F(num,denom)	Value probability	Unit root t-test
P_t	F(1, 99) =	62.648 [0.0000] **	-5.194**
ΔP_t^*	F(1, 99) =	12.087 [0.0008] **	3.477
E_t	F(1, 99) =	7.923 [0.0059] **	2.815
m_t	F(1, 99) =	0.016 [0.8991]	0.127
$\Delta\gamma_t$	F(1, 99) =	0.003 [0.9649]	-0.044
w_t	F(1, 99) =	6.650 [0.0114] *	-2.579
DU	F(1, 99) =	5.672 [0.0191] *	2.382
CSeason	F(3, 99) =	0.894 [0.4470]	-1.166

Table 6: Tests of significance of model variables (w.r.t. Table 4)

Variable	F(num,denom)	Value	Probability	Unit root t-test
P_t	F(1, 96) =	59.66	[0.0000] **	-4.817*
ΔP_t^*	F(1, 96) =	11.80	[0.0009] **	3.435
B_t	F(1, 96) =	2.310	[0.1318]	1.520
c_t	F(1, 96) =	0.016	[0.8952]	0.132
$\Delta\gamma_t$	F(1, 96) =	0.696	[0.4057]	-0.835
w_t	F(1, 96) =	8.905	[0.0036] **	-2.984
DU	F(1, 96) =	5.283	[0.0237] *	2.298
CSeason	F(3, 96) =	0.705	[0.5513]	-1.023

In both tests, the excess demand variable (growth of money or domestic credit) and output are statistically insignificant. The official exchange rate variable is significant (Table 5), while the parallel exchange rate (Table 6) is not significant. Past inflation, foreign inflation and minimum wage are significant, and in both cases, the first, third and fourth lags are the most significant (tests on lags are not included here).

The AR (auto regressive) tests of order 1 to 5 in both cases (tables 3 and 4) suggest a rejection of the null hypothesis that the errors are independently distributed. However, by the ARCH test, the low F-values suggest that the null hypothesis that the errors are independently and identically distributed cannot be rejected. The normality Chi-squared tests (with two degrees of freedom) indicate that the null that the hypothesis errors are normally distributed cannot be rejected.

Discussion of estimation results

In several of the regression estimates, a number of problems were encountered as the procedure moved from the "general" to the "preferred" model. The first relates to changing signs on some variables and their lags. The changing signs that were particularly remarkable are those associated with real money, real domestic credit and real growth rate of GDP.

It is suspected that possible measurement errors and particularly interpolation of three of the variables (foreign inflation, real minimum wage and GDP) may be among the causes of these mixed results. It is possible, too, that modelling variables that have a close relationship (theoretically or otherwise) may be a possible source of multicollinearity, which tends to reduce the t-values (or enlarge their standard errors); examples of these variables as real wage and output and output, and money are closely related.

Despite the poor performance of the model estimates some results are systematic,

mainly those in respect of lagged inflation rate, the exchange rate variables, foreign inflation, and to some extent, the wage rate and the dummy variable. All results show that current inflation is significantly related to its fourth lag, P_{t_4} (in a few cases the third lag) of inflation. The numerical value of the coefficient is about 0.6 and is statistically significant. This statistic shows a fair degree of persistence as the current rate reflects about 0.6 of its value four quarters back.

The foreign price coefficient is large (just over 2.0 in most equations) and statistically significant in the fourth lag ($\Delta P_{t\_4}^*$) (in some cases $\Delta P_{t\_3}^*$), which is plausible given the heavy import dependence of the economy: the strongest effect is reflected in the third or fourth quarter.

In the final "preferred equations" the fifth lag w_{t_5} had statistically significant coefficients of magnitude between 0.27 and 0.30; in some of the other lags the coefficients assumed changing signs. Therefore, the relationship between the real minimum wage and inflation rate cannot be confirmed. This may be because the relationship between inflation and real wage can be two-way (the wage–price spiral), the possible relationship between output and real wages, or the fact that wage controls, especially on the statutory minimum wage, have been in force.

