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THE BEHAVIOUR OF INCOME VELOCITY IN TANZANIA, 1967-1994

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The behaviour of income velocity in Tanzania 1967-1994

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The behaviour of income velocity in Tanzania 1967-1994

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I. Introduction

Tanzania's rapid expansion in domestic credit since the late 1960s has resulted in an increasing growth in money supply. This was given particular significance in the structural adjustment programme (SAP) adopted in 1982 and the three-year economic recovery programme (ERP) of 1986, commonly referred to as ERP-I, which was extended to ERP-II (1989-1992), also referred to as economic and social action programme (ESAP). In the ERP, it was categorically stated that the economy experienced strong monetary expansion that averaged 26% in the period between 1979 and 1984, after having reached 38% and 32% in 1979 and 1980, respectively (Tanzania., 1986).

Among other economic adjustment policies, these two programmes emphasized the need for a restrained expansion in money supply. Nonetheless, in practice, the targeted rates of growth in money supply remained untenable. During the SAP period (1982-1985), the growth in M2 averaged 17.8% as opposed to the planned average rate of 17% (Tanzania, 1986). Similarly, during ERP-I and ERP-II (1986-1992) the growth in M2 averaged 32.4% as opposed to the planned rates, which ranged from 10% to 17%. In both periods, the expansion in liquidity in the economy resulted largely from government borrowing from the banking system and the financing of crop authorities and the cooperative movement. Unfortunately, the expansion in money supply was accompanied by poor economic performance. The real income (GDP) growth mostly stagnated and in some years was negative prior to the mid 1980s. The real rates of growth of national income averaged 2.3% between 1967 and 1982 and 1.1% during the SAP period (1981-1985). Generally, however, the 1970s were characterized by very low and even negative rates of growth in real income, but after the adoption of the economic recovery measures the real income growth picked up from a low level of 0.34% in 1983/84 to an encouraging average rate of 4% from 1986 to 1994 (see Appendix Table A1).

The imbalance between the planned rates of growth in money supply and real income shows that the central monetary authority (Bank of Tanzania) has not yet put into practice a policy to target growth in money supply consistent with stable prices (see Tanzania, 1981).

Given Tanzania's approach to target growth in the national income and level of prices, the excess of actual growth in money supply over the planned rates could be attributed to, among other causes, inadequate information on income velocity behaviour —its determinants and predictability. Conversely, the apparent excess of actual money supply over the planned rates of growth would rise from ignorance about the demand for money function and its stability.

To date, only limited evidence exists on the income velocity or the demand for money

in Tanzania.[1] This study ventures to expand the frontier of knowledge on income velocity behaviour and its main determinants. Our investigation is also important in understanding the effect of changes in money growth on income over extended periods, thus helping policy makers to predict and target the national income. For, given the ability of the central monetary authority to achieve a desired money growth, "the success in achieving a nominal income goal depends on the precision with which velocity growth can be forecast" (Hein and Veugelers, 1983, p. 34.)

A theoretical discussion of income velocity is given in Section II, while Section III dwells on the existing literature and the main methodological issues. Section IV builds on these, addresses the measurement and definition problems of the main variables used in the analysis, and presents the main variables and proxies used in this study. The estimation models, the main hypotheses and the main data sources used in the analysis are given in Section V. The empirical results, based on a descriptive and econometric analysis, are presented and discussed in Section VI. A summary of the main findings, conclusions, policy implications and areas for further research are given in Section VII.

II. Theoretical framework on income velocity

The velocity of money, or rather the income velocity, is an old but timely concept in monetary theory. The concept is associated with Irving Fisher's equation of exchange (Fisher, 1926), the basis of the quantity theory of money and its restated variant put forward by Milton Friedman (Friedman, 1969). Basically, the equation stresses a direct causal relationship running from the nominal quantity of money to the price level. Simply, the equation states that:

$$MV = Py \tag{1}$$

where M stands for the total money stock, V is the income velocity, P is the general level of prices and y is the volume of transactions.[2]

The equation states that the expenditures of a period equal the total value of the things exchanged, so that it is an identity that holds irrespective of the cause of the change in money income (Newlyn and Bootle, 1978).

Rearranging Equation 1, V (which is equivalent to the inverse of the Cambridge School's "*k*"),[3] is expressed as,

$$V = \frac{Py}{M} \tag{2}$$

i.e., the ratio of money income to the nominal stock of money. In accordance with the classical monetary theory, the income velocity is almost constant. That is, changes in velocity are minor, so that for practical purposes velocity can be taken to be constant (Baumol and Blinder, 1982). It follows, therefore, that an increase in the quantity of money would either be absorbed by an increase in real income or by a rise in the general price level or by a combination of the two. Thus changes in money stock would change the nominal income proportionately, and the course of income would he predictable and controllable by predicting the stock of money (Baumol and Blinder, 1982).

The case of a constant income velocity in the classical quantity of money theory is, however, quite an extreme one. According to the contemporary monetarists and Keynesian monetary theory, the income velocity is held as not constant. Subsequently, diverse and even controversial hypotheses on the behaviour of the income velocity have developed. Ezekiel and Adenkule (1969) have shown that there are four existing hypotheses.

The first hypothesis arises from the contention by Fisher (1926) that there are economies of scale in holding money balances. This view, as Ezekiel and Adenkule explain, "implies an income elasticity of the demand for money that is lower than unity or, in other words, a rising secular movement in income velocity" (pp. 224-25).

Second is an hypothesis by Friedman (1959, p. 1) that the income velocity declines secularly because, "in countries experiencing a secular rise in real income per capita, the stock of money generally rises over long periods at a decidedly higher rate than does money income". This hypothesis has dominated most empirical works on income velocity and, given its implied elasticity of demand for money that is greater than unity, is dubbed the "luxury good hypothesis".

A third postulate arises from a contention held by Gurley and Shaw (1960)[4] that "if consumers desire to hold a constant proportion of their financial assets in money balances during output growth, the ratio of money to national income rises during the earlier stages of growth and then eventually levels off". Thus, during economic growth the velocity would first fall and eventually level off as national income rises.

The fourth hypothesis is argued by Dorrance and Brehmer (1962), who noted that "as national per capita income rises, up to a certain point, money holdings rise relative to real income; after a certain point, the ratio of money to income falls with rising national income". The income velocity, therefore, would fall and, after a certain point, would then tend to rise.

The link of velocity to the levels of economic growth as measured by the national income is central to the secular behaviour of velocity hypothesis. Given the different levels of economic growth and development, the consensus seems to be that the velocity in the developed countries is expected to rise and in semi-developed countries it is expected to be constant. In the less-developed countries, however, the income velocity is expected to fall and undergo more fluctuations than in developed countries (Bordo and Jonung, 1985).

In general, it is noted by Andersen (1975, p. 8):

> A common postulate in monetary theory is that holders of money balances desire, at a given point in time, a certain ratio of money to income and equilibrium income velocity is the inverse of this desired ratio. As such velocity changes are postulated to depend on those economic factors influencing desired money balances.

Thus, on the basis of the monetarists' and Keynesians' demand for money functions, a number of factors enter the velocity function as arguments for its secular behaviour. On the one hand, apart from growth in real per capita income (Friedman, 1959), the fall in income velocity may be caused by the process of monetization, financial sophistication, economic stability and security (Bordo and Jonung, 1981). On the other hand, the rise in the velocity results from improved quality of money substitutes (Gurley and Shaw, 1960; Tobin, 1965), the rise in interest rates (Latane, 1954), improvement in exchange economy, (Clower, 1969), and changes in the predictability of the price level (Klein, 1975).

As we shall show in the literature review, the propositions on the income velocity

behaviour and its determinants have been subjected to a number of empirical tests in various countries. The evidence generated precludes a blanket generalization of the secular behaviour and determinants of the income velocity across economies.

III. Literature survey

Existing empirical studies

The literature is rich with studies on the demand for money and income velocity. In the studies specifically and directly aimed at analysing income velocity, the line of inquiry has taken four courses. First, the early studies attempted to establish whether the income velocity was constant and predictable as in the classical quantity theory sense. The conclusion was that, as generally appreciated by both the monetarists and the Keynesians, the income velocity is far from being constant.

However, whether the income velocity is also predictable remains an area of controversy. While the monetarists argue that the velocity is stable and predictable in the long run, and possibly in the short run, the Keynesians consider that the velocity is very variable and unpredictable in both long- and short-run periods. Second, Friedman's hypothesis and its variants on the secular behaviour of income velocity have been tested. Studies of this type partly focus on the income velocity in the context of the aggregated demand for money function (Ezekiel and Adenkule, 1969; Melitz and Correa, 1970; Short, 1973); and partly investigate the effects of sectoral rather than aggregate demand for money functions on the income velocity.[5]

Third, policy analysts have specifically wanted to explain the observed movement in the income velocity.[6] The predictability and reliability of income velocity for monetary policy purposes have been investigated by looking into factors that explain its observed variability through time. An important culmination has been a questioning of the main proxies used to measure income velocity, in particular the definition of money and national income, and a trace of the observed behaviour of income velocity to macroeconomic policies. For example, the unexpected behaviour of the velocity observed in the USA in the 1980s, referred to as the "velocity puzzle" (Stone and Thornton, 1987) and an "atypical behaviour" (Santoni, 1987), resulted in a consideration of trade deficits and changes in tax rates as possible causes of the atypical velocity trend.

Lastly, there have been studies particularly concerned with a critique of Friedman's "luxury good hypothesis". The institutional factors, including monetization, financial sophistication, and growing economic stability and security, are expounded as of greater explanatory power in explaining the secular behaviour of velocity. Besides, the interest rate is heightened as an important rather than impotent factor in the velocity function.[7]

Most of the existing studies on income velocity have been carried out in the USA[8] and other developed countries. Only a few, which are largely cross-sectional, cover both

developed and developing countries. The secular behaviour of the income velocity, or rather the U-shape of the income velocity in the long run, stands undisputed, while the remaining area of concern, and indeed controversy, is to explain the secular and cyclical movements in velocity and establish its determinants and stability.

The results from the studies on income velocity are varied with regard to the explanatory power of the parameters used and the overall model. In a cross-section study that covered 70 developing countries, Gurley (1967) established that the velocity was inversely related to per capita income. Similar results have been obtained by Ezekiel and Adenkule (1969), Melitz and Correa (1970), Short (1973), Driscoll and Lahiri (1983), and Bordo and Jonung (1985).

Nonetheless, a number of studies either have been inconclusive or have established a positive relation between the income velocity and measure of economic growth. In an estimation of a velocity function for Malaysia and Singapore between 1951 and 1966, Short (1973, p. 298) found that the velocity varied inversely to real per capita income, but "the negative impact of per capita real income upon velocity was overpowered by the changes in monetary habits". Moreover, in a study of velocity of 12 developing agricultural-based countries, Driscoll and Lahiri (1983, p. 400) came to inconclusive results on the secular behaviour hypothesis:

> If sectoral shares (of income) remain unchanged, *ceteris paribus*, there does not appear to be any inherent tendency for velocity to decline with increasing income in ten out of the twelve economies [and] the standard velocity relation implied by Keynesian liquidity preference and quantity theory, as formulated by Latane (1954), does not perform satisfactorily in the twelve agricultural developing economies.

This conclusion is similar to the results obtained by Bordo and Jonung (1981, 1985) in the study of velocity in five advanced countries including USA (1880-1972), Canada (1900-1975), United Kingdom (1876-1974), Sweden (1880-1974) and Norway (1880-1974). Of these countries, only the USA had a negative but insignificant coefficient of permanent income. In the case of the developing countries, the studies by Khan (1974) and Kharadia (1988) also established a positive correlation between the income velocity and per capita income in Pakistan and India, respectively.

The inverse relationship between per capita income and income velocity is implicitly inferable from the studies in Tanzania, in which income is established to be positively correlated to the demand for money. Nonetheless, the orientation and scope of investigation of such studies precluded a sharper focus on the behaviour and determinants of income velocity. Phiri (1989) specifically investigated income velocity in Tanzania from 1966 to 1987 and also established an inverse relationship between income and income velocity. However, the study employed real national income (GDP) as a scale variable rather than per capita income as postulated and used in the studies on the secular behaviour of income velocity.

This present study complements the previous ones with a relatively expanded sample period and a sharper focus on the main postulates on the behaviour and determinants of

income velocity in Tanzania. The influence of institutional factors on income velocity and the plausibility of variables and proxies suggested in the literature as regards their explanatory power on velocity behaviour are explored using descriptive and econometric methods. This study should therefore enrich the literature and our understanding of income velocity in Tanzania.

Issues arising from previous studies

The heterogeneous results on the secular behaviour of income velocity across economies have, as would be expected in positive economics, taken economists back to examine the relevance of the propositions tested. The hypotheses on the secular behaviour of income velocity, as Ezekiel and Adenkule note (1969, p. 225), are generalizations from observed behaviour of velocity in a few countries and thus "there is very little empirical basis for assuming that the observed secular behaviour of income velocity in a few countries can be generalized".[9]

It is quite possible that, *ceteris paribus,* the non-conformity of the evidence to the established orthodox propositions best explains the actual behaviour of velocity or demand for money in a specific country. This can be appreciated from the fact that the evidence from the estimated velocity functions is generated from different sample periods that could be characterized by either booms, stagflation, recession, different institutional changes, monetary arrangements, and even economic stability and political regimes. The empirical findings of Bordo and Jonung (1981), Khan (1974) and Short (1973) underscore the importance of institutional factors in explaining the secular behaviour of income velocity.

