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Demand for Money and Shortages in Ethiopia

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Contents:

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Abstract

The paper discusses the long-run monetary conditions in Ethiopia in the last three decades. These decades can be characterised by large political changes, leading to shocks on income and population growth, and two serious periods of drought. Both affected inflation and real demand for M_1 through shortages of food. Shortage due to drops in rainfall might have long-run monetary consequences. Despite regime shifts we find support for stability of Ethiopian narrow money demand.

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[1]The author thanks the Economic Research and Planning Department of the National Bank of Ethiopia for its hospitality. Stefan Dercon kindly provided the coffee price index. Two anonymous referees are gratefully acknowledged for valuable comments. The author only is responsible for the remaining errors. omy is responsioic ior me remaining errurs.

1 Introduction

In developed countries demand for money is usually explained by income, inflation, and portfolio motives. The quest for a stable, predictable money demand function is in most cases supported by extensive data sets and a detailed knowledge about institutional settings. Almost the opposite is true for developing countries. Data sets are scarce and knowledge of the performance of these countries, like some of the African economies, is poor. On the other hand the demand for knowledge regarding monetary conditions in developing countries is large. Some of them are trying to reform the financial system and to introduce market-based economies. Especially in countries that try to reform a centrally-planned economy into a market-based system, the fear for inflation is large. In those cases knowledge of monetary conditions is absolute precondition for a successful liberalisation process. This is the main motivation of our study on monetary conditions in Ethiopia in the period 1966-1994.

In this paper we model monetary conditions in the multivariate Johansen-framework and allow for endogeneity of variables, that would otherwise be exogenous in single equation models of Ethiopian money demand. In case the explanatory variables are endogenous single equation techniques lead to inefficient estimates and a loss of information. Apart from the standard determinants of money demand we focus on specific circumstances that characterise the Ethiopian economy in the last decades, namely (1) changes in political regimes, and (2) climatological changes. We discuss both hereafter in more detail. We analyse whether these changes in regimes and effects of periods of drought are relevant to the issue of stability of Ethiopian money demand. A stable relationship between money and income can help further economic development through price stabilisation.

This study fits into recent empirical research on money demand for African economies. Here we refer to a number of studies with a methodology similar to the one used in this paper: Domowitz and Elbadawi (1987) for Sudan, Adarn

(1992) for Kenya, Adam (1995) for Zambia and Moser (1994)[2] for Nigeria. These studies tend to find stability of money demand, a unit income elasticity, serious effects of inflation and sometimes of currency problems, represented by the black market premium.

The paper proceeds as follows. Section 2 gives a review of the macroeconomic development of the Ethiopian economy. It presents the major time series used. Section 3 reviews the theory of money demand and its particular aspects for developing countries facing shortage. Next we turn to the econometric specification of the long-run model, its properties and the corresponding short-run Vector Error Correction Model in Section 4. We sum up with conclusions in the final Section 5.

[2] Moser (1994) is of special interest for this study since Moser discusses the consequences of severe agroclimatic circumstances for inflation.

2 Ethiopian economy

The recent history of the Ethiopian economy can be characterised by serious peaks and depressions, due to shocks in politics and climate. First we discuss the political conditions. In this paper we review the period 1966-1994, which can be split up into three political subperiods:

1. 1966-1974: the feudal regime of Haile Selassie, which can be characterised by a US oriented market system.
2. 1975-1991: the communist regime of Mengistu, which can be characterised by a planned economy. Financial markets were abolished, the exchange rate was fixed, capital controls were absolute, price regulation was pursued, etc.
3. 1991-1994: the Tigrayan regime. A coalition of ethnical political parties formed a government in 1991 with a strong influence by the Tigrayan party. This government adopted IMF-led stabilisation and structural adjustment plans, opened the country for trade and tried to implement a market-based system.

There is a second cause of possible breaks in Ethiopian economic trends. As in some other African countries the climate is in Ethiopia important determinant of economic life. High temperatures and sometimes shortage of (drinking) water depress food production. Ethiopia is tortured by two periods of drought in our sample: 1975 and 1985. These dry periods lead to shortage of foods. As we discuss hereafter agroclimatical conditions may affect food prices and therefore inflation.

So, we have three possible break points in our sample, based on both political and climatological conditions: 1974-1975, 1985-1986 and 1991-1992. Table 1 lists averages of some key indicators of the economic conditions during the three regimes. The first two rows indicate monetisation, measured by the two definitions of the money stock (M_1 narrow money and M_2 broad money) over income (*GNP*). In terms of GNP growth (given by $\dot{g}$ = ? log GNP, the growth rate of GNP in the third row), inflation ($\dot{p}$ = ? log *P* in the fourth row) and shortage, measured as the ratio of food-prices over non-food prices, (see for an explanation hereafter; *S* in the fifth row) the feudal period performs best in our sample.

Knowing the general conditions during the three subregimes we turn to a more detailed description of some key variables of the monetary conditions of the Ethiopian economy. Figure 1 gives the time series plots of the variables used in the econometric model. The upper left panel plots the key variable of our study: the log of real per capita M_1, holdings.[3] The plot shows two serious peaks in the time series of per capita M_1 that coincide wit the regime breaks: an increase short after 1975 and a permanent increase after 1985.