Also, it is unexpected that the variables of excess demand m_t and c_t do not perform well, right from the "general" to our "most preferred" versions. The data of these variables, it is believed, were probably the more accurately recorded (by the sources) than the others and a measurement problem is not suspected. The result contradicts theory and documented evidence. As late as 1994, expansion of domestic credit and money supply beyond target levels (mainly fiscal deficit financing) were labelled as major factors behind a poor inflation record (URT, 1994b: 3).

The coefficient of the growth rate of real GDP assumes an apparently correct sign in the fifth quarter ($\Delta \gamma_{t\_5}$), and is large and statistically significant. However, the signs kept changing during stages of simplification. Lags 4 and 5 were significant at different stages. The last variable is *DU*, a dummy for price controls in the period specified. It takes a positive coefficient that was not always statistically significant. This suggests that the price controls did not have a restraining effect on the rate of inflation or, conversely, that inflation persisted despite the controls.

Results with respect to wages and price controls are to be taken with caution because of the institutional arrangements that reflected administrative fiat. Price controls aimed, inter alia, to reduce the variability of the prices and to promote social "equity" (Mongi, 1980). As Hyuha (1990) noted, however, it was possible for "influential" firms to obtain permission from government (the now defunct National Price Commission) to raise prices of their goods by percentages that exceeded the rate of devaluation itself. The price controls provided a means to shield firms from any adverse impact of devaluation, foreign prices, and competition from private or foreign firms. Also, the number of items covered increased up to a peak in the mid 1980s, when coverage began to decline. Otherwise, announcements of a price control lift on different commodities were ad hoc; some were

not announced. So the extent of coverage was not a constant and did not change at some uniform rate. In practice, the controls were plagued by enforcement problems (Mapunda, 1987; and Bagachwa and Maliyamkono, 1990). Similar arguments apply to wage and salary controls: Government still sets the statutory minimum wage and revisions have occurred often, but at irregular intervals. The minimum wage policy has been maintained during the reform period, but trade union activity is now freer than during the control regime. Generally, the controls on wages warrant questioning of the wage–price spiral hypothesis, i.e., whether there has been a strong relationship between wages and inflation rate. This cannot be confirmed from the estimations.

Official and parallel exchange rates

The rate of change of the official exchange rate (E_{t_1}) is statistically significant. In many estimates, the impact of official devaluation on inflation is strongest after one quarter (current devaluation always carried a negative insignificant sign and was ignored). It is remarkable that the parallel rate coefficient, although smaller in size over the entire period of estimation, is the more instantaneous. That is, a change in the rate (B_t) makes immediate impact within the quarter – a slightly faster impact than the official rate.

The difference in the relative effects of the two types of exchange rates is one of the leading research questions of the present study, as are the relative impacts of "controlled" and "more open" exchange regimes. The fact that the coefficient of the official rate is larger than that of the parallel rate might seem to contradict findings by Ndulu and Hyuha (1990) and Camen (1994) for Tanzania, Chhibber and Shaffik (1992) for Ghana, and Hyuha (1992) for Uganda, that the parallel exchange rate has (had) a stronger influence than the official exchange rate on inflation. The result here may be plausible, however, considering that our sample period covers periods of both controlled and liberalized exchange rate regimes, whereas the other studies looked at particular periods leading up to and/or during adjustment.

A further attempt was made to segment the period into a subperiod wherein the parallel exchange rate may have been overriding. Subperiod 1978–1993 was considered. Two separate estimations involving the two exchange rates in comparable circumstances were then made. The year 1978 was chosen as a period when controls and intensifying shortages were accompanied by a dramatically rising parallel market. Prior to 1978, the official exchange rate was also paramount and the parallel market was not as pervasive as beginning 1978/79. The year 1993 was a period during which (in August) exchange rate unification occurred and the parallel market was weakened considerably. Though some positive premium continued, it faded away and has never regained momentum. Hence it may be posited that from 1993 onwards the official rate was dominant.