The methodologies adopted to study income velocity are variable. Most of the studies are based on cross-seclional analysis. Consequently, as Driscoll and Lahiri (1983, p. 393) note:

> Cross-section studies involving developed and developing economies do not provide satisfactory indications of what happens to velocity over time in any individual developing economies. Firstly, velocities have not behaved uniformly in all the developing economies. Secondly, international cross-country comparisons do not adequately explain why velocity changes in any individual economy.

Ezekiel and Adenkule (1969) note that conceptual and measurement problems pose potential difficulties in carrying out cross-sectional studies.

Moreover, the orientation of the analysts in addressing the traditional debate on whether "money matters" may also explain the perverse results on income velocity![10] But the most important methodological aspect concerns the variables and proxies used in studying income velocity. These are neither defined nor measured uniformly . Apart from the problems and paucity of data in the developing countries, the variation in the results has a definite effect on the determinants of income velocity in individual country and cross-

sectional studies.

A number of studies carried out in Tanzania suffer from methodology problems as regards the measurement, definition, selection of appropriate proxies and specification of estimated functions. For example, the GDP rather than gross national product (GNP), permanent income or wealth is used as a proxy in the velocity function because of the paucity of data. The velocity function specified also differs in connection with the explanatory variables used.

Similar concern is given to the composition of the explanatory variables or their proxies used. Over and above the standard velocity function,[11] and the varied sample periods, the velocity functions estimated are far from being the same. This may also explain the diversity of the results generated by the studies in Tanzania. Accordingly, the issues arising from the previous studies preclude generalization of the hypotheses on income velocity and call for a case-by-case approach to test their relative importance across economies.

Given the various economic stabilization and recovery programmes adopted since the mid 1980s, our study also provides a modest insight into their effects on the economy on "before-and-after approach" basis (see Khan, 1988). Being country-specific our investigation enriches the understanding of the velocity and validity of its main hypotheses in differing economies.[12] Thus as Brunner and Meltzer (1963, p. 323) have noted:

> Discrimination between hypotheses is not only shown by tests. Continued exposure of hypotheses to new data generated in a variety of economic climates adds to one's understanding of the range of the hypotheses and their comparative explanatory power.

IV. Definition and measurement issues in velocity analysis

As noted above, the main variables used in the studies on income velocity differ across countries studied. This is partly because of data problems, but probably more important is the lack of an appropriate and universal measure of these variables that cuts across all economies, either developed or underdeveloped. The latter aspect not only necessitates a note on their appropriateness in Tanzania but also calls for an insight on how the respective data are obtained or generated. The main variables include the measure of national income, definition of money, opportunity cost of money, the rate of monetization and financial development.

National income

In most studies on demand for money, measured current income, i.e., either GNP or GDP, is used as a proxy for the volume of transactions in an economy. However, the measured current income reported in the official statistics is considered to be an inappropriate proxy and when used introduces specification errors in the velocity function. Various alternative measures are thus suggested for the total volume of transactions. First is permanent income or wealth. Following Friedman's permanent income hypothesis, these measures are considered superior because "individuals primarily base their consumption decisions on their permanent income or wealth, rather than current income".[1] The demand for money, or conversely the income velocity, is thus a stable function of the permanent income or wealth.

A second measure, suggested by Haraf (1987) and Stone and Thornton (1987) is the gross domestic final demand (GDFD), which is the GNP less a sum of changes in inventories and net exports (X-M). They argue that this measure is the one that constitutes the total volume of goods and services transacted in money in an economy. If current income is used, velocity may decline if consumers increase their money balances to purchase imported goods or preceding periods' inventories of produced goods. Current income would then remain the same and demand for money would rise and cause a decrease in velocity. A similar effect on income velocity would be induced by a decline of exports caused by a weak demand in the foreign market.

Since the aggregate official national income statistics in the developing countries includes imputed income from the subsistence sector, the use of official GDP statistics as a proxy for the volume of transactions also introduces specification error in estimating the velocity function. Thus, as Coats and Khatkhate (1979, p. 20) note, "the use of income

data for the monetized sector only is simplest, when available and the non-monetized (subsistence) sector which uses and demands no money by definition, can be simply ignored".

The measure of income in estimating the velocity function in contemporary developing countries is also complicated by the existence of an underground economy. The medium of exchange in the underground economy is still the money issued by the central monetary authorities. However, the volume of its transactions, or rather the level of economic activity, is not reported in official national income data.[14] But, as Ghosh (1988, p. 2513) declares, if "black incomes" were to be added to the official GDP data, "velocity would come down slightly". Hence use of the official national income statistics only biases the income velocity upward.

In our study, annual GDP data have been used to estimate the velocity function for Tanzania. However, this may introduce a seasonal factor into the velocity estimates since agricultural production accounts for the largest share of the total GDP and, due to the seasonality of agricultural output, the demand for money and conversely the income velocity would exhibit a seasonal pattern (see Park, 1973, p. 388). Moreover, since agriculture in Tanzania accounts for the largest volume of total exports, using the official GDP data may also introduce instabilities prevailing in the international scene, which may arise either from a lack of foreign demand or changes in the terms of trade (see Goldstein and Khan, 1982; Singer, 1983; and Khan, 1988).

To overcome the seasonality problem the quarterly average data of the official GDP should be used. Such quarterly national income data are not reported in Tanzania but could be generated.[15] But to avert a bias that would come from the use of such a method the official GDP data have been used as a proxy for the volume of transactions. Due to the effect of the instability on GDP caused by the international scene, the GDFD has been tried as a proxy for the volume of total transactions in the economy. In addition, the permanent income has been tried as a proxy in estimating the velocity function.[16]

Definition of money

It is well known that an appropriate definition of money in developing as well as developed countries remains a subject of controversy and is yet to be proven by empirical research.[17] According to Johnson (1962), however, the definition of money that gives improved empirical results is the best. In our study, an incremental approach has been used and thus money is defined as the currency in circulation (C), the sum of currency in circulation and demand deposits (that is the conventional narrow money, denoted by M1), the sum of narrow money and quasi-money (referred to as broad money and denoted by M2), and the sum of broad money and foreign currency deposits (referred to as extended broad money, M3) in official use since 1993. These four definitions have been used to obtain the five measures of velocity used here. The results from the four definitions have been compared to establish the degree of substitutability, or rather "moneyness", of money in Tanzania.

Due to our use of official money statistics the velocity function estimated may not

reflect the real behaviour of velocity because the increased demand for money in the underground economy is likely to increase income velocity.[18] However, unlike the national income statistics, data for money in Tanzania are readily available, even on a monthly basis. To circumvent the possible seasonality in money supply, we have employed the averaged quarterly data rather than the end-of-year (annual) data.

Monetization and financial deepening

According to Chandavarkar (1977), monetization refers to the fraction of total output exchange for money; financial deepening refers to the extent that the monetized sector utilizes the money and services of financial intermediaries in an economy. Hence both factors increase the demand for money, but, as Coats and Khatkhate (1979) argue, monetization initially tends to primarily expand the use of currency while financial depth increases the use of bank deposits. The income velocity would therefore fall with the increased rate of both monetization and financial depth.

Various proxies have been suggested and used to capture the effects of the degree of monetization and financial depth in the velocity functions. These include the monetization ratio,[19] number of bank branches and "Goldsmith's classification of countries".[20] Moreover, the currency-to-money ratio, the ratio of total non-bank financial assets to total financial assets, ratio of total private non-bank financial assets to total private assets, and illiteracy rates have been used as measures for financial development. (See Bordo and Jonung, 1981.)

We use the number of bank branches as a proxy measure of monetization in the sample period 1967-1994 and the monetization ratio (MoR) introduced in the velocity functions estimated for the 1967-1982 sub-period.[21] The currency-to-money ratio (C/M) has been introduced in the basic model as a proxy for the spread of commercial banking in the entire sample period.

Opportunity cost of holding money

An appropriate proxy for the opportunity cost of holding money is the interest rate. Nonetheless, most studies on income velocity or demand for money in the developing countries ignore interest rates because money and capital markets are thin and interest rates are pegged by the governments.[22] Instead, the expected rate of inflation is considered the most appropriate proxy for the opportunity cost of money holding. Park (1973, p. 387) notes, "If the fluctuations in the real rate of interest are not substantial over time, the expected rate of inflation may be a reasonable measure of a representative nominal interest rate".[23] In addition, Wong (1977) suggests a measure of domestic credit restraint as an alternative to the repressed interest rates in developing countries. Additional proxies suggested in the literature and tested in various countries are the real rate of return on money and the number of bank offices.

Until the adoption of financial reforms in the mid 1980s, the interest rates in Tanzania

were pegged by the government and remained virtually constant. Given the prevailing inflation rates the real interest rates remained negative (see Appendix Table A4). Thus the expected rate of inflation has been used as a proxy for the opportunity cost of holding money in the sub-periods. However, since the nominal interest rates started increasing after the financial reforms adopted in the second half of the 1980s, the real interest rates have been tried as a proxy measure of the opportunity cost of holding money in the velocity functions estimated for the 1983-1994 sub-period. In this study we explore an explanatory power of the rates of interest in explaining income velocity using the interest rates charged on saving deposits of the commercial banks.

V. Estimation models, hypotheses and data sources

The tests of the hypotheses on income velocity in Tanzania are based on two main models. First is the standard income velocity function, stated thus:

$$\log V = a_1 + a_2 \log y^{pc} + a_3 p^e + u \tag{3}$$

where V is the velocity measure, y^{pc} is real per capita income and p^e is the expected rate of inflation as a proxy for the opportunity cost of holding money.

The second model derives from the equation of exchange and incorporates an institutional variable, namely BRA, which denotes the number of branches of the commercial banks and is used as proxy for monetization. The model follows from the equation of exchange, thus:

$$\frac{M}{P} = \frac{1}{V} y \tag{4a}$$

where M/P is the real money balance, hereafter denoted by *m*, *y* is real income and 1/V is the reciprocal of the income velocity.

From Equation 4a it follows that:

$$\log m = \log y - \log V \tag{4b}$$

such that the income velocity may be observed as a residual:

$$\log V = \log y - \log m \tag{4c}$$

Assuming that real income (and hence y^{pc}) is exogenously determined, the following demand for money function is substituted into Equation 4c:

$$\log m = b_0 + b_1 \log y^{pc} - b_2 p^e - b_3 \log BRA + b_4 \log m_{-1} + u \tag{4d}$$

where m_{-1} is a one-period lagged real money balances, and other variables remain as defined above.

A substitution of Equation 4d into Equation 4c, coupled with a simple manipulation, then yields the following second velocity function estimated here:

$$\log V = b_0 + (1 - b_1)\log y^{pc} + b_2 p^e + b_3 \log BRA + b_4 \log m_{-1} + u. \qquad (5)$$

From theory, the income velocity is expected to be inversely related to the real income per capita (y^{pc}), as per Friedman's "luxury good" hypothesis. Similarly, in accordance with the demand for money theory, m_{-1} in Equation 5 is expected to be negatively related to the velocity.

The expected rate of inflation (p^e) should be positively related to the income velocity. That is, a rise in the opportunity cost of holding money balances would decrease demand for money to raise the income velocity. The same applies to rates of interest, which have also been tried in this study.[24] A positive relationship is also expected between the income velocity and the rate of monetization, proxied by BRA. An increased availability of banking facilities, as Short (1973) notes, first encourages the use of cheques and holding of demand deposits (DD); and, second, improves the information base of the depositors on the cost of holding currency (CC) and DD rather than time deposits (TD). People would hence economize on their CC and DD balances and use the remaining money balances more intensively, thereby increasing velocity.

Sources of data

The basic data employed to test the aforementioned hypotheses on income velocity are from the *Economic and Operations Reports* published by the Bank of Tanzania (BOT) and *Economic Surveys* and revised *National Accounts of Tanzania, 1976-1994* published by the Ministry of Planning and Development and the Bureau of Statistics, respectively. Data for BRA are from the publications of the National Bank of Commerce (NBC) only. This is the case because the bank has the largest network of branches, which mobilize the lion's share (around 90%) of the total commercial bank deposits in the country. It is worth noting that the National Consumer Price Index (NCPI) published by the bank of Tanzania forms the only deflator used in generating all real variables, except real income, which is at 1976 prices. The NCPI has also been used to generate the current and expected rates of inflation.

Approach and methods of analysis

Apart from a descriptive analysis, the above (semi-) natural log velocity functions have been estimated using the ordinary least squares method (OLS) for the four measures of velocity, namely V_0, V_1, V_2 and V_3.[25] Some of the functions were found to be plagued by varying degrees of serial correlation. This was corrected using the Cochrane-Orcutt first-order iterative procedure. As Appendix Table A5 shows, multi-collinearity problems

plagued the variables used. These problems, common in time-series data, were circumvented by dropping one of the collinear variables as long as by so doing the basic model remained meaningful.