[3] We include M_1 in our analysis and do not study the demand for M_2 for two reasons. Firstly, we develop a theoretical model that is based on the shopping time model. This model, which will be discussed hereafter, is a basic model to describe the transactions demand for money. It does not directly focus on portfolio motives that might be relevant to the demand for money. The second reason for focusing on *M*, rather than M_2 is the relative quantity of secondary liquidity in the Ethiopian economy. Quasi money is about half of the primary liquidity, as can be seen from Table 1. We do not disaggregate M_1 further into demand for currency and demand deposits separately, because both currency and demand deposits are in active use in transactions and we do not want to complicate the model any further. Moreover, such a disaggregation would lower the applicability of our results in monetary policy. We use per capita definitions for two reasons. Firstly, we use a microeconomic framework to explain money demand per capita in the next section and want to be as close as possible to this theoretical model. Secondly, in Ethiopia population growth certainly varies substantially, which might trouble econometric models in neglecting it. In western economies population growth is not so relevant to include in a money demand model, since the rate of population growth is rather constant.

Table 1 *Macroeconomic conditions in the three regimes*

Variable	feudal	communist	Tigrayan
M_1/GNP	40.28	80.62	123.26
M_2/GNP	56.73	112.89	171.54
$\dot{y}$	0.70	0.37	-0.09
$\dot{p}$	2.89	7.66	12.82
S	1.04	1.29	1.39

$\dot{y}$: growth rate of real GNP (%), $\dot{p}$: annual inflation (%), *S*: shortage

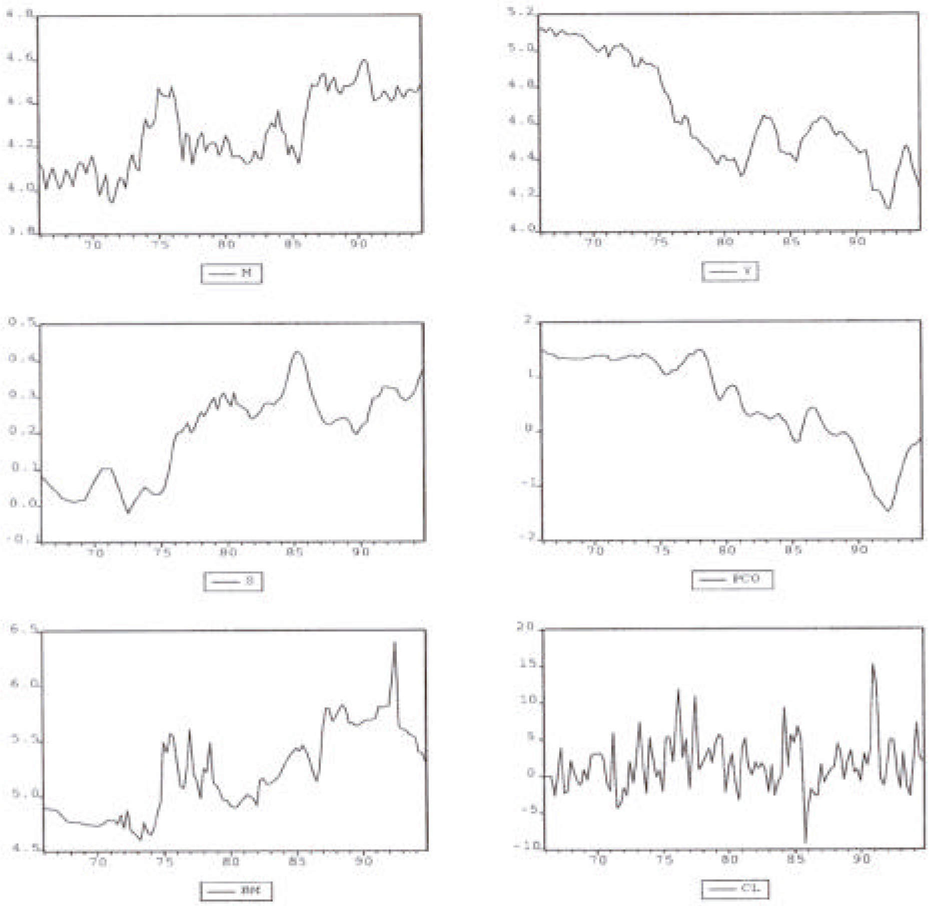
The upper right-hand panel of Figure 1 shows the log of real per capita GNP in the period 1966-1994.[4] One can see that dry periods and changes in political regime affect real per capita income rather seriously. On average one cannot observe real growth of per capita income over the last three decades.

Next we turn to a discussion of shortage. In general dry periods lead to a shortage of foods and probably to a price increase in food prices. Moser (1994) analyses the effects of agroclimatic conditions on inflation in Nigeria. He concludes that a 10 per cent drop in rainfall below the average rainfall level leads to a 7 per cent increase in the general price level.[5] Because official rainfall data are hard to obtain for Ethiopia we selected from the *Quarterly Bulletin* of the National Bank of Ethiopia the food prices in Addis Ababa. Food takes a weighting share of about 56 per cent of the general price index. After that we computed the price index of non-foods and took the ratio of food prices over non-foods as the index

[4] We constructed quarterly data using annual observations from the World Bank Indicator-source on nominal GNP for those quarters where no quarterly data were available. The algorithm used is the Boot-Feibes-Lisman routine (see Boot et al., 1967). GNP and GDP of Ethiopia in the World Bank Indicator data set show a correlation of 0.999 for the sample 1966-1994, so we refrain from using GDR

[5]In Nigeria the general price index is for 69 per cent dependent on the food price index.