Under these assumptions, the regression estimations briefly reported below (sample: 1978.1 to 1993.4, and t-statistics in parentheses) as equations 6 and 7 show that the parallel rate had a larger and more statistically significant coefficient during this period,

consistent with those studies cited above, particularly Camen (1994) covering 1971–1992. But then, taking the whole period 1967–1995, the official exchange rate has a slight edge.

$$P_t = 0.54 \ P_{t\_3} + 0.04 \ E_{t\_1} - 0.44 \ \Delta P^*_{t\_3} + 0.02 \ c_{t-3} - 2.09 \ \Delta \gamma_{t\_3} - 0.14 \ w_{t\_5} + 2.42$$
DU + 3seasonals

(4.74)   (2.44)   (-0.32)   (0.31)   (-1.62)   (-0.68)   (2.38) (6)

$R^2 = 0.769889$ s = 3.8831; Sample: 1978:1 to 1993:4

$$P_t = 0.57 \ P_{t\_3} + 0.06 \ B_t - 1.04 \ \Delta P^*_{t\_3} + 0.04 \ c_{t-3} - 2.09. \ \Delta \gamma_{t\_5} - 0.21 \ w_{t\_5} + 1.90$$
DU + 3seasonals

(5.34)   (2.56)   (-0.76)   (0.64)   (-1.67)   (-1..11)   (1.92) (7)

$R^2 = 0.783752$ s = 3.76432 DW = 2.06; Sample: 1978:1 to 1993:4

It emerges from these equations that overall the official exchange rate (including its lags) is marginally significant (at the 9% level). In the comparable equation in which the parallel exchange rate replaces the official rate, the parallel exchange rate is statistically significant and higher than that for the official rate. Nevertheless, it is also learned here that the performance of entire regressions faces problems similar to those in tables 3 and 4.

Stability of exchange rate coefficients

One of the assumptions of the OLS is that the coefficients of the independent variables remain constant throughout the sample period. This need not always be the case. Because of the less than impressive results of the multiple regressions above, focus for the analysis of the stability of coefficients is directed at the exchange rates only. A simple regression model was considered that relates the rates separately to the domestic inflation rate and was estimated recursively. Beginning with five lags, it turned out that similar to the estimations above, it is lag 1 of the official exchange rate and the current parallel exchange rate that eventually performed best. The analysis of their coefficient stability was made by tracing the recursive least squares coefficients, one-step residuals and the scaled recursive Chow test (Appendix figures A5 and A6).

The coefficients of the official exchange are bounded within two standard deviations on either side of their path. Initial instability reflects the small number of observations used at the start of the recursions and is therefore inconsequential now. Apart from this, however, the recursive coefficient trails steadily until about the mid 1980s, when it makes a visibly sharp bend downward and continues at this low value until 1995. In contrast, the coefficient on the parallel exchange rate exhibits higher variability, but stabilizes

after the mid 1980s.

The one-step residuals are a second guide to parameter constancy. The plots of these for the official exchange rate variable, the residuals, fluctuate within the two standard error bands; those for the parallel rate "pierce" through the upper band around 1984 and 1986. In both cases, the Chow test value is above 1 around 1985/86 for the official rate (spike at third quarter, i.e., 1986.3) at which point a structural break could have occurred. It appears, then, that around the mid 1980s a shift was registered, and thereafter the coefficients were relatively more stable. However, this statistical impression of "stability" ought to be qualified when looking at the exchange rate regime in a wider economic sense.

Concluding remarks on model estimation and results

The credibility of some results from this model estimation may be doubted, particularly those relating to excess demand measures. Thus, modelling monetary and structural factors together does not seem to lead to very sensible results on all variables, most probably because the specification of the model fails to recognize the interdependence of the explanatory variables. Further, the movement from controls to the market was not "linear"; neither did it have a definitive pattern. Some aspects of de-control attempts met resistance from influential followers of the erstwhile political ideology especially in the second half of the 1980s. As such, the data magnitudes of the policy variables did not generally move together as the levels of control and liberalization occurred at different dates and paces.