The estimation of the velocity functions has been carried out for two sub-periods, 1967-1982 and 1983-1994, and for the overall period (1967-1994). The main factor characteristics in each sub-period that motivate the analysis in this study are highlighted below under the respective sub-periods.

The 1967-1982 period

This period was characterized by drastic changes in monetary institutions and shifts in macroeconomic management in Tanzania after the adoption of the Arusha Declaration in 1967. The demise of the East African Currency Board (EACB) and the concomitant formation of the Central Bank of Tanzania (BOT) in 1966 provided the possibility for an articulation of monetary policies and strategies to manipulate economic development. The BOT was expected to play an aggressive role in regulating and promoting economic growth and development. The importance of this task was heightened by the nationalization of foreign financial institutions and the creation of state-owned ones. This was followed by the adoption of the finance and credit plan (FCP) and the foreign exchange plan (FEP) in 1971, all implemented annually as components of the five-year finance plan, which involved "measures of monetary, fiscal, public debt, foreign exchange and foreign borrowing policies" (see Nyirabu, 1981).

In practice, during the period the increase in money supply was planned for under the money supply and credit allocation plan (MSCAP), which was a part of the FCP. In particular, in MSCAP the planned increases in money supply were carried out in accordance with "the forecast of the increase in demand for money (mainly equal to the increase in the nominal GDP including an assumed change in the rate of monetization of the economy)" (Nyirabu, 1981, p. 49). Accordingly, in this period the rate of change in broad money (M2) and real income (GDP) exhibited the same trend at least from 1967 until the experiences of drought and the two oil shocks in 1973 and 1975. These experiences led to a surge in domestic credit expansion and consequently rapid growth in broad money (M2) from 17% in 1973 to 24.7% in 1975 (see Appendix Table A5). The expansion in liquidity decreased slightly between 1976 and 1978 due to the 1976-1977 coffee boom, which drastically reduced the net debt of the government (see Ndanshau, 1982, p. 29). However, the collapse of the East African Community (EAC) and the war against Idi Amin of Uganda in 1978 and 1979 considerably increased the domestic credit expansion, which resulted in an unprecedented 54% growth in M2 in 1979.

The performance in the real sector, however, deteriorated from the impact of drought and rapid villagization on agricultural production. The growth in real GDP declined from 3.1% in 1967-1975 (in which the maximum rate was 5.8% in 1972 and the minimum rate was -6.8% in 1969) to 2% in the 1976-1982 period (in which the maximum rate was 6.1% in 1976 and the minimum rate was -0.5 in 1981). The surge in the rate of growth of the money supply coupled with stagnant rate of growth in real income and the price

control regime that existed during the period caused inflationary pressure. Inflation, which was only 3.4% in 1970, increased to 25.9% in 1975; by 1980 it had reached 30%, but averaged 28.25% in the 1980-1982 period.

The 1982-1994 period

In this period the Government of Tanzania implemented structural adjustment (SAP) and economic recovery (ERP) measures from 1982 to 1992. Among others, the policy measures emphasized strict monetary and fiscal stances to curb expansion of the money supply; reformed the financial sector to allow the entry of private financial institutions and deregulate interest rates to restore efficiency in the sector; and liberalized trade. In sum, the programmes practiced during the period aimed to put in place a market-led (price mechanism) system instead of the government controlled resource allocation system that existed from the mid 1960s until the mid 1980s.

The structural adjustment policies have resulted in a turn-around in growth. The real rate of growth in GDP rose from an average of 1.9% in the pre-reform period to an average of 3.86% in the 1986-1990 period and 4.11% during 1991-1994. The growth rates achieved, compared to those that prevailed in the pre-reform period, are encouraging. However, they are not only lower than the 4.5% targeted under the reform period, but have mostly oscillated between 3% and 4.9% (See Appendix Table A1). Similarly, this period has been characterized by failure to attain the targeted rate of inflation, set at 15%. Inflation averaged 32.25% in the 1983-1985 period and only decreased slightly to about 31.96% in the 1986-1990 period and 27.51% in 1991-1994. Due to the high inflation rates, the strides made to increase the nominal rates of interest failed to turn around the negative real interest rates to become positive. For, while the nominal interest rate on saving deposits increased from an average of 7.75% in 1982-1985 to an average of 21.20% in 1986-1980 and 25% in 1991-1994, real interest rates averaged -21.2% in 1982-1985 and -2.3% in 1991-1994 because of the high inflation during the period.

Whether the non-attainment of both economic growth and stability during this period is attributable to the policies or to the manner and the actualities under which they were implemented is beyond the scope of our study. Nonetheless, it suffices to note that the targeted rates of growth in money supply aimed at reducing the rate of inflation remained elusive. The broad money (M2) increased from an average of 17.6% in 1983-1985 to an average of 27.7% in 1986-1990 and 31.3% in 1991-1994. Similarly, the growth in the extended broad money (M3) averaged 33.8% in 1986-1990 and 36.02% in 1991-1994 (see Appendix Table A1). As in the pre-reform period (1967-1982), the rates of growth in money supply exceeded the planned rates, which averaged less than 20% per annum. For example, during 1994/95 M3 was targeted to increase by 13% but increased by 34.1% (Tanzania, Bank of, 1995, p. 11). As in the pre-reform period, the main source of the expansion in liquidity in this period was the expansion in domestic credit largely dominated by government borrowing from the banking system.

The two sub-periods are thus characterized by different developments with varying effects on the financial sector and consequently the real sector. Hence the sub-division of

the sample size into two estimation periods intends to test for a possible shift of the velocity function in the two periods. The behaviour of people (which influences their demand for money) depends on structural factors such as the uncertainty brought about by economic instability, wars and bold measures adopted to transform the economy to rely predominantly on market forces. Hence, the effect of these factors needs to be brought into perspective to establish their influence on the income velocity or demand for money. An alternative approach of using dummy variables to gauge the effects of these non-quantifiable factors on income velocity was also tried.

VI. Empirical findings

Descriptive evidence of velocity behaviour

The behaviour of income velocity and its comparison in the context of its four measures used in this study are presented in figures 1-5. It is evident that the velocities of currency in circulation (V_0), narrow money (V_1), broad money (V_2) and extended broad money (V_3) exhibit similar behaviour. Because of this similarity the discussion in this section is based on the velocity of broad money (V_2).

In the sample period there are three discernible phases in the behaviour of the income velocity that do not change with the definitions of money and income adopted.[26] First is the general sharp fall in velocity in the period between 1967 and 1978 (see area A in Figure 5).[27] In this period the income velocity (V_2), which averaged 3.88, fell continuously from 4.84 in 1967 to 3.62 in 1977. In this period the V_2 and V_1 averaged 3.9 and 3.8; both had a standard deviation of 0.4, that is, around 10% of the mean values, which implies a small deviation from the mean. As Figure A2 in the Appendix shows, the behaviour of the income velocity from 1967 to 1978 followed the changes in the stock of money and income. Thus, as the money stock increased the velocity fell, and as income increased the velocity rose (see Figure A1 in the Appendix). Indeed, a closer examination of the rates of growth leading to Figure A1 reveals that the behaviour of income velocity was more influenced by variation of the stock of money than the income.

A second feature of Figure 5 is the "puzzling trough" from 1978 to 1989 (see area B). In this period the velocity fell sharply from 3.81 in 1978 to a minimum of 2.51 in 1981 and thereafter rose to 5.1 in 1989. The mean velocity of the broad money (V_2) is 3.1 and the standard deviation is 0.8, that is about 26% of the mean, implying a very high deviation from the mean. With reference to the developments presented in Section V, the "puzzling trough" can be explained by the adjustment mechanisms in the financial sector. Given a perfect adjustment of prices to changes in money stock, or rather an equilibrium between desired and actual real money balances, the trough in the income velocity in Tanzania could be attributed to an increase and decrease in demand for money that would have accompanied the shortages of consumer goods and subsequent reduction thereof before and after liberalization policies. With the shortages, demand for liquidity would increase to address the uncertain supplies.[28] Jucker-Fleetwood (1958) observed for Finland and Sweden during World War I and for the USA and the United Kingdom during World War II that the firm-households had to hold excess liquidity either because they could not buy

Figure 1: Behaviour of the velocity of currency in circulation (V_0) 1967-1994

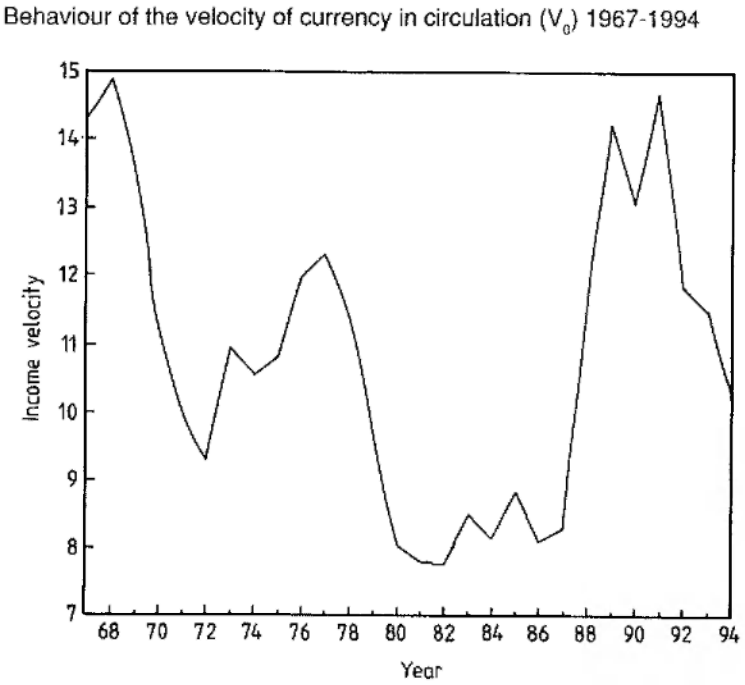


Figure 2: Behaviour of the income velocity of narrow money (V_1) 1967-1994

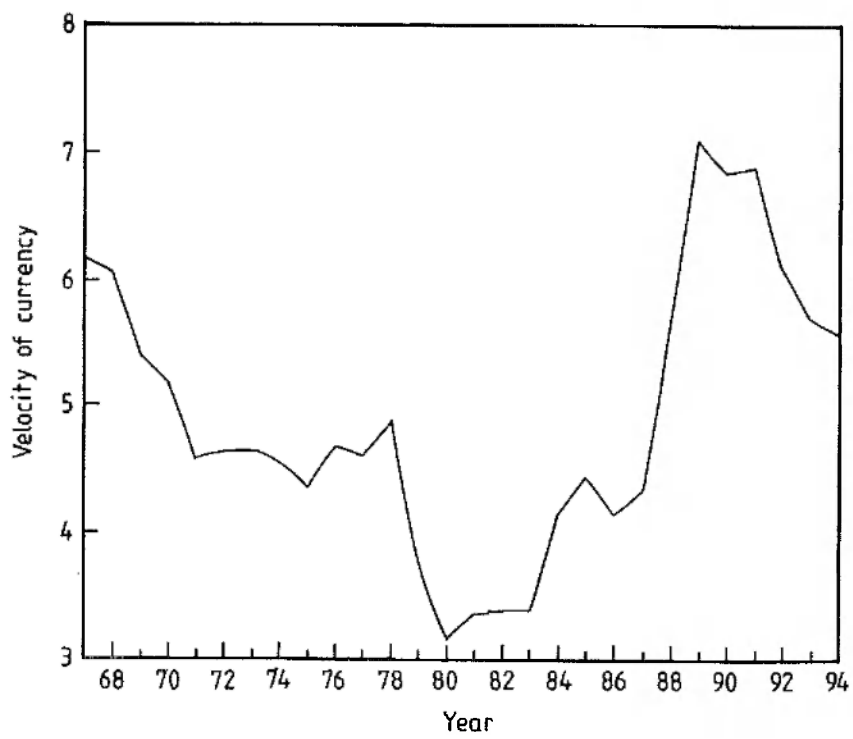


Figure 3: Behaviour of the income velocity of broad money (V_2) 1967-1994

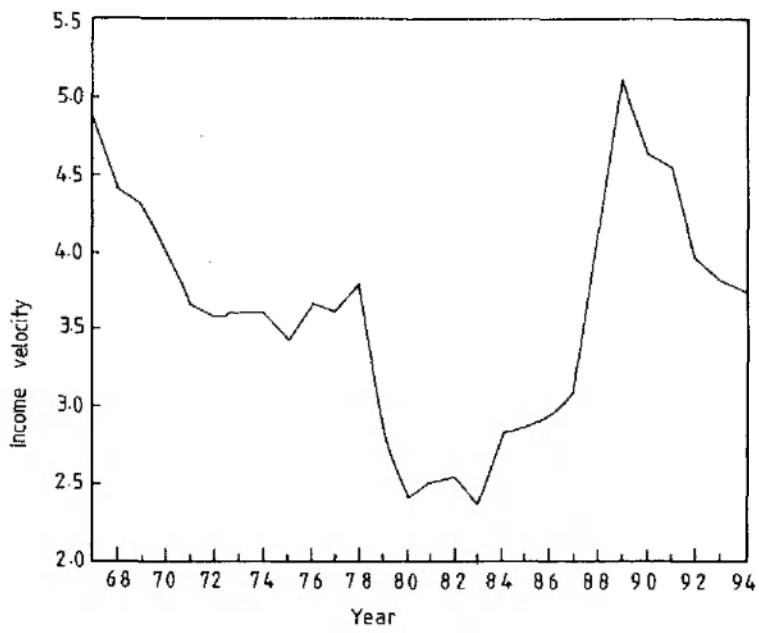


Figure 4: Behaviour of the income velocity of extended broad money (V_3)1967-1994