Figure 1 *Time series plots (1966:1–1994:4)*



of shortage (see also Polanski, 1990, who uses this index to measure repressed inflation for Poland). Note that this index is a true index of a possible relative shortage of food, since there is no inflation effect in the index any longer. However, the index is not uncontroversial. Suppose that there are official food price controls. The price of food actually paid for is equal to the price used to compute the CPI. An increase in the index would then imply an actual decrease in the price of nonfoods and not imply shortage. Moreover, the price decrease of non-foods would imply a relative abundance. It might also be the case that an increase in food prices could be a policy instrument to increase food production. This might be the case after the last political reform (say after 1991). There are two empirical arguments, which might be raised against these observations. The first is that the price-index number of non-foods shows almost no decreases, with two exceptions: 1983 an 1986 with slightly negative numbers. Secondly, there is no evidence that prices and production show a very strong positive short-run correlation. This contradicts the idea that price increases could go hand-in-hand with decreases in shortage. The left-hand middle panel of Figure 1 represents the log of the shortage indicator $s = \log S$. One can see that before 1975 our indicator does not point at shortages. In 1975 the food price gets a permanent shock and remains at a high level due to price controls. This regime shift coincides with the transition from the feudal to the communist period. The second dry period of 1985 leads to a food price increase with a more transitory character. The Ethiopian economy receives a lot of aid starting from the fourth quarter of 1984. From that quarter onwards aid is almost doubled compared to the levels before the fourth quarter of 1984. So in the years after 1986 international food transports apparently improved the standard of living by lowering the relative price of food. In 1991 the civil war led again to a rather steep increase of food prices relative to non-foods. In recent times shortage has not been banned yet, as can be seen from the data after 1991. The fact that the index indicates a rather high level after 1991 compared to the pre 1980-levels may seem rather confusing. This fact illustrates the possible weakness of a shortage indicator based on prices in an economy in disequilibrium. It might be so that price rationing may not be relevant for the foods market in Ethiopia, but that there might have been quantity rationing as well. We have by no means a possibility to measure notional quantity rationing on the foods market though. This warning should be kept in mind in interpreting the econometric results.

In studying money demand it is important to consider real money balances as a portfolio item and therefore include a yield on an alternative asset. Since a capital market is absent and the time series of official interest rates are uninformative, indicators of alternative yields must be used. In such a case one might use real assets, foreign currency or black market indicators. Here we use the price development of an important real asset, coffee as an alternative yield for money. Coffee is seen as an important black market product (see Dercon and Ayalew, 1995). As there is a serious black market premium on the Birr, coffee smuggling is common practice in Ethiopia. Although coffee prices probably adjusted rapidly to world coffee prices, domestic factors still play a role. Coffee prices might therefore be informative, as coffee fulfils the role of alternative asset on the one hand and black market activity on the other. The right-hand middle panel of Figure 1 gives the log of the real export price index of coffee ($p_{co} = \log(P_{coffee}/P)$).[6]

Next we turn to the exchange rate. Here we need to distinguish official and black market activity. The major change in official exchange rate policy can be observed in the fourth quarter of 1992: the Birr devaluated from 2.1 to 5 Birr per US dollar. Black market activities in Ethiopian Dollars (until September 21, 1976) and Birr (afterwards) have been important at various times.[7] Until 1975 the black market rate fluctuated between 2.5 and 3.5 Ethiopian dollars per US dollar. Early 1975 the political change led to larger premiums. Anticipating the devaluation on October 1 1992 the black market rate boomed in September 1992. In order to assess the impact of the black market rate we include the black market premium (bm = BMERIE; see the lower left-hand panel of Figure 1).

Finally we turn to annual inflation, that averaged 7.1 per cent in the period 1967-1995. This is a remarkably low figure for a developing country. If the price level rises the real value of money holdings declines. The capital loss is equal to (M_t-1/P_t) - (M_t-1/P_t-1) = m_t - m_{t-1}. Using $\dot{p}_t = \frac{p_t - p_{t-1}}{p_{t-1}}$ we can express the so-called capital loss rate on M_{t-1} / P_{t-1} by (see Calvo and Leiderman, 1992):

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[6] 5 Coffee prices are converted from annual figures into quarterly figures using the algorithm developed by Boot et al. (1967). It is remarkable to notice a downward trend after 1979 until 1992.

[7] The World Currency Yearbook (until 1983 Pick's Currency Yearbook) gives the black market rates of US Dollars.

$CL_t = \frac{p_t}{1+p_t}$ This rate is given in the lower right panel of Figure 1. The Figure shows that there is no obvious negative correlation between real money holdings and the capital loss rate.

3 Money demand and shortage

We present a microeconomic money demand model that includes shortage of goods. The model improves upon the general model by taking into account specific constraints of (previously) centrally planned economies. This point-of-view is valid for the Ethiopian economy, since a large part of our sample relates to the communist regime. The model is based on the microeconomic shopping-time model of Saving (1971) or McCallum. and Goodfriend (1987). Although aggregation problems might come to the fore there seem to be no a priori grounds for not using a microeconomic foundation of money demand.
Suppose a centrally planned economy has an official market and a black market. With the existence of financial and real assets utility maximisation becomes an intertemporal optimisation problem for a representative household[8]:

$$\max U = \sum_{i=0}^{\infty} b^{i} u(c_{t+i}, l_{t+i}) \qquad (1)$$

where c_t and l_t are the household's real consumption of good x and leisure during period t, and b =1/(1+d), with 0<d <1 representing the household's rate of time preference. U is strictly quasi-concave and, as non-satiation is supposed, continuously increasing in both c_t and l_t.