Thus, even though the mid 1980s are probably the turning point, actions and actual shifts in exchange rates and money supply, budget performance, output, wages, etc., occurred at different time periods. Basically, however, the results highlight the major "turning points" in the exchange rate policy, but even then, not the exchange rate alone was on the move, but also accompanying trade and tightening up of fiscal and monetary policies will have helped further the exchange rate depreciation throughout the 1990s. At the same time, the parallel market previously "fed" by shortages receded. Though the estimations ended in 1995, it is maintained that 1995 is within the 1993–2002 period that is characterized by strengthening unification of the foreign exchange market, falling inflation and improving economic growth.

7. Conclusions and recommendations

Two exchange rate regimes have been identified and associated with the macroeconomic policy phases. The parallel market exerted greater influence during periods of shortage and controls; it disappeared as further liberalization took hold. The weakened parallel market since the mid 1990s and the continued fall in the annual rate of inflation signify a good measure of macroeconomic stability. Improved macroeconomic performance (fiscal and monetary discipline), growth of real GDP, continued efforts for more efficient collection of domestic revenue and prudent spending (guided by the poverty reduction strategy since 2000) tend to cast domestic policy in a favourable light for public, domestic and foreign investors.

Over time, however, it is true that inflation has been driven by monetary and fiscal factors, on the one hand, and by structural constraints on the other. Bank of Tanzania (BOT, 1995: 7) admits that monetary expansion was attributed largely to net claims on government by the banking system and higher net foreign exchange holdings by commercial banks (especially after foreign exchange liberalization). Thus, although the model does not confirm the relationship between money supply and inflation, an indirect association of these can be found in apparent co-movement of inflation and government bank borrowing over the years.

The impact of foreign prices and exchange rate changes depends on existing pricing arrangements, which in Tanzania have ranged from controls to "market". As noted earlier, the impact of controls could not be precisely quantified although generally, they had a restraining effect on inflation (resulting in suppressed inflation) and were, in turn, counterproductive by resulting in corruption and inefficient allocation of resources, particularly when shortages were severe. Now that the price controls have been removed, fluctuations in the exchange rate will be transmitted faster to domestic prices.

While a more or less "stable" nominal exchange rate is desirable for trade and investment decisions, it is more important to maintain the rate at sustainable levels. The level and prospects of the foreign reserves position are important in this respect. Output and export strategies to ensure a well supplied foreign exchange market need to be furthered. The supply of foreign currency would also include foreign grants and/or loans. The challenge is for policy to induce positive assessment of the country's commitment to reforms and a stable macroeconomic environment and good governance. Active debates on these matters have been going on in Tanzania. While the charged exchanges of the 1980s by opponents to devaluation have petered out, the exchange rate remains precariously sensitive and easily vulnerable to exogenous shocks (e.g., terms of trade, weather, capital flows, etc.), domestic economic factors (e.g., domestic interest rates and interest rate differentials, now that interests have also been liberalized), and non-economic events like social or political instability that may generate a desire to shift financial assets into a foreign currency considered to be more secure. For example, close to the 1995 general elections a temporary but significant surge in the demand for foreign exchange was observed.

Notes

1. This can be compared with that in some of the developing countries with "moderate" inflation episodes studied by Dornbusch and Fischer (1993). Here "moderate" in terms of magnitude distinguishes it from *high* inflation or hyper inflation cases: a "moderate inflation episode" is defined as one with annual rates between 15 and 30% for three consecutive years.

2. This macroeconomic policy stance continues to the present, basically, but the model estimations presented in this paper maintain the quarterly data up to 1995.

3. The divide is not very sharp at 1985; it is noted that up to 1987, state regulation of the economy was still remarkable.

4. This strategy followed World Bank (1961) and featured in the Three-Year Plan (1961–1964), the First Five-Year Plan (1964–1996) and the Second Five-Year Plan (1969–1974). See, for example, Skarstein and Wangwe (1986).