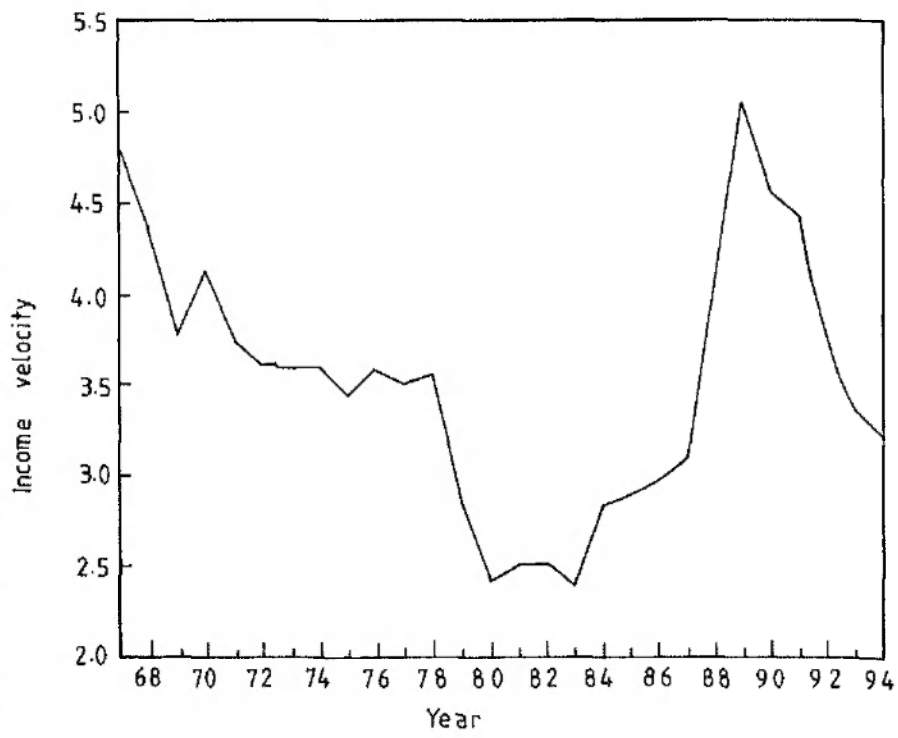


Figure 5: The income velocity of M2 and its three phases

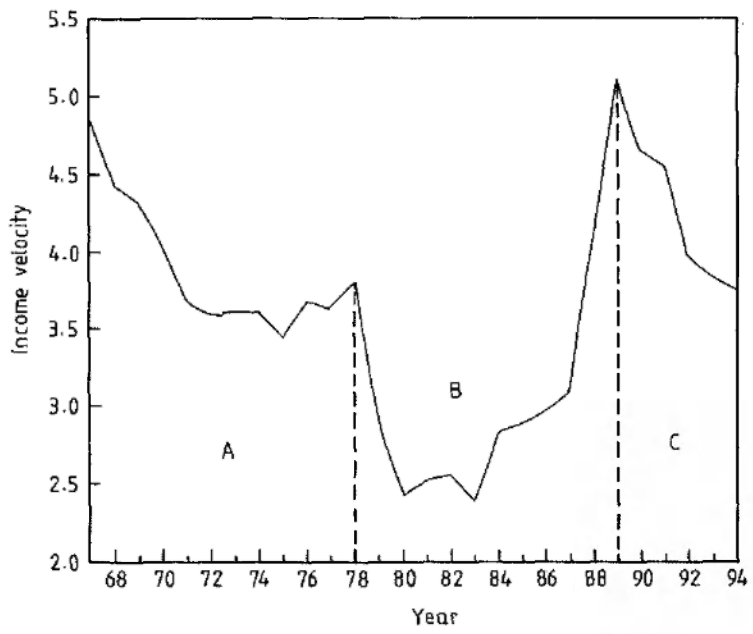
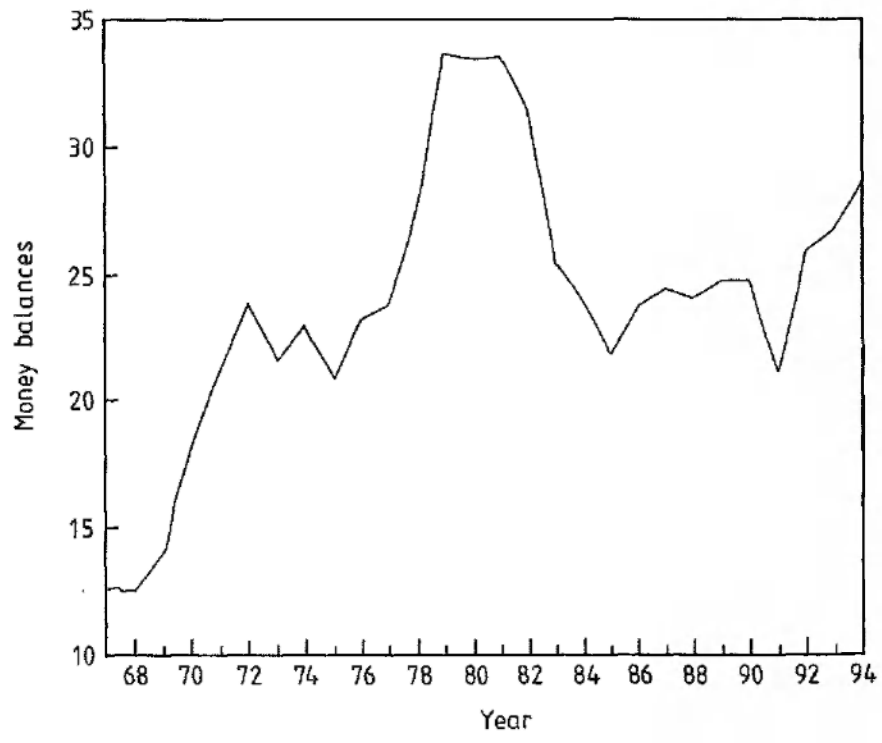


Figure 6: The time path of real money balances (M2) in Tanzania, 1967-1994



goods, or had to cover their credit requirements and increases in prices. The opposite would prevail during the period of abundance to increase the income velocity, as evident after 1983-1989.

Given the rigidities in Tanzania and other developing countries, such a high speed of adjustment of the financial sector to monetary shocks is virtually impossible. Instead, the development of the trough in the income velocity is better explained by the monetary emission phenomenon explained by Khan (1980a, p. 250):

> Because of a lagged effect between the change in the supply of money and the response of inflation or nominal income, a short-run 'increase in the rate of monetary emission results in a larger initial stock of real money balances, or what amounts to the same thing, that velocity tends initially to move in the opposite direction of the changes in monetary growth'.

The relevance of this phenomenon in explaining the trough in velocity in Tanzania is first seen in Figure A2, which shows the lagged inflationary effect on monetary emission. This response could also have been intensified by price controls existent until the mid 1980s. Second is the explosion in money supply in 1978, which, given the price adjustment behaviour, results in the "inverted cone" of the time-path of real money balances in Figure 6. The inverted cone is consistent with Khan's hypothetical time-path of real money balances, which underscores the monetary emission phenomenon.[29] In addition, therefore, the rising part of the velocity from 1983 may be explained by the measures taken to control the stock of money. As Wong (1977, p. 62) observes, "during tight credit policies, households and entrepreneurs tend to economize on available money balance and to rely more on the lenders in the non-organized markets in order to realize their planned expenditures; and the result of this is an increase in income velocity". Similarly, McKinnon (1973) contends that structural and economic recovery measures as adopted in Tanzania since the first half of the 1980s, which are "implemented through monetary contraction, invariably produce an initial rise in velocity of circulation (using M2) and hence a credit squeeze in real terms. Only later does declining inflation raise real money demand and so reduce velocity" (quoted in Fry, 1989, p. 64).

From these arguments, it is plausible that the trough in the income velocity in Tanzania is only a short-run deviation from the general falling pattern observed in other developing countries. The falling pattern seems to have emerged again in 1990-1994, which marks the third phase in the velocity behaviour. This can be seen in Figure 5, which shows a falling trend in income velocity of the broad money, V, (area C).

Econometric results

The regression results on the four measures of income velocity considered in this study are given in this section. For the purpose of clarity, the functions estimated are presented according to the two sub-periods adopted and also the overall sample period.

The time trend of the income velocity

Table 1 shows the results of the regression of the four measures of velocity over time:

$$V = a_0 + a_1 T \tag{7}$$

where T stands for time and its coefficient is expected to be negative.

The results show that in the 1967-1982 period the trend coefficients of the four measures of velocity of circulation have the expected negative sign and all are significant at the 1% level and above. However, in the 1983-1994 sub-period only the time trend coefficient of the currency in circulation (V_0) has the expected negative sign. The time trend coefficients of the remaining measures of the income velocity of narrow money (V_1), broad money (V_2) and extended broad money (V_3) are statistically significant at 10% and above but have an unexpected sign. In contrast, none of the trend coefficients in the estimated velocity functions for the overall period (1967-1994) are statistically significant at the customary test levels. The signs of the estimated coefficients are negative as expected, except the trend coefficient in the estimated velocity function of narrow money.

Chow's test suggests a shift in all the estimated trend functions for income velocity. However, the statistics of good fit, namely the adjusted- R^2 and F-statistics, for the sub-sample period regressions are higher than those for the overall sample, implying a better fit of the sub-sample regressions. Moveover, a comparison of the results in Table 1 and Table 2 shows that the overall sample regression results for all four measures of income velocity have relatively larger standard errors and standard deviations, which are about 20% of the mean values, implying poor fit of the estimated functions for the overall sample. In the overall, however, the estimated velocity function of the extended broad money (V_3) for the period 1967-1994 bears a relatively smaller standard error (0.21). For both the sub-sample and overall regression results, the estimated functions for V_3 have relatively smaller standard deviations, implying a relatively better fit than those of the remaining velocity measures.

Sub-period regression results

Table 3 gives the sub-period regression results for the four measures of income velocity based on function 3. The results show that in the 1967-1982 period the coefficient of per capita income, or rather the income elasticity of velocity of narrow money (V_1) and extended broad money (V_3), are negative as expected. The income velocity of currency in circulation (V_0) and broad money (V_2) have the opposite sign from that expected. None of the (per capita) income elasticities of the four measures are statistically significant at the conventional test levels. The expected inflation (p^e) has an unexpected positive sign and a very low impact on the income velocity. The results reveal the expected inflation to have significantly influenced all four measures of income velocity.

Table 1: Sub-period regression results for the behaviour of income velocity with respect to time

Dependent variable	Period	Constant	T	R^2	SE	D-W	F-stat.	Growth rate	Mean	SD
V_0	1967 - 82	13.849[a] (0.772)	-0.350[a] (0.080)	0.548	1.47	0.60	19.19	-0.03	10.92	2.19
	1983 - 94	1.200 (3.734)	-0.425[b] (0.164)	0.34	1.96	0.85	6.71	0.04	10.76	2.42
V_1	1967 - 82	5.993[a] (0.208)	-0.165[a] (0.022)	0.794	0.40	1.04	58.81	-0.04	4.59	0.88
	1983 - 94	-0.298 (1.695	0.251[a] (0.074)	0.485	0.89	0.65	11.36	0.05	5.34	1.24
V_2	1967 - 82	4.669[a] (0.159)	-0.130[a] (0.016)	0.805	0.30	0.96	63.09	0.04	3.56	0.68
	1983 - 94	0.117 (1.245)	0.158[b] (0.055)	0.400	0.65	0.62	8.36	0.05	3.67	0.84
V_3	1967 - 82	4.573[a] (0.140)	-0.127[a] (0.014)	0.835	0.27	1.23	76.76	0.04	3.49	0.66
	1983 - 94	0.988 (1.412)	0.113[c] (0.062)	0.175	0.74	0.54	3.34	0.03	3.54	0.82

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail tests of significance.