[8]We refrain from corporate demand for money. Secondary liquidity is relatively small in a large part of our sample. If there is forced holdings of domestic financial assets, it is likely that firms would hold time and savings deposits.

Purchase of the consumption good x requires shopping time, n_t. We assume labour to be supplied inelastically, so total non-work time can be normalised to 1. As the household divides its total non-work time between leisure and shopping, l_t=1-n_t. Shopping-time is assumed to be a function of consumption, real shortage in the official sector during period t, S_t and real money balances, m_t:

$$n_t = f(c_t, S_t, m_t) \tag{2}$$

The first two first-order partial derivatives are positive and the third negative. Money balances facilitate shopping. Whenever shortage increases households will have to hold additional money balances to keep their real balances at a constant level. On the one hand these additional balances have the function of hunting money in the official market, on the other hand they are needed as the price premium on the black market increases.

Households might want to invest wealth into other assets (such as coffee, see Dercon and Ayalew, 1995) with a real value of b_t (= B_t/P_t, with B_t>0). The assets b_t can be purchased at a price 1/(1 + r_t^a) in period t and can be exchanged at their nominal price in period t+1. The household is subject to the following real budget constraint:

$$y_t + \frac{m_{t-1}}{1+p_t} + b_{t-1}\frac{1+r_{t-1}^a}{1+\dot{p}_t} = c_t + m_t + b_t \tag{3}$$

where y_t represents total household real income out of labor income. Maximalisation of utility given the real budget constraint leads to the following first-order condition:

$$u_2(c_t, 1-f(.))f_3(c_t, S_t, m_t) = \frac{r_t^a}{1+r_t^a}\left[u_1(c_t, 1-f(.)) + u_2(c_t, 1-f_1(c_t, S_t, m_t))\right] \tag{4}$$

where u_i denotes the partial derivative of the utility function with respect to argument i, and f_j is the partial derivative for the shopping-time function with respect to argument j. For plausible utility and shopping functions the effect of ct on money demand will be positive. An increase in shortage S_t can be neutralised on both sides only through an increase in real money holdings through its impact on $f(.)$. An increase in the interest rate, c_t and S_t being equal, increases the right-hand side of the equilibrium condition. A decrease in real money holdings lowers the marginal utilities, but the sign is ambiguous through its impact on $f(.)$. Here we assume that, as in McCallum and Goodfriend (1987), the impact of real money holdings will be negative.

This microeconomic analysis shows that the traditional income (y) based transactions motive in the money demand function might be extended with a variable that indicates money holdings due to shortages (S). Moreover the model shows that the yield on an alternative assets can be included (here we use the real price of coffee p_{co}). Since we estimate a macroeconomic money demand model we have to discuss aggregation and macroeconomic conditions that might influence money demand. The model is formulated in real per capita variables (see also Fair, 1987). There might be aggregation effects, which would require the inclusion of population effects (measured by the variable $P\ 0$ P). Moreover there might be the effects of capital loss and money illusion, which would require a separate inclusion of inflation in the model. Finally, the demand for domestic currency might be determined by exchange rate considerations (for instance by the black market premium bm). This leads to the following general macroeconomic model of money demand:

$$m = f(y, S, p_{co}, POP, CL, bm) \qquad (5)$$

We have the following a priori expectations on the signs of the variables. Real per capita income increases probably have a disproportionate effect on real per capita money holdings, as is shown in money demand models for former socialist countries. It might be so that black market activities trouble the precise measurement of income. Shortage of goods increases per capita money demand, as money demand is a device to offset searching costs. An increase in the real coffee price will have a negative impact on money holdings. Inflation will erode money holdings. The same holds for increases in the black market premium.

4 Econometric specification

We estimate the monetary conditions in Ethiopia in the period 1966-1994 using the following methodology. Since we are interested in the long-run properties we focus on the long-run equilibrium relationship(s). Because we estimate a system of variables and include a number of variables that might be endogenous, we use the Johansen framework. First we test for the stationarity properties of the individual time series. As will become apparent hereafter we find that the log of real per capita M_1 holdings (*m*), the log of real per capita income (*y*), the log of the shortage indicator (*s* = log *S*) and log of the real coffee price (p_{co}) are all variables of order *I* (1). The capital loss rate (*CL*) and the black market premium (*bm*) are found to be stationary.
Next we use a cointegration framework in the style as proposed by Johansen (1988, 1995). The possibly endogenous key variables are the *I*(1) series: *m*, *y*, *s* and p_{co} We estimate an unrestricted VAR, where we focus on the appropriate number of lags and normality of residuals (although Lütkepohl (1991) shows that the Johansen procedure does not strictly depend on the normality assumption). We do not include stationary variables in the VAR, although this is allowed in the Johansen procedure. Including a stationary series would imply one additional cointegration vector per definition. In order to avoid problems in identifying which of the possibly multiple vectors might represent the stationary series we include stationary variables as exogenous variables in the VAR. We include population growth, the capital loss rate and the black market rate as exogenous variables.
Next we test for the cointegration rank. We find a rank order 1. After that we test for weak exogeneity. If the wrong rank is selected the weak exogeneity statistic is generally not asymptotic X^2 (even under the null of weak exogeneity). It appears that income and the real coffee price van is considered to be endogenous. This implies that single equation OLS estimation of the

Ethiopian money demand equation would have led to a loss of information. Next we plot the recursive eigenvalues of the Johansen-test to address stability of the long-run equilibrium vector. Moreover we plot the cointegration vector found and test for its stationarity. Finally we give the Vector Error Correction Model that describes the short-run dynamics of our model.