5. National Economic Survival Programme (NESP) for 1981 and 1982 and government-authored three-year structural adjustment programme (SAP) (1982/83–1984/85).

6. With the exception of financial year 1973/74, the recurrent budget had recorded surplus all along until 1977/78.

7. ERP (ERP I) covered the period 1986/87–1989/90 (ERP II/ESAP) and was implemented during (1989/90–1991/92). These were followed by annual forward budgeting and rolling plans.

8. There are now more than 20 *foreign exchange bureaux*, mostly located in Dar es Salaam, and in Mwanza, Moshi and Arusha. The licensed banks include: National Bank of Commerce (1997) Ltd., National Microfinance Bank Ltd., CRDB Bank Ltd., Standard Chartered Bank (T) Ltd., Stanbic Bank (T) Ltd., Eurafrican Bank (T) Ltd., CitiBank (T) Ltd., Diamond Trust Bank (T) Ltd., Akiba Commercial Bank Ltd., Kenya Commercial Bank (T) Ltd, Exim Bank (T) Ltd., Habib African Bank Ltd., Barclays Bank Ltd., Kilimanjaro Co-operative Bank Ltd., and International Bank of Malaysia (T) Ltd. Non-bank financial institutions include:

Tanzania Postal Bank, Furaha Finance Ltd., Crown Leasing and Finance Ltd., Karadha Company Ltd., First Adili Bancorp Ltd., Savings and Finance Ltd., and Stanbic Financial Services Ltd.

9.   Some studies use the weighted average rate depreciation of both the official *(E)* and parallel exchange rates *(B)*, in which case such a weighted exchange rate would be written as $E_t^{wtd} = kE_t + (1 - k)B_t$. The parameter k is the proportion of trade transacted at the official exchange rate and the rest $(1-k)$ is carried out at parallel exchange rate. In the course of estimation in this study, the two rates are evaluated separately in Equation 5.

10.   The Dickey–Fuller test assumes that the underlying data generating process follows an autoregressive process of order 1, i.e., AR(1); thus, letting $y = \alpha + \rho y_{t-1} + u_t, u_t \sim (0, \sigma^2); \ y_0 = 0$, the DF tests the size and significance of ρ. In unit root testing, the null of non-stationarity $\rho = 1$ is being tested. Since quarterly data are used, seasonal dummies were also attached to remove the effect of seasonality; they were included in all estimations. The sample size is 116 (may differ slightly where lags are involved), as in the ADF test.

11.   The SBDW test is defined as $DW(y) = \Sigma(y_t - y_{t-1})^2 / \Sigma(y_t - y)^2$, where *y* stands for a given series. High values of the statistics tending towards 2 imply *y* is I(0), and low values suggest the variable is I(1).

12.   Implementation of the single equation error correction model (SEECM) yielded similar results but is not appended.

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Appendix: Charts and tables

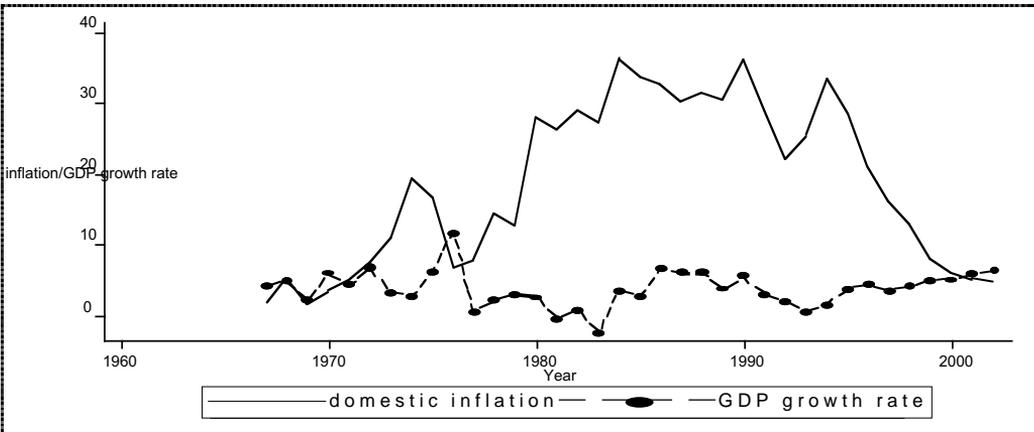**Figure A1: Domestic inflation and GDP growth rates, 1967–2002**