Table 2: Overall sample period regression results for the behaviour of income velocity with respect to time

Dependent variable	Period	Constant	T	R^2	Standard error	D-W	F-stat	Growth rate	Mean	Standard deviation
V_0	1967 - 94	11.435[a] (0.880)	-0.040 (0.053)	- 0.016	2.26	0.40	0.57	-0.004	10.85	2.25
V_1	1967 - 94	4.495[a] (0.423)	-0.029 (0.025)	0.010	1.09	0.27	1.28	-0.005	4.91	1.10
V_2	1967 -94	3.695[a] (0.294)	-0.006 (0.018)	-0.034	0.76	0.29	0.11	0.002	3.61	0.74
V_3	1967 - 94	1.292[a] (0.081)	-0.004 (0.005)	-0.013	0.21	0.30	0.64	0.004	1.23	0.21

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail tests of significance.

Table 3 also shows that in the 1983-1994 period the per capita income elasticity of velocity is not significant at the conventional test levels for any of the four measures. However, all the coefficients of income ealsticity have the expected negative sign. The coefficient of the expected rate of inflation has the expected positive sign for the estimated functions for V_1, V, and V_3, but not V_0. The results for the 1983-1994 period, even when corrected for serial correlation, show that the expected rate of inflation has a very low and statistically insignificant influence on income velocity, however measured.

Table 3: Sub-period regression results for standard velocity function

Dependent variable	Period	Constant	Log y^{pc}	p^e	R^2	SE	D-W	Rho	F-stat
log V_0	1967-82	2.129[a] (0.624)	0.057 (0.082)	-0.012[b] (0.005)	0.221	0.18	0.70		3.12
	1983-94	12.05 (7.759)	-1.317 (1.077)	-0.006 (0.008)	0.581	0.14	1.24	0.81	6.08[c]
log V_1	1967-82	1.759[a] (0.532)	-0.003 (0.070)	-0.015[a] (0.004)	0.397	0.15	0.86		5.95[c]
	1983-94	8.180 (8.415)	-0.947 (1.068)	0.009 (0.008)	0.585	0.15	1.11	0.98	6.17[c]
log V_2	1967-82	1.480[b] (0.526)	0.002 (0.069)	-0.016[a] (0.004)	0.446	0.15	0.88		7.04[a]
	1983-94	6.628 (7.780)	-0.779 (1.038)	0.008 (0.008)	0.595	0.15	1.19	0.96a	6.40[b]
log V_3	1967-82	1.097[b] (0.375)	-0.003 (0.026)	-0.006[b] (0.003)	0.820	0.08	2.02	0.87a	22.2[4]
	1983-94	4.822 (7.750)	-0.507 (1.080)	0.003 (0.008)	0.604	0.14	1.12	0.80	6.59[c]

Note: Figures in parentheses are the standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance (one tail).

The regression results for the expanded velocity function 5 in the sub-period presented in Table 4 reveal that in the 1967-1982 period the income elasticity coefficient is statistically insignificant and has an unexpected positive sign for all four measures. In this period the coefficient of the expected rate of inflation (p^e) has an unexpected negative sign, which does not conform to the standard demand for money theory. The estimated coefficient of p^e is, however, only significant at 10% in the estimated function for V_3. The coefficient of the number of bank branches (BRA) has the expected positive sign in

Table 4: Sub-period regression results for the expanded velocity function

Depencent variable	Period	Constant	Log y^{pc}	p^e	Log BRA	Log m^{-1}	R^2	SE	D-W	F-stat
log V_0	1967-82	3.445[a]	0.046	-0.001	0.294[a]	-0.854[a]	0.832	0.08	1.64	18.39
		(6.346)	(0.039)	(0.003)	(0.092)	(0.134)				
	1983-94	2.814	-1.388	-0.002	1.350[a]	0.810[b]	0.690	0.12	1.54	7.12
		(6.883	(1.077)	(0.009)	(1.350)	(0.427)				
log V_1	1967-82	2.885[a]	0.023	-0.003	0.219	-0.296[a]	0.774	0.09	1.74	13.01
		(0.394)	(0.043)	(0.004)	(0.140)	(0.083)				
	1983-94	-4.890	-0.020	0.008	1.335[a]	-0.033	0.792	0.11	1.59	11.47
		(8.919)	(1.276)	(0.008)	(0.349)	(0.098)				
log V_2	1967-82	2.702[a]	0.027	-0.003	0.224	-0.301[a]	0.869	0.08	1.83	16.52
		(0.377)	(0.040)	(0.003)	(0.127)	(0.076)				
	1983-94	-6.796	0.205	0.009	1.402[a]	-0.070	0.736	0.12	1.57	8.66
		(9.871)	(1.414)	(0.008)	(0.384)	(0.106)				
log V_3	1967-82	2.628[a]	0.022	-0.005[c]	0.180[c]	-0.265[a]	0.871	0.07	2.10	24.65
		(0.303)	(0.032)	(0.003)	(0.102)	(0.060)				
	1983-94	-6.223	0.077	0.009	1.652[a]	-0.155	0.695	0.12	1.48	7.26[b]
		(10.153)	(1.458)	(0.009)	(0.380)	(0.102)				

Note: Figures in parentheses are the standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail tests of significance.

all four measures of velocity but the coefficient is only statistically significant at 1% and 10% test levels in the velocity function of currency in circulation V_0, and extended broad money V_3, respectively. In the same period the coefficient of the lagged real balances (m_{-1}) has the expected negative sign and is very significant in all four measures of the income velocity.

The regression results of function 5 for the 1983-1994 period show that the income elasticity of velocity of currency in circulation and narrow money has the expected negative sign, and that of broad and extended broad money has an unexpected positive sign. For all four measures of velocity the coefficient of income elasticity, the expected rate of inflation and lagged real money balances are statistically insignificant, and the coefficient of the bank branches (BRA) has the expected positive sign and is statistically significant at 1% test level. Moreover, for all four measures of velocity the coefficient of the expected rate of inflation (p^e) is statistically insignificant at the conventional test levels and has the expected sign in the estimated functions of V_1, V_2 and V_3, but not V_0 for which the sign remains negative as in the 1967-1982 period.

Comparing the results in Tables 3 and 4 it can be seen that the inclusion of BRA as a proxy for monetization and M_{-1} to capture the lagged effect of real money balances lowered

the impact and significance of the coefficient of per capita income in the estimated function for V_0 but decreased and changed the sign of the income elasticity coefficient of V_1, V_2 and V_3 in the 1967-1982 period. Conversely, in the 1983-1994 period the income elasticity coefficient of the currency in circulation increased while that of narrow money, broad money and extended broad money decreased. Moreover, in the 1983-1994 period the sign of the income elasticity coefficient of V_0 and V_1 remained negative as in the standard velocity function, but that of the estimated expanded velocity function for V_2 and V_3 became positive. For all four measures of velocity estimated for the two sub-periods, the inclusion of BRA and m_{-1} lowered the significance level of the coefficient of the expected rate of inflation. However, from the statistics of good fit reported in Tables 3 and 4, it can be seen, first, that the introduction of BRA and m_{-1} improved the explanatory power of the standard velocity function of the currency in circulation (CC), narrow money (M1) but not broad money (M2), and extended broad money (M3). This may imply that the number of commercial branches (BRA), used as a proxy of monetization, better affects currency in circulation and demand deposits than quasi-money (savings and time deposits). Second, it remains evident that the estimated income velocity of extended broad money (V_3) bears relatively lower standard errors and deviations from the mean. The adjusted R^2 and the D-W statistics are low, however, implying possible multicollinearity problems.

To confirm multicollinearity as a problem, Appendix Table A6 shows high correlation between y^{pc}, BRA, inf and cc_{-1}. Dropping BRA to circumvent the multicollinearity problem led to varied effects on the velocity functions estimated for the two sub-periods. In the 1967-1982 period estimates, the statistics of good fit for V_0 deteriorated to show a reduced explanatory power of the estimated function of the velocity of the currency in circulation (CC). In contrast, the statistics of good fit in the estimated functions for narrow money (M1), broad money (M2) and extended broad money (M3) improved to show an increased explanatory power of the estimated functions. The statistical significance of the coefficients was not affected by the dropping of BRA. However, a comparison of Table A4 and Appendix Table A4 shows that dropping BRA from function 5 not only drastically reduced the explanatory power of the model, but also specifically reduced the explanatory power of variables in the estimated function for V_0, and increased that in the estimated functions for V_1, V_2 and V_3 in the 1983-1994 period. Generally, this suggests that BRA is an important explanatory variable in the estimated income velocity functions for the 1982-1994 period.

Appendix Tables A4a-A4d first show that the monetization ratio (MoR) has a positive but insignificant effect on the income velocity, however defined. Similarly, the results show that the currency-to-money (C/M) ratio has an insignificant and perverse effect on all the four measures of the velocity. As is also evident, introduction of the C/M ratio in the expanded velocity function 5 lowered the impact of per capita income and lagged money balances on the income velocity, but improved the explanatory power of the models estimated. Furthermore, the results in Appendix Tables 4a-4d show that real interest rates significantly influenced the income velocity in the 1983-1994 period. However, it is evident that the significance of real interest rates undermined the explanatory power of the lagged money balances, but caused the coefficient of the income velocity to bear the expected negative sign for all four measures of the velocity. In absolute terms

Table 5: Overall s ample period regression results for the standard and expanded velocity function

Dependent variable	Equation number	Constant	Log y^{pc}	p^e	Log BRA	Log m^{-1}	R^2	SE	D-W	Rho	F-stat.
log V_0	3	2.211[a]	0.020	-0.002			0.618	0.12	1.43	0.77[a]	15.04
		(0.344)	(0.043)	(0.004)							
	5	3.129[a]	0.052	-0.007	0.249	-0.685	0.447	0.15	1.03		6.27
		(0.634)	(0.071)	(0.005)	(0.086)	(0.152)					
log V_1	3	1.693[a]	-0.017	-0.001			0.728	0.12	1.24	0.86[a]	24.18
		(0.335)	(0.038)	(0.003)							
	5	-0.800	-0.015	-0.003	0.331	0.083	0.746	0.11	1.46	0.85	15.69
		(1.655)	(0.037)	(0.003)	(0.257)	(0.107)					
log V_2	3	1.346[a]	-0.014	-0.001			0.711	0.11	1.29	0.83	22.28
		(0.313)	(0.037)	(0.003)							
	5	-0.565	-0.013	-0.003	0.258	0.057	0.696	0.11	1.44	0.87	12.45
		(1.759)	(0.038)	(0.004)	(0.261)	(0.114)					
log V_3	3	1.280	-0.006	-0.003			0.691	0.11	1.33	0.81[a]	20.42
		(0.310)	(0.038)	(0.003)							
	5	-0.357	-0.005	-0.004	0.319	0.006	0.671	0.11	1.49	0.85[a]	11.18
		(1.505)	(0.038)	(0.004)	(0.250)	(0.098)					

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for the 1%, 5% and 10% two-tail tests of significance.

the income elasticity coefficients also increased relative to that obtained in the estimated function, which included the expected rate of inflation as a proxy for the interest rates.

Regression results for the overall sample period

The results from the estimation of functions 3 and 5 for the overall sample period, that is from 1967-1994, are presented in Table 5. The results show that all velocity measures, except V_0, have the expected negative sign, implying that income velocity is inversely related to economic growth as proposed in theory. Nonetheless, none of the coefficients is significantly different from zero at the conventional test levels.

Similarly, the coefficient of p^e is statistically insignificant and has an unexpected negative sign in all estimated functions for both the standard and expanded velocity functions.[30] The coefficient of the number of bank branches (BRA) in the standard and expanded velocity functions 3 and 5 has the expected sign but is not significant at the

customary test levels.[31] The coefficient of the lagged real money balances, introduced in the velocity functions estimated to capture the short-run effect of the monetary shocks on the income velocity and conversely the demand for money, has the expected negative sign only in the velocity function of currency in circulation (V_0). The coefficient, however, is not significant in any of the four estimated functions.[32] In general, the standard velocity function estimated for all four definitions shows better explanatory power than the expanded models.

VII. Conclusions

This study set out to investigate income velocity in Tanzania. The models used, which incorporate demand for money hypotheses, have been estimated for the four definitions of velocity, namely the income velocity of currency in circulation (V_0), narrow money (V_1), broad money (V_2) and extended broad money (V_3).

The income velocity was analysed by descriptive and econometric methods. The models estimated by the ordinary least squares (OLS) method are two-fold. The standard velocity function, which includes a scale variable and the opportunity cost of holding money balances, and an expanded model, which incorporates institutional variables and one-period lagged real money balances as an additional variable. The overall sample period covered is from 1967-1994. However, it was found necessary to study the velocity in three periods — 1967-1982, 1983-1994 and then the entire period from 1967-1994 – to establish possible shifts in the income velocity function estimated. Chow's test was employed to check if the estimated functions were significantly different.

The descriptive analysis of income velocity revealed four aspects. First, the behaviour of income velocity was found to exhibit the following main phases: a continuous fall during the period from 1967-1978; a "puzzling trough" in the 1979-1985 period; and a cyclical pattern in the rest of the sample period. Second, the behaviour of income velocity was not significantly influenced by the measures adopted for the volume of total transactions (GDP or GDFD) nor the use of quarterly-averaged rather than end-of-period data for the stock of money. Similarly, use of an incremental approach to define the stock of money revealed that the extended broad definition of money (M3) provided "better behaved" income velocity, with a relatively smooth pattern, free of seasonal fluctuations.