4.1 Time series properties

Prior to the statistical specification of the model it is necessary to determine the integrating properties of the variables. To start we tested for quarterly seasonality of the data by regressing the variables under consideration on quarterly dummies.

No serious seasonal effects appear. We performed standard (Augmented) Dickey Fuller regressions to address integration properties. Rybinski (1996) has shown that (A)DF's have better long-run properties than Phillips-Perron regressions in case of two expected structural breaks of the series.[9]

The logs of real per capita money, real per capita income, shortage and the real coffee price are of the order $I(1)$ at the maximum. Since population is a quarterly constructed series we do not test for the order of integration, but simply assume stationarity after taking first differences. The black market exchange rate premium and the quarterly capital loss variables are both of order $I(0)$. The results for the black market premium are reinvestigated using the Phillips-Perron test, because

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[9] In case of one regime shift Hubrich (1999) shows that the Phillips-Perron test with a stepdummy variable is a good alternative of the (A)DF-test.

Table 2 *Unit-root tests*

	Levels	ADF(c,t,i)	?	ADF(c,t,i)
m=log(M_1/(POP*P_c))	-3.04	(c,t,0)	-10.16	(.,.,0)
y=log(GNP/(POP*P_c))	-2.42	(c,t,1)	-6.82	(.,.,0)
S = log(P_f/P_{nf})	-2.47	(c,t,1)	-5.90	(c,0)
P_{co} = log(P_{coffee}/P_c)	-2.96	(c,t,2)	-5.14	(.,.,1)
bm = log($BMER$ /E)	-3.45	(c,t,0)		
$CL = \dot{p} / (\dot{p} + 1)$	-6.85	(.,.,0)		

Sample: 1966.I-1994.IV c: intercept included, t: trend included. i: maximum lag order.

the ADF-test is close to the 5 % significance level of rejecting the null of nonstationarity. The Phillips-Perron test results confirm the stationarity of the series.

4.2 Investigating the long-run relationship

In order to characterise the long-run equilibrium relations between the variables mentioned we start with the following basic closed VAR model with Gaussian errors (see also Fisher and Vega, 1993):[10]

$$X_t = m + \Sigma_{i=1}^{k} A_i X_{t-i} + \Psi D_t + u_t, t = 1,.....,T, \quad (6)$$

where X_t is the vector of the n variables of the system, assuming X_t to be $I(d)$ with $d \leq 1$, A_i coefficient matrices, D_t a vector of deterministic terms and exogenous variables and u_t residuals following a normal distribution $N(0, S)$. A reparametrisation of this VAR(k) results in an error-correction form:

$$\Delta X_t = m + \Pi X_{t-1} + \Sigma_{i=1}^{k-1} \Gamma_i \Delta X_{t-i} + \Psi D_t + u_t, t = 1,.....,T. \quad (7)$$

[10] We followed strictly the software package CATS (see Hansen and Juselius, 1995).

Here, ? is an (n, n) coefficient matrix which contains information about longrun relationships between the variables in the data vector. ? can be factorised according to the number r $(0 \leq r \leq n)$ of linearly independent cointegration vectors:

$$\Pi = a\, b\,' \tag{8}$$

where a is the (n, r)-matrix of adjustment coefficients and $ß'$ the (r, n) matrix of cointegration vectors. The matrix ? has rank r. Johansen (1988) distinguishes three possible cases:

- The matrix ? has full rank n, indicating that the vector process X_t is stationary;
- Rank(?)=0, i.e. the model reduces to a traditional VAR-model in first differences;
- Rank(?)=r < n, implying r cointegration equilibrium vectors.

The hypothesis of cointegration implies that $ß'X_t$ and ?X_t are stationary, while X_t needs not to be stationary. The long-run relationships correspond to those combinations of variables which have $I(0)$ residuals. [11]

The application of the Johansen procedure results in a maximum likelihood estimation of the parameters of the model. The eigenvalues of the system are ordered, starting with the largest eigenvalue. The number of eigenvalues ?$_i$ significantly different from zero indicates the rank of ? :r. A likelihood ratio test is carried out to test the hypothesis: HO: Rank(Π) = r against H_0: Rank(?) = r + 1. A testing sequence is carried out for r=1,2, .. and continues until the null hypothesis is not rejected anymore. The test statistic is equal to $-T$ log(1- $\hat{l}_{r+1}$).[12]

[11] Being a statistical exercise the Johansen procedure picks out those combinations with the most stationary residuals, but these need not correspond to meaningful economic relationships. The cointegration vectors will, however, usually be linear combinations of the underlying economic relationships and we need to recover these using identification conditions. If we find only one cointegration vector this vector is identified.

[12] We refrain from discussing the Trace test.