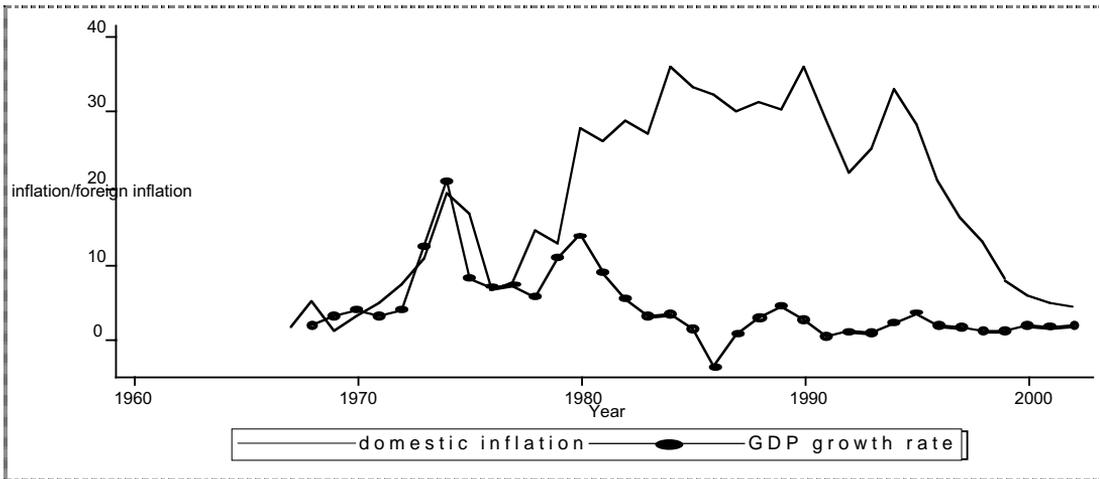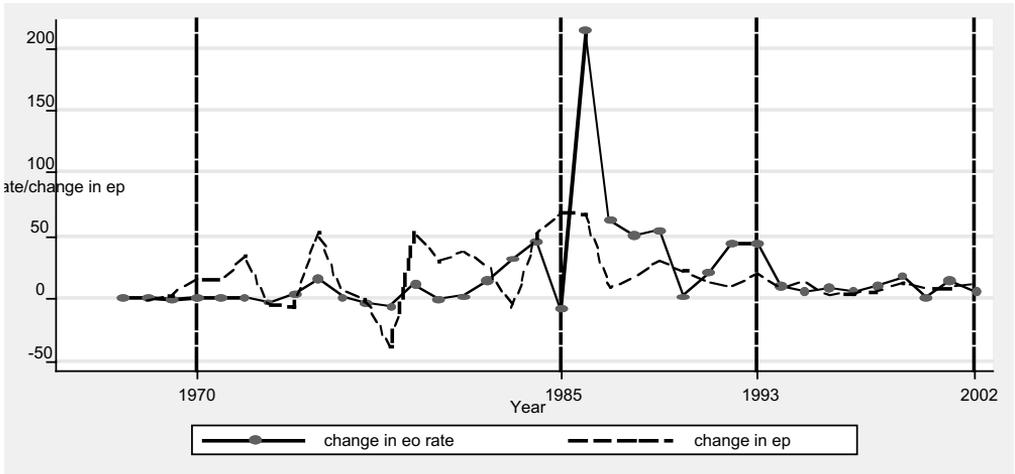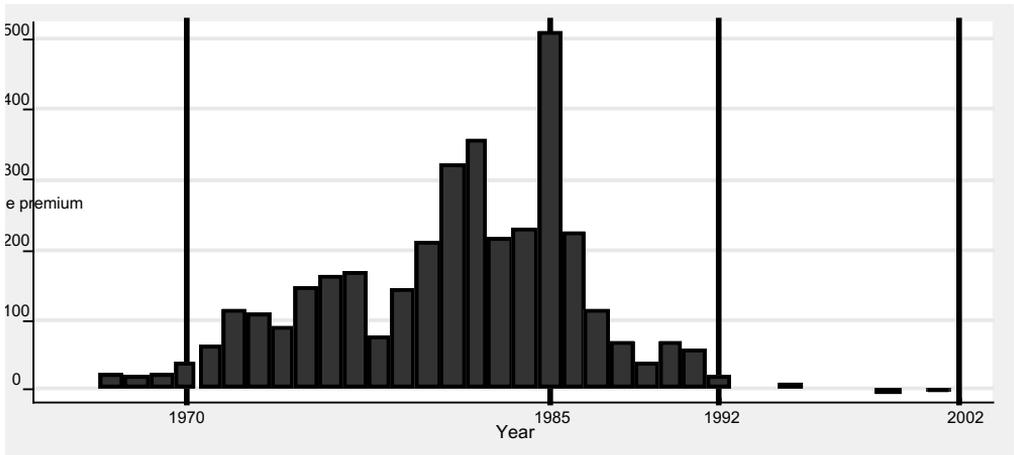**Figure A2: Domestic versus foreign inflation rates (%)**