Third, the "puzzling trough" that developed from an exceeding expansion in the stock of money is explained by the monetary emission phenomenon. This means the lagged effect of price adjustment to monetary emission drastically increased the real money balances to cause a fall in income velocity. The gradual adjustment of prices, coupled with a lift of price controls and a check on the money stock, explains the increasing part of the velocity in the period after 1982. Fourth, the course of the income velocity was established to be inversely related to the changes in money supply, especially in the period before 1982. In this period there was a trough in the velocity when the growth in money supply was at its peak.

Generally, the descriptive analysis leads to the conclusion that income velocity in Tanzania exhibited a falling pattern in the 1967-1994 period. The overall regressions of income velocity on time variable showed that only the velocity of narrow money was not inversely related to the time trend variable in the two sub-periods. However, in support

of the descriptive evidence, the other three measures of income velocity were found to decrease with time from 1967-1982 and increase in 1983-1994. Thus the estimated velocity functions for the two sub-periods were significantly different.

The regression results are not completely conclusive for the main hypotheses tested on the secular behaviour of the velocity, the opportunity cost of holding money, rate of monetization and financial development. The overall estimated standard velocity function had the expected negative sign for the per capita income elasticity for all velocity measures, except that of the velocity of currency in circulation. This implies that, by excluding the velocity of currency in circulation, income velocity in Tanzania has been a decreasing function of the per capita income, as hypothesized on the secular behaviour of velocity in a developing country. However, according to our results the per capita income is an insignificant determinant of income velocity in Tanzania over the sample period 1967-1994.

The results of the estimated standard and expanded velocity models also show that the income velocity in Tanzania is a decreasing function of the expected rate of inflation. The explanatory power of the expected rate of inflation in the standard model is quite weak; the elasticity coefficients calculated at the mean are elastic for the velocity of currency in circulation, broad money and extended broad money, and inelastic for the income velocity of narrow money. The currency-to-money ratio was found to be an insignificant determinant of income velocity, and the real interest rate is established as a significant determinant of the velocity. In contrast, lagged real money balances have been established to bear an insignificant effect on income velocity in Tanzania.

Policy implications

In Tanzania and other developing countries, policies are designed to influence economic growth and conducive price levels on the basis of the income velocity. A good understanding of the behaviour and determinants of income velocity, or the nature of the demand for money function, is therefore required. However, the evidence from our study casts doubt on the reliability of income velocity as an input for the formulation of monetary policy in Tanzania in several respects. First, this is due to the shift of the income velocity function within the study period, while the reliability of income velocity in deploying effective monetary policy depends on its stability.

Second, the results (which were not wholly consistent with the hypothesis of the secular behaviour of income velocity) imply that "the money issuing authorities cannot issue more money and obtain a greater leverage on resources than if velocity were constant or rising" (Short, 1973, pp. 291-92). In relation to this is the high elasticity of the expected rate of inflation with respect to income velocity. Since inflation taxes money balances, its high elasticities (especially in the expanded velocity function) suggest that an increase in inflation would lead to a rapid substitution of money balances for inflation hedges. The chances of monetary authorities in Tanzania generating inflation tax revenues by issuing money would thus be limited.

The positive correlation between the income velocity and the number of bank branches

demonstrates the importance of the latter in the process of monetization. For policy purposes it could be contended that the insignificance of the bank branches in explaining income velocity requires an increased effort to avail financial services to check holding of real money balances. Similarly, the positive but insignificant influence of the currency-to-money ratio on income velocity underscores the importance of the spread of commercial banking activities on the demand for money in Tanzania. In fact, because of the very lucid line between the effect of monetization and financial deepening on income velocity and, conversely, the demand for money, it could be concluded that the currency-to-money ratio provides a better proxy measure for both. The results of the study also underscore the importance of real interest rates, partly in modeling income velocity and conversely the demand for money, and partly in the design of management stabilization policies.

Limitations of the study

Attainment of accurate results in any econometric analysis is often subject to a number of limitations. In this study at least four limitations are noteworthy. First is the general methodological problem pertaining to the data and measurement of variables. The variables and respective data used in this study are far from being consistent with the theoretical definitions. Instead, a number of proxies have been used, thus limiting the inferences that may be drawn from the results. Similarly, for generalization purposes the definitions and measurement of the variables used may narrow the comparison of the results generated to only similar studies in Tanzania. However, as a country-specific study the results are worthwhile.

Second is the fact that any inference on the estimators obtained has to be made with caution because of the problem of multicollinearity in the data and the presence of serial correlation. This is notwithstanding measures to circumvent both problems, as that could also bias the parameter estimates. Additionally, other factors that are non-quantifiable but exert significant effects on the income velocity were not adequately taken into consideration. These include economic and political stability, non-bank financial intermediaries (NBFI), existence of an underground economy, and economic reform measures adopted in the 1980s and pertaining price adjustment mechanisms. These aspects definitely influence the way expectations are formed in the economy and ipso facto the demand for money. A further study that considers the effects of these variables would improve and extend our frontier of knowledge on income velocity and the demand for money in Tanzania.

Notes

1. See studies by Groes (1966), Loxley (1971) and Kimei (1986), which provide velocity statistics, and a study by Phiri (1989) that analyses income velocity behaviour in Tanzania.

2. It is assumed that the T is constituted by the final stage purchases in an economy such that y is used to denote real national income.

3. The Cambridge School demand for money function is: i) $M^d = kPy$, where k is a proportion of nominal income (Py) people desire to hold in money balances (M^d). From Fisher's equation of exchange (1) it is clear that: ii) $M^d = 1/vPy$.

4. Quoted by Ezekiel and Adenkula (1969).

5. The contention held is that use of aggregate demand for money function is fraught with a specification error that arises from varied sectoral demand for money functions. For the studies that have followed this line of thinking, see Goldfeld (1976) and Driscoll and Lahiri (1983).

6. These studies have been on the USA and have been championed by experts at the Federal Reserve Bank of St. Louis. Among others, see Andersen (1975), Stone and Thornton (1987), Santoni (1987), and Ghosh (1988).

7. This includes studies by Klein (1973), Hanson and Vogel (1973), and Latane (1960) that explore the impact of interest rates and inflation on income velocity; and the studies by Jonung (1978) and Bordo and Jonung (1981, 1985), which emphasize influences of institutional factors in the income velocity function.

8. In the last two decades, see Stone and Thornton (1987), Klein (1973), and Andersen (1975).

9. Similarly, Short (1973, p. 292) is skeptical on whether "it is justifiable to conclude that, what is true for the United States, or what is true over cross-sections of developed and underdeveloped countries is true over time for any single underdeveloped economy".

10. Using the USA data and a broad definition of money Friedman (1959, 1966) was unable to find a close connection between interest rates and the cyclical behaviour of income velocity. However, a study by Meltzer (1963) concludes that both demand for money and velocity depend on interest rates. As noted, the poor performance in the results by Friedman resulted from the non-consideration of autocorrelation problems. Yet Adenkule (1968) shows that the demand for money is interest elastic in developing countries while, for example, Biswas (1962) and Gujarat (1968) have shown that the demand for money is not sensitive to either short-term or long-term government bonds interests. Generally, the great debate on interest rates has been propagated by the monetarists' belief in the importance of interest rates in the demand for money and the Keynesians' counterview.

11. See the standard velocity function 3 below, which has only a scale variable and the expected rate of inflation as proxy for the opportunity cost of holding money.

12. The focus on velocity has potential for resolving the still existing debate on whether the monetarist rather than Keynesian monetary theory is more appropriate and applicable in developing countries. For a detailed discussion of this aspect, see among others, Park (1972, 1973).

13. Friedman (1956) quoted in Stone and Thornton (1987, p. 11).

14. According to estimates generated by Malyamkono and Bagachwa (1990) the income of the underground economy in Tanzania as a proportion of the GDP increased from 6.6% in 1975 to over 30% in 1986 (see Table 2.4, p. 144). The estimates by Mtatifikolo show that, as a share of GDP, the income of the underground economy increased from 5.2% in 1978 to 33.6% in 1987.

15. One of the approaches is one proposed and used by Diz (1970) and recently used by Naho (1985).

16. In this study a one-period lagged per capita income has been used as proxy for the permanent income.

17. On this aspect and the arising problems in estimating velocity or demand for money function, see Newlyn (1967), Mason (1976), Coats and Katkhate (1979), Batten and Thornton (1985), Stone and Thornton (1987, especially p. 13), and Ghosh (1988), among others. For example, Newlyn notes that the "doubt where you draw the link between money and claims on money has a long history and is complicated by the fact that the correct answer has not always been the same because of the changes in the form of money as between different stages of monetary development". For Tanzania, Loxley (1971) has argued that there are strong grounds, both theoretical and practical, for using quasi-money in the definition of money. Park (1973) notes, however, that the prevailing consensus on demand for money

(and analogously income velocity) points to M1 as the most appropriate definition of money.

18. It would be important therefore to calculate velocity using the official GDP data and a sum of the money circulating in the official and underground economy to get a better estimation of the velocity function. However, how to estimate the money circulating in the underground economy remains a problem (see Ghosh, 1988). Indeed, even the monetary approach used to estimate the size of the underground economy, from which the underground money could be inferred, is based on a key assumption that the velocity in the underground economy is the same as in the official economy. For these methods and their complications, see Feige (1989).

19. Though suggested, the monetization ratio is bedeviled with serious data problems. Besides, Driscoll and Lahiri (1983) have argued that its use in time-series study treats the crucial phenomenon of monetization as autonomous.

20. The number of bank branches has been used by, among others, Short (1973), Khan (1980), Bordo and Jonung (1981), and Phiri (1989). The Goldsmith's classification was used in the cross-country study of velocity by Melitz and Correa (1970), but its plausibility is questioned by Wallich (1971) and Hanson and Vogel (1973). Other proxies for monetization include a measure of urbanization used by Melitz and Correa (op cit.), and share of labour in non-agricultural pursuits used by Bordo and Jonung (1981). For a detailed explanation of monetization and other proxies, see Jonung (1978, pp. 221-22).

21. In the sample covered by this study the data for non-monetary output in Tanzania were only available from 1967 to 1982. Since then an estimation of the non-monetary sector's output was ended because of an unexplained tendency of the sector to grow rather than decline.

22. On the limitation of using interest rates in developing countries, see Ezekiel and Adenkule (1969) and Wong (1977), among others.

23. For a similar argument, see Khan (1980a, pp. 253-54) and Ojo (1974).

24. The real interest rates on saving and borrowing were generated using the following formula: $r = (1 + i)/(1 + p^e) - 1$, where r is the real interest, i is the nominal rate of interest and p^e is the inflation rate.

25. From the equation of exchange the four definitions are:
    1) $V_0 = GDP/CC_p$ 2) $V_1 = GDP/M1$
    3) $V_2 = GDP/M2$ 4) $V_3 = GDP/M3$

where V_0 is the velocity of currency circulation; V_1 is the velocity of narrow money, M1; V_2 is the velocity of broad money, M2; and V_3 is the velocity of extended broad money.

26. The GDFD and quarterly average data for money stock rather than GDP and annual money statistics were tried to check for the definitional and measurement problems of the volume of transactions in the economy. However, the use of the GDFD caused the velocity to fluctuate more than when the GDP was used but still retaining the main pattern of behaviour, which was more pronounced in the period prior to 1975 and in the brief period between 1984 and 1987. The use of quarterly averaged data for money supply to some extent circumvented the seasonality but did not significantly lead to a different pattern in the behaviour of the income velocity.

27. This is in sharp contrast to the rising behaviour of income velocity calculated by Kimei for the period prior to 1967 (see Chart A-7 in Appendix A). In the even much earlier period from 1954 to 1960, Loxley (1971) established much more pronounced consistency and even more significant increase in the income velocity, which continued to the mid 1960s. According to Loxley, the increase in income velocity in the period prior to 1967 resulted from a very rapid growth of a wide range of financial intermediaries, growth of money substitutes, expansion banking facilities and spread of a banking habit.

28. From Friedman's permanent income hypothesis (PIH) a period of shortages may be claimed to constitute the "boom" rather than slump period for the firm-households as that would tend to lead to increased legal and illegal profit opportunities.

In contradistinction, the slump period for the private firm-households would prevail during economic recovery that reduces shortages of goods. In the "boom" and "slump" periods the transitory income would, respectively, become positive and negative. Accordingly, demand for money balances would decrease during the "boom" and increase during the "slump" period, as a rise (during the "boom") and fall (during the "slump") in transitory income would cause a recourse to the windfall savings in money balances to finance or to sustain the previous level of economic activity and consumption. Thus the "slump" period would be accompanied by economizing on cash balances such that the velocity would rise – and conversely fall during the "boom" period. This "inversion" of the PIH to resolve the trough in income velocity in Tanzania is in line with a perception of money holding as a shock-absorber asset element in the balancesheets of the firm-households, which is increased temporarily when the transitory income is positive and is drawn down, if necessary, to finance consumption when transitory income is negative (see Friedman, 1959, p. 333).