In implementing the Johansen cointegration technique a number of crucial empirical decisions have to be made. The first decision concerns the lag-length in the VAR, for which we used the Schwartz Bayesian Information Criterion as an a priori sign and a check on normality and autoregressive properties of the estimated residuals ex post. Secondly, as addressed by Johansen (1992) one can use the socalled Pantula principle to determine simultaneously the choice for deterministic components in the cointegration space and/or short-run model and testing for the rank condition. [13]

First we estimate the unrestricted initial VAR, including m, y, s and *pco* as endogenous variables and log(*P0P*), *bm* and *CL* as exogenous variables. We do not include *bm* as an endogenous variable, although this might be attractive from a theoretical point-of-view, because of its stationarity. Moreover, by including the real coffee price we have an alternative yield variable in the model. Finally, as

Table 3 *Descriptive statistics of the VAR-model*

Equation	? m	? ?	? s	? p_{co}
$\bar{R}^2$	0.90	0.99	0.98	1.00
Schwartz	-5.25	-6.19	-7.70	-5.86
Jarque-Bera	1.95	7.11	4.03	9.78
ARCH(3)	2.23	0.27	5.12	0.22

Effective sample: 1966.IV-1994.IV

[13] There are basically three alternatives for the appropriate choice of the deterministic components:

1. Model A: including a constant in the cointegration space;
2. Model B: including a constant in the short-run model (allowing for the presence of linear trends in the levels of the data);
3. Model C: including a trend in the cointegration space.

Model A is clearly the most restricted, followed by model B. The Pantula principle suggests to test for the rank of the long-run model by estimating the three model versions sequentially from the most restricted to the least restricted one. The decision rule is then to pick the model the first time the null hypothesis is not rejected using the trace test.

Table 4 *Johansen test of the cointegration rank*

Eigenvalue	?$_{max}$	l^{95}_{max}	H_O:*r*	*p-r*
0.265	65.38	62.99	0	4
0.109	30.83	42.44	1	3
0.094	17.95	25.32	2	2
0.060	6.92	12.25	3	1

Effective sample: 1966.1V-1994.IV

we show below, the black market premium parameters are not of major statistical significance in the VAR.

For our model we use a VAR with 3 lagged observations (as indicated by the Schwartz-criterion (see Table 3).[14] Based on experimenting following the Pantula principle we include a constant and a trend in the cointegration space (since we use logs excluding the constant would lead to interpretation problems). Table 3 gives some basic statistics of the VAR-model. The fit is represented by the $\overline{R}^2$, the information criterion by the Schwartz statistic and the normality of the estimated residuals by the Jarque-Bera statistic. The latter statistic shows that normality of the *m* and *s*-residuals can be assumed, but that we have to reject normality for the *y* and p_{co}-residuals at the 5 % significance level. Moreover we tested the residuals on autoregressive conditional heteroskedasticity (ARCH(3)) using a Lagrange Multiplier test statistic. This test shows that for the shortage equation we reject the null hypothesis of absence of ARCH(3).

[14] Information criteria are used to warn for potentially overparameterising the model. The Schwarz criterion is defined by SC = log & + K (log T)l T for K regressors and a sample length T. & is the unadjusted residual variance.

Table 5 *Likelihood Ratio tests on stationarity and weak exogeneity*

Hypothesis	$X^2(n)$	m	y	s	p_{co}
Stationarity	12.59(6)	17.71	12.71	15.46	20.37
Weak exogencity	3.84(1)	0.54	6.24	3.10	4.03

(n) represents the degrees of freedom.

The unrestricted model yields one possible cointegration vector according to Table 4. The implied cointegration vector is:

$$Coint_1 = m - 1.39y - 0.28s + 0.72p_{co} - 0.04t + 6.13, \quad (9)$$

where t represents a trend. Given the rank of the system we test again for stationarity of the time series and weak exogeneity. As Hubrich (1999) illustrates testing for stationarity of the data in the unrestricted VAR is more informative than applying the single equation techniques, since the null hypothesis is, in contrast with the ADF, stationarity in the VAR. Table 5 gives the results. It again appears that all time series are nonstationary. Testing for weak exogeneity reveals that, given the cointegration rank being equal to 1, real per capita money holdings and shortage can be interpreted as a weak exogenous variables, but real income and the real coffee price are endogenous. This implies that a single equation estimation of money demand would have led to inefficient estimates and we need to proceed in a Vector Error Correction Model to describe short-run dynamics of the system.

4.3 Stability of the long-run model

The key issue of this paper is the quest for a stable narrow money demand function in Ethiopia. In Section 2 we illustrated the possibility of breaks due to changes in political regime or the impact of food shortages in dry periods. Since we used the whole sample to estimate the long-run model, the stability issue is basically an issue of stability of the cointegration model. It is known that the Johansenprocedure is sensitive to the choice of the sample. In order to assess the stability of the estimated parameters we computed the recursive eigenvalues. In case stability of the eigenvalues that characterise the cointegration space is found, stability of the parameter estimates of the cointegration vector is established. There are several other methods to test for stability of cointegration vectors. For a detailed discussion we refer to Hansen (1992) and Quintos and Phillips (1993).

So in order to address the stability of the cointegration vector we analyse the stability of the eigenvalues of recursive estimation of the model. We can start the estimation in the third quarter of 1973. The first estimates are however somewhat unreliable in this case due to a lack of observations (about 25 instead of 100).