Figure A3: Annual changes in official and parallel exchange rates

*Since 1993 unification of exchange rates, with IFEM and bureaux de change rates.

Figure A4: Parallel market premium (%)

Computed as {(ep-eo)/eo}*100.

Table A1: Distribution of data

	Mean	Standard deviation	Skewness	Excess kurtosis	Minimum	Maximum	Normality Chi^2 (2)
P_t	5.09	4.47	0.96	1.20	-2.14	22.72	17.99 [0.00]
P_t^*	1.21	1.16	1.29	2.09	-0.73	5.32	35.35 [0.00]
E_t	4.78	15.81	7.37	64.11	-5.08	151.50	2093.20 [0.00]
B_t	5.62	20.36	2.80	12.12	-38.00	118.12	124.08 [0.00]
m_t	2.07	18.80	2.52	14.06	-47.32	113.34	52.95 [0.00]
c_t	19.57	107.38	4.97	26.34	-88.68	706.09	1283.9 [0.00]
γ_t	0.83	0.64	-0.43	-0.56	-0.70	1.79	9.01 [0.01]
w_t	-0.39	4.12	0.84	0.45	-7.47	11.91	18.42 [0.00]

Table A2: Unit root tests of rates of change

Variable	ADF (lags)	DF	SBDW	Order of integration
P_t	-3.897 (5)	-12.03	1.68	I(0)
E_t	-4.878 (4)	-10.33	1.93	I(0)
B_t	-4.066(4)	-11.35	2.167	I(0)
P_t^*	-2.876 (5)	-2.793	0.18	at least I(1)
ΔP_t^*	-4.128 (5)	-10.49	2.017	I(0)
m_t	3.488 (3)	-10.92	2.843	I(0)
c_t	-3.555 (5)	-12.24	2.325	I(0)
γ_t	-3.123 (3)	-2.699	0.33	at least I(1)
$\Delta \gamma_t$	-4.926 (5)	-10.4	1.953	I(0)
w_t	-1.724 (5)	-3.575	0.477	at least I(1)