29. See Khan (1974), Figure 1, p. 255. It is worth noting that the inverse relation

inverse relation between changes in money stock and velocity is also quite evident in the late 1960s and 1970s and towards the mid 1980s. See Chart 8-a. .

30. Some studies which have established a positive correlation between the income velocity and inflation used the current rate of inflation rather than the expected rate of inflation. See, for example, Ezekiel and Adenkule (1969); Hanson and Vogel (1973) and Short (1973). Others have used the current rate of inflation by evoking an assumption of static inflationary expectations. Phiri (1989) used the expected rate of inflation generated by the adaptive expectation method in Tanzania and also got results consistent with ours.

31. Short (1973) found the number of bank branches to have a powerful and significant positive influence on the income velocity. Phiri's study (1989) in Tanzania also found that BRA and V_0, V_1 and V_2 were positively correlated, and that the elasticity of BRA with respect to V_1 and V_2 were statistically significant. On the statistical significance our results are consistent with the evidence obtained by both studies.

32. The coefficients of adjustment are 0.53, 0.77, 0.60, and 0.73 for the income velocity of currency in circulation (V_0), narrow money (V_1), narrow money plus saving deposits (V_3), and broad money (V_2), respectively.

Appendix

Table A1: Various measures of income velocity and per capita income in Tanzania, selected years

Year	Real GDP growth	Growth M1	Growth M2	Growth M3	V_0	V_1	V_2	V_3	Real per capita income
1967	-	-	-	-	14.3	6.2	4.8	4.8	1400.10
1968	4.5	8.8	17.5	17.8	14.9	6.1	4.4	4.3	1424.15
1970	4.8	14.9	18.7	18.2	11.2	6.1	4.0	4.1	1430.80
1972	5.8	12.1	16.3	17.7	9.3	4.6	3.6	3.6	1461.20
1974	2.3	24.5	22.2	22.1	10.5	4.5	3.6	3.6	1321.20
1976	6.1	22.7	22.5	25.1	12.0	4.7	3.7	3.6	1328.00
1978	2.2	6.9	8.2	12.6	11.4	4.9	3.8	3.5	1273.05
1981	-0.5	15.4	18.2	18.1	7.8	3.4	2.5	2.5	1215.50
1982	0.6	19.0	17.9	19.5	7.7	3.4	2.5	2.5	1185.00
1983	-2.4	12.2	19.9	17.8	8.5	3.4	2.4	2.4	1167.45
1985	4.6	23.0	29.3	29.0	8.8	4.4	2.9	2.9	1172.85
1986	1.9	41.7	29.0	29.0	8.1	4.1	2.9	2.9	1181.10
1989	4.0	26.0	28.5	29.5	14.2	7.1	5.1	5.0	1223.90
1990	4.5	34.8	42.1	43.3	13.1	6.8	4.6	4.5	1262.00
1991	5.7	22.4	26.1	26.9	14.7	6.9	4.5	4.4	1162.00
1992	3.5	36.7	38.4	42.7	11.8	6.1	4.0	3.7	1304.00
1993	4.2	32.9	28.8	39.3	11.5	5.7	3.8	3.3	1321.00
1994	3.0	32.8	31.9	35.1	10.3	5.5	3.8	3.2	1287.00

Note: V0, V1, V2 and V3 are the velocity of C, M1, M2 and M3, respectively. The real per capita income is at 1976 prices.

Table A2: Money stock and some of its important ratios

		1967	1970	1974	1976	1978	1980	1982	1984	1985	1986	1989	1991	1993	1994
1	Money stock (M2) (m.sh.)	1520	2279	4437	6779	8770	17405	2425	30125	38884	50235	114807	205818	367095	484037
2	Money stock (M3) (m.sh.)	1540	2220	4462	6947	9396	17520	24729	30218	38971	50353	116295	211579	420635	568430
3	Demand deposits (DD) (m.sh.)	680	947	1995	3260	3912	8100	10334	10065	12551	17500	41323	72321	124924	151837
4	Currency held by public (C) (m.sh.)	512	818	1517	207	2915	5245	7988	10472	12719	18309	41094	63604	122167	176406
5	(3) as % of (1)	44.7	41.5	45.0	48.1	44.6	46.5	42.6	41.5	32.3	34.8	36.0	35.1	34.0	31.4
6	(3) as % of (2)	44.2	42.7	44.7	46.9	41.6	46.2	41.8	33.3	32.2	34.7	35.5	34.2	29.7	26.7
7	(4) as % of (3)	75.2	86.4	76.0	63.5	74.5	64.7	77.3	104.0	101.3	104.6	99.4	87.9	97.87	116.2
8	(4) as % of (1)	33.7	35.9	34.2	30.5	33.2	30.1	32.9	34.8	32.7	36.4	35.8	30.9	33.3	36.4
9	(4) as % of (2)	33.2	36.9	34.0	29.8	31.0	29.4	32.3	34.7	32.6	36.4	35.3	30.1	29.0	31.0

Source: Bank of Tanzania, *Economic and Operation Report*. (various issues).

Table A3: Structure of Interest rates in Tanzania, 1985-1994

	Saving deposit		Short-term deposit		Fixed deposit		Short-term lending rate[1]		Medium- and long-term lending		Inflation
Year	Nominal	Real	Nominal	Real	Nominal[1]	Real	Nominal[1]	Real	Nominal[1]	Real	
1985	10.0	-17.5	5.0	-21.2	10.0	-17.5	13.5	-14.7	13.5	-14.8	33.3
1986	10.0	-16.9	5.0	-20.7	10.0	-16.9	13.5	-14.2	13.5	-14.3	32.4
1987	21.5	-6.5	14.5	-11.9	21.25	-6.7	23.5	-5.0	24.0	-4.6	30.0
1988	21.5	-7.4	14.5	-12.7	21.25	-7.6	23.5	-5.9	24.0	-5.5	31.2
1989	26.0	-3.4	16.0	-11.0	23.0	-5.7	25.5	-3.8	26.0	-3.4	30.4
1990	26.0	-7.3	16.0	-14.6	23.0	-9.5	25.5	-7.6	26.0	-7.3	35.9
1991	26.0	-2.2	16.0	-9.9	23.0	-4.5	25.5	-2.6	26.0	-2.2	28.8
1992	26.0	+3.4	16.0	-4.8	23.5	+1.3	24.5	-18.0	30.0	+6.6	21.9
1993	24.0	+0.96	17.0[1]	-7.8	23.5	-1.4	26.5	+1.0	30.0	+3.8	25.2
1994[1]	25.0	+4.0	17.5[1]	-9.7	23.75	-4.9	33.35	+2.4	31.5	+1.0	30.2

Note: Average real interest rates calculated as a ratio of (1 + rate) to (1 + inflation rate) less a unit.
Source: Based on Tanzania, Bank of (1994), Table 1.14, p. 68.

Table A4a: Sub-period regression results for income velocity of currency in circulation (V_0), using proxies

Period	Equation number	Constant	Logy^{pc}	i_s	p^c	Log m1$_{-1}$	Log C/M$_1$	Log MOR	R_2	SE	D.W.	Rho	F-stat.
1967-82	3	1.553[a]	-0.006		-0.003		-0.756		0.751	0.10	1.39	0.87[a]	11.58
		(0.478)	(0.034)		(0.003)		(0.358)						
	5	2.782	0.023		-0.003	-0.468	-1.037		0.833	0.08	1.51		18.52
		(0.370)	(0.042)		(0.003)	(0.080)	(0.324)						
	5	3.872	0.078		0.001	-0.558[a]		0.309	0.701	0.11	1.17		9.20
		(0.716)	(0.050)		(0.004)	(0.114)		(0.275)					
1983-94	3	4.846	-0.511		0.010		-1.264		0.462	0.16	1.22	0.96[a]	3.359
		(10.781)	(1.397)		(0.012)		(0.778)						
	3	8.557	-0.946	0.027[a]					0.565	0.13	1.64		11.51
		(7.594)	(1.079)	(0.006)									
	5	4.930	-0.433	0.028[a]		-0.219	-0.951		0.652	0.13	1.67		6.15
		(8.089)	(1.720)	(0.007)		(0.544)	(0.763)						

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance.

Table A4b: Sub-period regression results for income velocity of money (V_1), using proxies

Period	Equation number	Constant	Log y^{pc}	i_s	p^c	Log m1$_{-1}$	Log C/M$_1$	Log MOR	R_2	SE	D.W.	Rho	F-stat.
1967-82	3	1.553[a]	-0.006		-0.003		0.243		0.725	0.10	1.39	0.87[a]	10.21
		(0.478)	(0.034)		(0.003)		(0.358)						
	5	2.565[a]	0.021		-0.004	-0.178[a]	-0.333		0.739	0.09	1.92		10.92
		(0.423)	(0.050)		(0.004)	(0.039)	(0.380)						
	5	3.257[a]	0.035		0.002	-0.203[a]		0.262	0.743	0.09	1.62		11.14
		(0.711)	(0.044)		(0.004)	(0.046)		(0.270)					
1983-94	3	4.201	-0.437	0.029[a]					0.755	0.11	1.74		17.95
		(6.912)	(0.983)	(0.006)									
	3	4.846	-0.511	0.010			-0.265		0.964	0.16	1.22	0.96[a]	4.18
		(10.781)	(1.397)	(0.012)			(0.778)						
	5	6.830	-0.816	0.027[b]		0.027	0.265		0.696	0.13	1.67		7.29
		(10.279)	(1.538)	(0.010)		(0.113)	(0.575)						

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance.

Table A4c: Sub-period regression results for income velocity of money (V_2), using proxies

Period	Equation number	Constant	Log y^{pc}	p^c	i_s	Log $m1_{-1}$	Log C/M_1	Log MOR	R_2	SE	D.W.	Rho	F-stat.
1967-82	3	1.518 (4.940)[a]	0.020 (0.037)	-0.001 (0.004)			0.375 (0.391)		0.649	0.11	1.35	1.005[a]	7.48
	5	2.230[a] (0.439)	0.026 (0.046)	-0.004 (0.004)		-0.180 (0.037)	0.376 (0.348)		0.784	0.09	1.97		13.73
	5	2.918[a] (0.696)	0.042 (0.043)	-0.003 (0.004)		-0.199[a] (0.045)		0.205 (0.261)	0.773	0.09	1.61		12.94
1983-94	3	5.859 (9.808)	-0.587 (1.287)	0.001 (0.010)			0.280 (0.647)		0.637	0.14	1.227	0.82[a]	5.82
	3	5.939 (6.564)	-0.735 (0.933)		0.029[a] (0.005)				0.769	0.11	2.03		19.31
	5	5.818 (9.816)	-0.675 (1.467)		0.030[b] (0.009)	-0.010 (0.104)	0.182 (0.518)		0.554	0.15	1.28		7.72

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance.

Table A4d: Sub-period regression results for income velocity of money (V_3), using proxies

Period	Equation number	Constant	Log y^{pc}	p^c	i_s	Log $m1_{-1}$	Log C/M_1	Log MOR	R_2	SE	D.W.	Rho	F-stat.
1967-82	3	0.962[b] (0.437)	-0.002 (0.026)	-0.006[b] (0.003)				-0.330 (0.644)	0.807	0.08	1.91	0.889[a]	15.65
		1.217[b] (0.527)	0.001 (0.026)	-0.005 (0.003)			0.204 (0.234)		0.816	0.08	1.63	0.894[a]	16.56
	5	2.338[a] (0.347)	0.028 (0.037)	-0.005 (0.003)		-0.169[a] (0.030)	-0.163 (0.221)		0.839	0.07	2.01		19.30
	5	2.539[a] (0.583)	0.037 (0.036)	-0.004 (0.003)		-0.176[a] (0.037)	0.069 (0.210)		0.832	0.07	1.74		18.39
1983-94	3	12.817 (7.468)	-1.710 (1.062)		0.030[a] (0.006)				0.679	0.13	1.82		12.66
	5	(7.468)	(1.062)		(0.006)								

Note: Figures in parentheses are the standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance.

Table A5: Overall sample period regression results for income velocity of money, using proxies

Dependent variable	Equation number	Constant	Log y^{pc}	p^c	Log $m1_{-1}$	Log C/M_1	R_2	SE	D.W.	Rho	F-stat.
log V_0	5	2.869[a]	-0.006	-0.0004	-0.339	-0.778[b]	0.655	0.11	1.32	0.85[a]	10.50
		(0.793)	(0.039)	(0.003)	(0.245)	(0.295)					
log V_1	5	0.816	-0.003	-0.004	0.105	0.330	0.744	0.11	1.16	0.78[a]	15.58
		(0.787)	(0.040)	(0.004)	(0.066)	(0.280)					
log V_2	5	0.819	-0.001	-0.003	0.078	0.333	0.703	0.11	1.22	0.80[a]	12.85
		(0.858)	(0.039)	(0.004)	(0.070)	(0.281)					
log V_3	5	1.065	0.005	-0.004	0.056	0.382	0.684	0.11	1.12	0.79[a]	11.85
		(0.728)	(0.039)	(0.004)	(0.061)	(0.246)					

Note: Figures in parentheses are standard errors.
a, b and c, respectively, stand for 1%, 5% and 10% two-tail test of significance.