Figure 2 *Recursive estimates of the largest eigenvalue (1972:3-1994:4)*

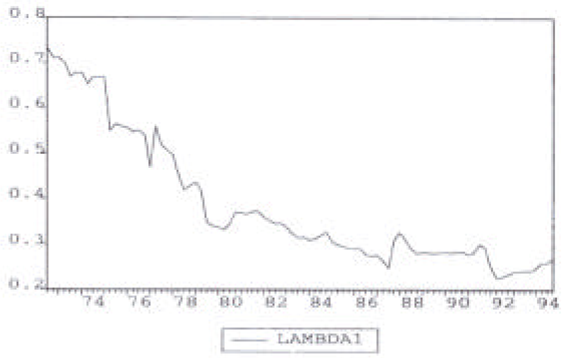

Figure 3 *Cointegration relationship*

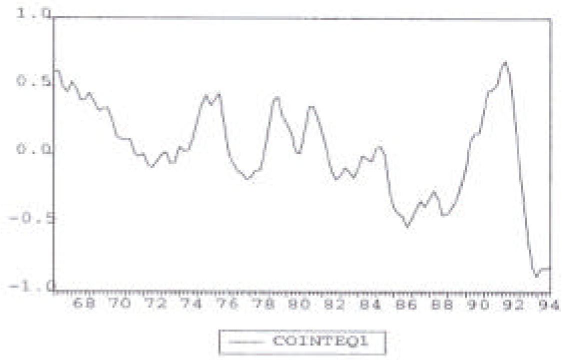

Figure 2 plots the recursive estimates of the largest eigenvalue of the system. After 1979 the first eigenvalue is twice as big as the second largest, which supports our finding that the rank of the cointegration space is equal to one.

In terms of the regime switches we observe instability of the system in 1974-1975. This might be due to a lack of valid observations to estimate the model at that time. After 1979 the largest eigenvalue fluctuates around 0.3, indicating stability of the system. We can observe a slight jump after the second dry period and a slight hump in 1992, another year of regime shift. The overall performance of the model in the last 15 years is stable however.

A second way of discussing the stability of the model is to plot the cointegration vector $Coint_1$ (see for instance Hendry (1995) and Hubrich

(1999)). Although visual inspection of the cointegration vector in Figure 3 seems to indicate nonstationarity testing for stationarity gives a clear acceptance of the null hypothesis (ADF=4.73).
Now we established the long-run cointegration vector we can give an interpretation of the findings. We find an income elasticity of 1.39. Testing of a restriction to a unit elasticity is rejected: X^2=9.24. This rather large income elasticity is sometimes found for centrally planned economies (see Hartwig (1987), Charemza and Ghatak (1990) and Chawluk and Cross (1994)) (1984). Suppose that due to black market activities income is underestimated, one might observe elasticities of this kind. Secondly, we find a modest influence of our shortage indicator. The fact that the elasticity is not so large might be due to the fact that the price indicator is not a good proxy of shortages, especially at the end of the sample.

4.4 Short-run properties

Although the main focus of our paper is on the long-run it is natural to discuss the short-run properties of the system. In the estimation of the unrestricted VARmodel we observed that 3 lags need to be included to describe the dynamics of the variables. Moreover there is one cointegration vector, the four key variables are nonstationary in the VAR and we can accept weak exogeneity of real per capita money holdings and shortage, while real income and the real coffee price are endogenous variables. We can reduce the short-run unrestricted VAR by including restrictions on the parameters to be estimated. In this case we want a reduction of the complexity of the model. Another solution is to present the VAR that includes the cointegration vector in a Vector Error Correction Model. Remember that a reduction to a single-equation model of money demand would require weak exogeneity of income, shortage and the coffee price index, which is an hypothesis that has to be rejected. Therefore we first present in Table 6 the VECM estimates.
From the Table we can make the following observations. The first observation is that the feedback of the cointegration relationship is significant in the real per capita income and the real coffee price equation. Secondly, short-run money

demand depends mainly on changes in shortage, population growth and inflation mainly. Remarkable is the negative effect of shortage on money demand. Real income, the real coffee price and the black market premium do not have a short-run impact on money demand. Secondly, the black market premium plays a marginal role in the model. Short-run inflationary effects are important though. The role of shortage is also limited in the short run. Finally the model seems to be rather invariant to changes in population growth.

The problem with such a large system as the one reported in Table 6 is a proper interpretation. Hendry (1995) advocates to construct a parsimonious VAR (PVAR) to enhance interpretability. A reduction of our model would imply a reduction to a model that describes the short-run dynamics of real income and the real coffee price and not real demand for M_1. This analysis goes beyond the scope of our paper though.[15]

[15] A final point we can make to address the stability of the short-run coefficients is an investigation into the stability of the coefficients over regime shifts. To that purpose we made the assumption that we can focus on the conditional density of mt given the other variables and test for a single equation model. Given the endogeneity of y and p_{co} we loose efficiency of the coefficient estimates. In order to stay as close as possible to the multivariate model we include the longrun cointegration vector in this experimental model. So we estimated a model in first differences with real per capita money demand as the endogenous variable including up to 3 lags for all determinants as shown in the VECM. We reduced the model to significant parameter estimates only. The final model specification is estimated recursively. From the recursive parameter plots it can be seen that the specification of the model shows some instability during the first break in 1975, but stability thereafter.