Figure A5: Stability tests from recursive estimations (official exchange rate)
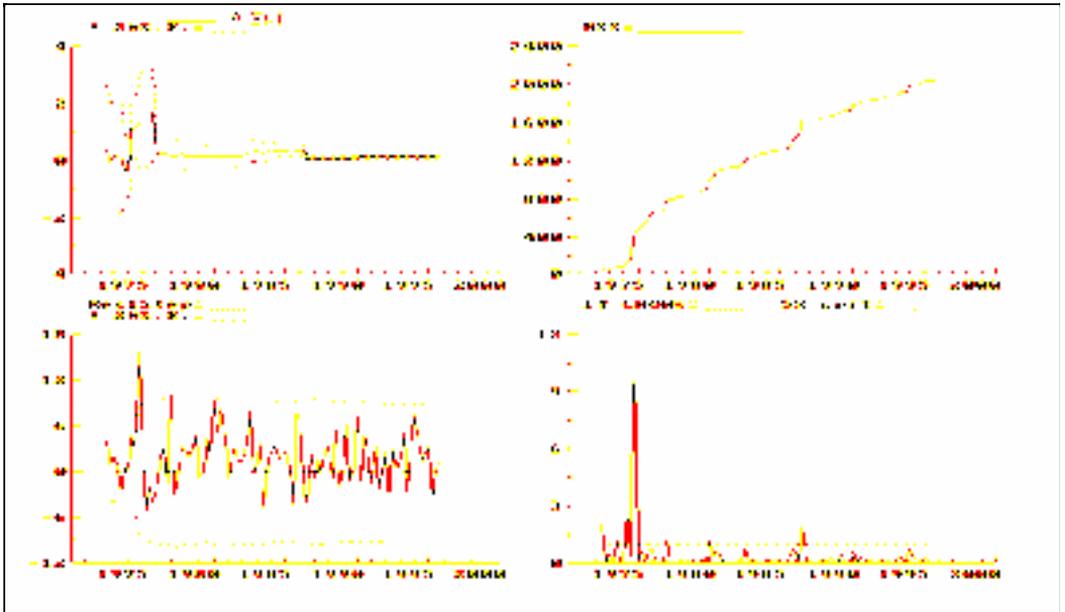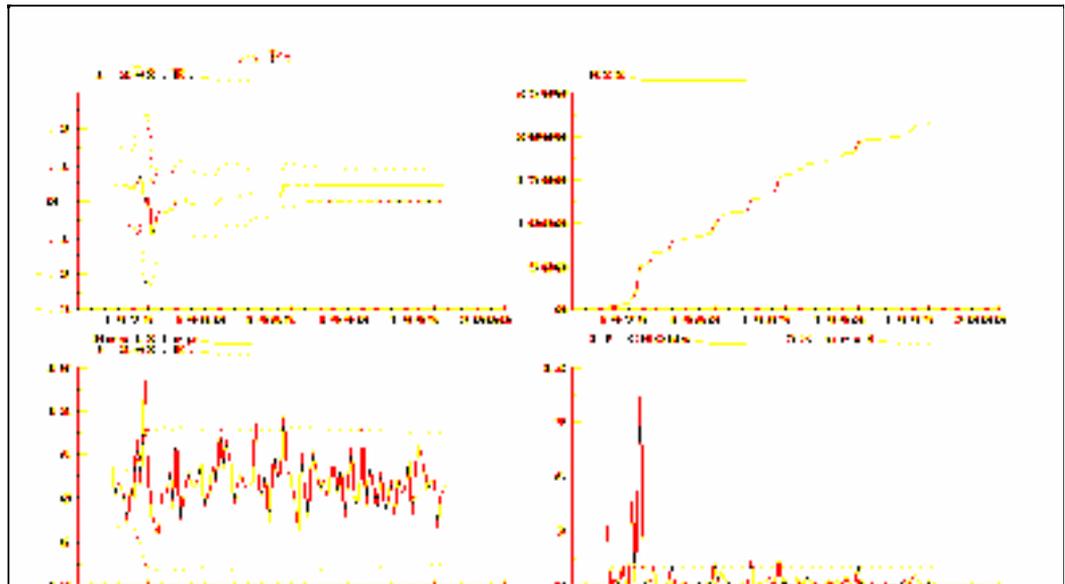

Figure A6: Stability tests from recursive estimations (parallel exchange rate)

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