Table A6: Correlation matrix of the explanatory variables used in the analysis

Variable	y^{pc}	p^e	BRA	$CC_{(1)}$	$m1_{(1)}$	$m2_{(1)}$	$m3_{(1)}$	MoR	CM1	CM2	CM3
y^{pc}	1.00										
p^e	-0.24	1.00									
BRA	-0.09	0.98	1.00								
$CC_{(1)}$	-0.05	0.61	0.43	na							
$m1_{(1)}$	-0.05	0.51	0.43	na	1.00						
$m2_{(1)}$	-0.05	0.51	0.43	na	na	1.00					
$m3_{(1)}$	-0.05	0.51	0.43	na	na	na	1.00				
MoR	0.17	0.27	na	0.47	0.60	0.60	0.61	1.00			
CM1	-0.33	0.50	0.60	-0.02	-0.02	na	na	-0.45	1.00		
CM2	-0.28	0.08	0.12	na	na	-0.20	na	-0.49	na	1.00	
CM3	-0.24	-0.01	-0.05	na	na	na	-0.17	-0.50	na	na	1.00

Note: "na" stands for not applicable, or rather the correlation is not important in the analysis of the regression results.

Figure A1a: Behaviour of the rates and growth in Y2 and M2

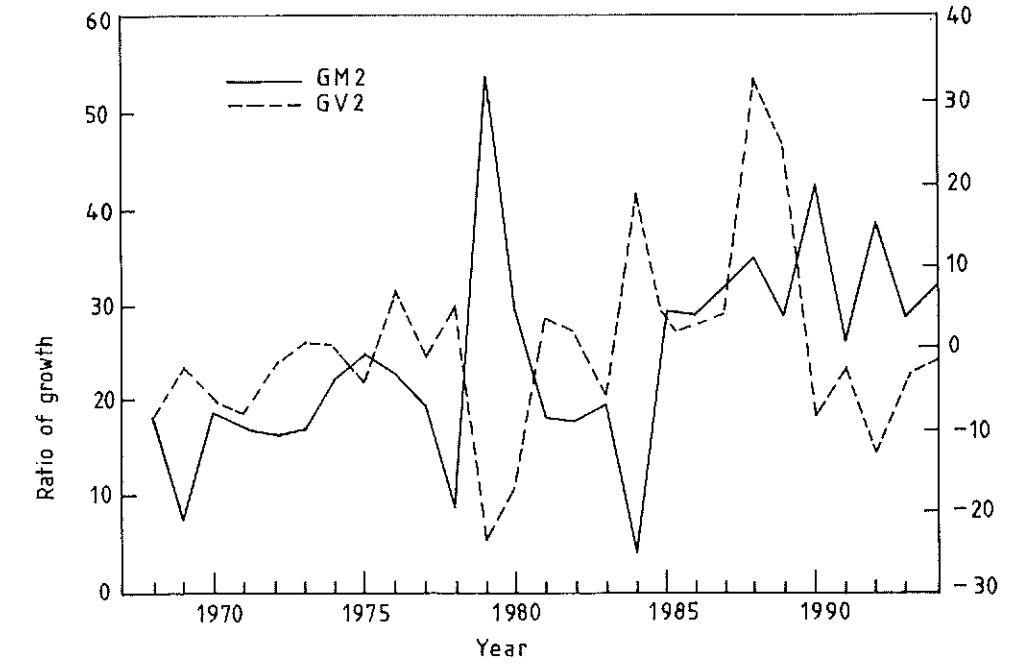


Figure A1b: Growth in GDP and income velocity (Y2)

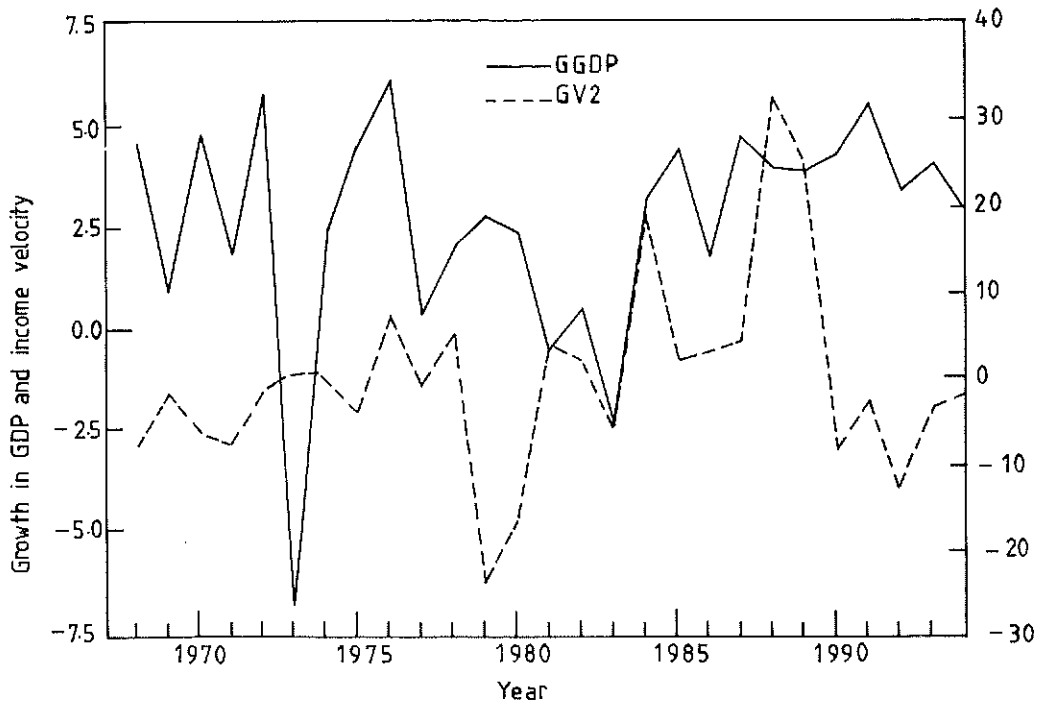


Figure A2a: Rates of growth in money stock (M2) and inflation

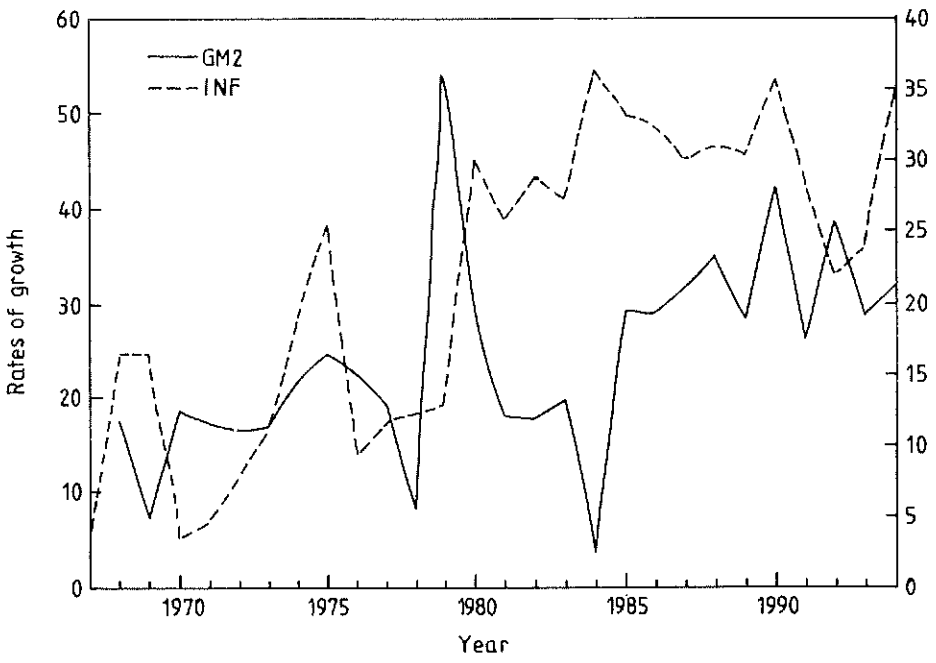


Figure A2b: Inflation and growth in Y2 (1987-1994)

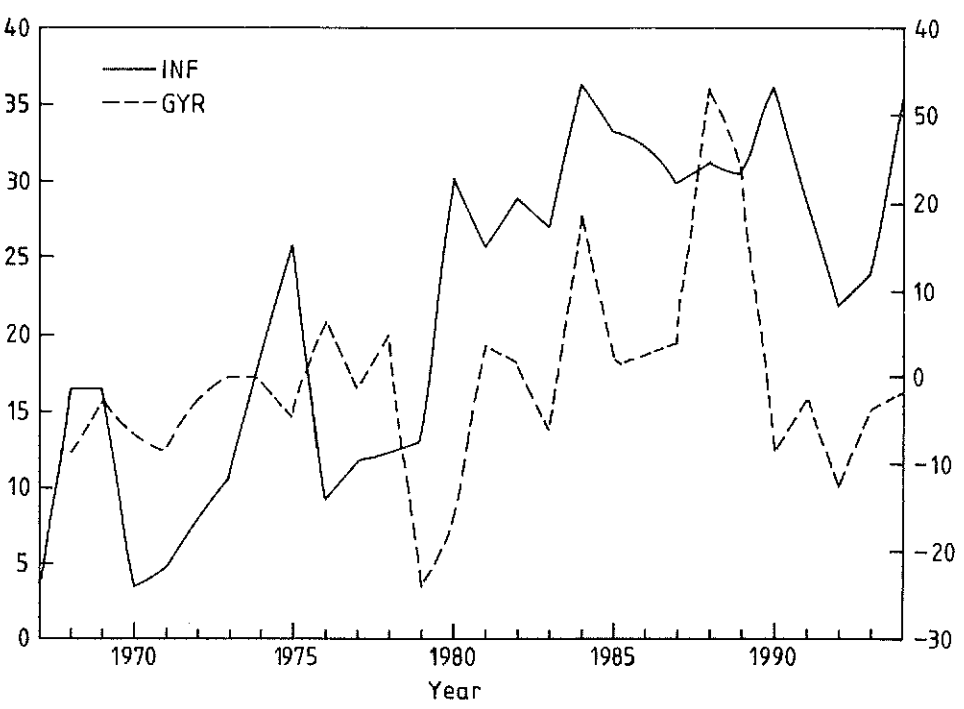
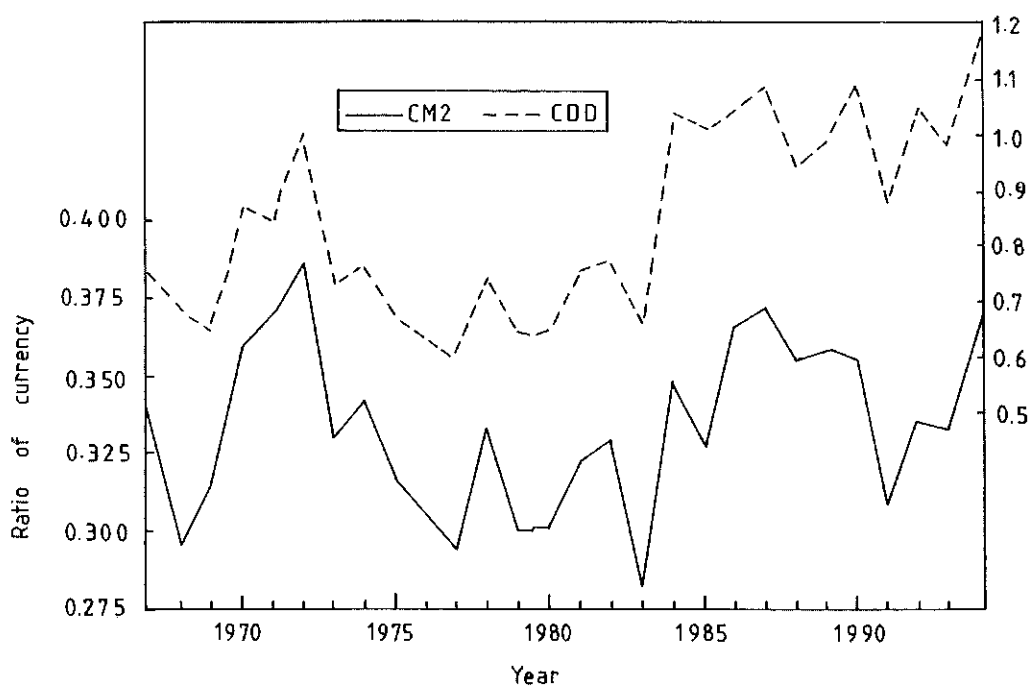


Figure A3: Ratio of currency to demand deposits and M2



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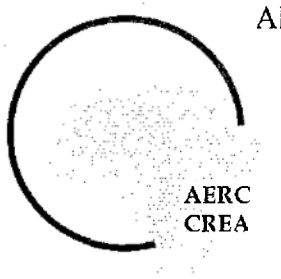
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