Table 6 *Vector Error Correction Model (1966:4-1994:4)*

	? *m*	? *y*	? *S*	? p_{co}
$Coint_l$	-0.05	0.04*	-0.00	0.04*
? m_{-1}	0.08	-0.29*	-0.01	-0.28*
? m_{-2}	-0.53*	-0.03	0.03	-0.02
? m_{-3}	0.17	0.01	0.05	-0.22
? y_{-1}	-0.34	0.60*	0.00	-1.65*
? y_{-2}	0.44	-0.29	-0.09	1.85*
? y_{-3}	-0.31	0.29	0.01	-0.39
? S_{-1}	-0.02	-0.24	0.43*	-0.18
? S_{-2}	-0.85*	0.46	0.00	-0.45
? S_{-3}	-0.25	0.15	0.15	0.32
? pco_{-1}	0.12	-0.05	-0.03	2.24*
? pco_{-2}	0.01	0.18	0.03	-1.95*
? pco_{-3}	-0.17	-0.14	0.00	0.67*
? log*POP*	2.08	-1.90	-2.80	-2.64*
? logPOP_{-1}	-15.00	-3.48	0.67	-6.21
? logPOP_{-2}	15.35	2.62	-1.46	5.80
? logPOP_{-3}	-7.56	1.82	-0.52	2.26
bm	0.02	0.00	0.01	0.01
bm_{-1}	-0.01	0.01	-0.01	0.01
bm_{-2}	-0.01	0.00	0.01	-0.01
bm_{-3}	0.00	0.00	0.02*	0.00
CL	-0.01*	-0.01*	0.01*	-0.01*
CL_{-1}	0.00	0.02*	0.00	0.01*
CL_{-2}	-0.01*	-0.01*	0.00	-0.01*
CL_{-3}	0.01*	0.00	0.00	0.00
$\bar{R}^2$	0.37	0.31	0.26	0.85
Schwarz *SC*	-5.65	-9.16	-7.67	-6.94

A * indicates significance at the 95% confidence interval.

5. Summary and conclusions

In this paper we estimated a money demand equation for the Ethiopian economy over the period 1966-1994 using quarterly data. This period is characterised by both climatological disasters and political breaks: two changes of the political regime in 1974 and 1991 as well as two serious periods of drought in 1975 and 1985. The main goal of the paper is to study the stability of monetary conditions over the sample. We consider real demand for narrow money, real income, shortage and a real alternative yield as the central endogenous variables in the model. Moreover we include the possible effects of population growth, inflation (capital loss rate) and the black market premium as exogenous variables in the model.

We estimate an unrestricted VAR from which we can derive and identify a long-run equilibrium condition, relating real per capita money demand, real per capita GNP, shortage and the real export price of coffee. We tested the VAR on its properties. We conclude that the true endogenous variables in the model are real income and the real coffee price, while real money holdings and shortage are weak exogenous variables. We tested the stability of the long-run cointegration vector. We conclude that the model shows some instability during the first break in 1974-1975. This instability is probably due to a lack of data used to estimate the model.[16] We finally address the short-run outcomes, which again show some instability halfway the seventies but not at the end of the sample.

Interpreting the long-run cointegration vector we find that the income elasticity exceeds the unit elasticity This result has been obtained for other former centrally planned economies and might point at black market activities. Once the economy will be reformed it is likely that the income elasticity drops to unity. A one percentage point increase in food prices over non-food prices leads to a 0.2 percentage point increase in real per capita money holdings. In

[16] It is sometimes suggested to invert the time range and estimate the model from the future to the past.

order to accomodate this increase in demand for money balances the monetary authorities could consider an increase in the supply of money during a period of food shortage. Since inflation is rather low in the sample period in Ethiopia it seems that the increases in money holdings are necessary to achieve a better allocation of goods among consumers.

We conclude that other factors might influence real money holdings. In the long run an alternative yield (the real coffee price) is relevant. In the short-run inflation has a negative effect on real money holdings. Moreover we find some effects of population growth on real per capita money demand. There is no serious evidence of a hard influence of the parallel exchange market on monetary conditions.

The model presented in this paper can be a first step as an instrument to monitor monetary conditions in Ethiopia. Monetary authorities should be aware of changes in the relevant transactions variable in case of shortage. On the other hand the stability of the relationship between income, money, shortage and the real coffee price can be used to pursue a monetary policy focused on domestic intermediate monetary targets. In Ethiopia, with a limited amount of international capital mobility, monetary authorities can achieve both internal and external price stability using either money supply or the short-term interest rate to achieve both goals. A stable money demand relationship, like the one presented above, is a prerequi-site to pursue such a policy. In such a case money can serve as an intermediate targeting variable.

A Data description

We used the following sources:

- M_1: Narrow money, International Financial Statistics, CD-ROM produced by the IMF.
- P_c: Consumer price index, National Bank of Ethiopia, Quarterly Bulletin.
- P_f: Addis Ababa food price index, National Bank of Ethiopia, Quarterly Bulletin.
- POP: Population. Annual figures from the World Bank Indicators CD-ROM. Quarterly figures produced using the Boot-Feibes-Lisman algorithm.
- GNP: Gross national product. Annual figures from the World Bank Indicators CD-ROM. Quarterly figures produced using the Boot-Feibes-Lisman. algorithm.
- P_{cof} : Export-price index of coffee. Figures provided by Dercon (see Dercon and Ayalew, 1995).
- *BMER*: Black market exchange rate. Until 1983 Pick's Currency Yearbook, from 1985 World Currency Yearbook.
- E: Official exchange rate, International Financial Statistics, CD-ROM produced by the IMF.

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