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Demand for Money in Mozambique: Was There a Structural Break?

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Abstract

The paper provides estimates of an error-correction model of the demand for narrow money (*M1*) and broad money (*M2*) in Mozambique. In addition, it assesses whether the rapid growth in money balances during 1996–97 represents a structural break or can be associated with the rapidly expanding economic activity and lower opportunity costs of holding money. In contrast with several studies of economies at a similar level of development as Mozambique, the paper obtains statistically significant coefficients for both financial and real explanatory variables. In this connection, it successfully includes the yield of foreign instruments (expressed in local currency) as one of the key explanatory variables.

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SUMMARY

The objectives of the study are to estimate a co-integrating, error-correction model of money demand in Mozambique and to assess whether the large increase in real balances during 1996–97 represents a structural break. The study is conducted within a portfolio approach framework in which money holdings are seen as a choice between alternative assets, including real and financial, and domestic and foreign. In this connection, the yield of foreign financial instruments, expressed in local currency, is presented as a key determinant of money demand. In addition, and in contrast with several other studies of countries at a similar level of development as Mozambique, real variables play a major role in both the proposed and estimated versions of this model.

The estimation is based on monthly data for January 1991–September 1997. Evidence of cointegration was found for both narrow money *(M2)* and broad money *(M1)* with respect to the level of economic activity (*Y*) and the yield of foreign financial instruments (i^*). The coefficients for *Y*, between 0.5 and 0.6, while not in line with the standard quantitative theory of money, are consistent with the Baumol-Tobin framework, which predicts an elasticity of 0.5. The money demand equations retained *Y*, *i* (domestic interest rate), and i^* as explanatory variables and imply a speed of adjustment (coefficient of ECM_{t-1}) of 8-9 percent a month. The hypothesis that there was a structural break in money demand during 1996–97 was consistently rejected by a number of tests. The conclusion is that the increase in money demand can be accounted for by the expansion in economic activity and the lower yields of foreign instruments (expressed in local currency) resulting from a lower (higher) depreciation (appreciation) of the exchange rate.

I. Introduction

The objectives of this study are twofold. The first objective is to estimate an error-correction model of money demand in Mozambique, including as explanatory variables both economic activity and opportunity costs of holding money balances with respect to other domestic and foreign assets. In doing so, we intend to extend to the case of Mozambique the methodology that has been successfully applied during the last decade to numerous developed and developing countries. The second objective is, based on the result of the estimated equations, to determine whether the expansion in real money balances during 1996–97 can account for changes in our explanatory variables or whether these changes represent a structural shift in money demand.

II. Real Money Balances During 1991–97

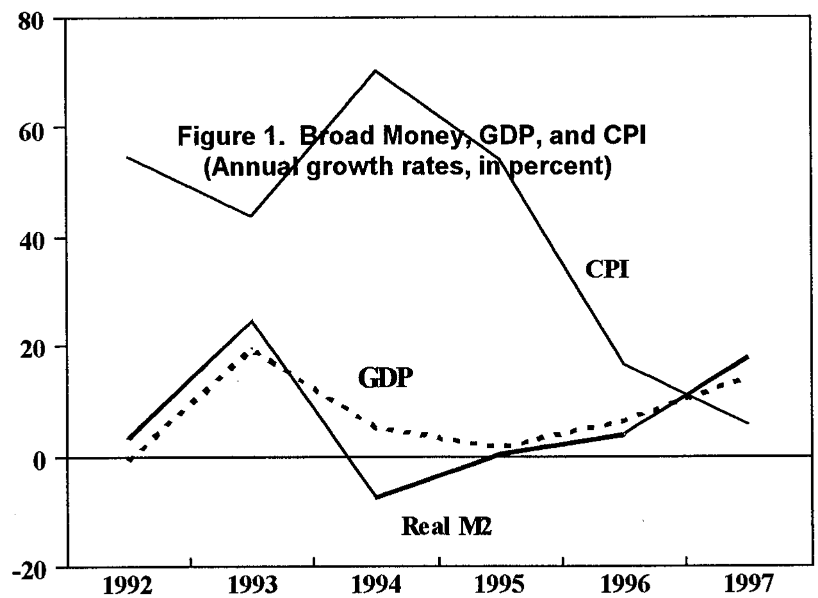
Real money balances increased by close to 50 percent during 1992–97 in the case of M2 and by almost 30 percent in the case of M1. These increases could be attributed to a financial deepening resulting from the opening of vast areas of the country to productive and financial activities as a result of the end of the war in late 1992, the gradual development and liberalization of the financial and foreign exchange markets, and an economic expansion averaging 7.3 percent per year during 1992–97. The substantial increase in term deposits, as shown by the faster expansion in M2, is also believed to be a strong indicator of the development of, and growing confidence in, the financial system. Closer inspection of the figures, however, reveals that the trend has not been continuous and that there have been marked differences from year to year in the performance of monetary indicators.

Table 1. Selected Indicators (Annual percentage change)

	1992	1993	1994	1995	1996	1997
Real narrow money (M1)	0.5	22.1	-5.2	0.7	--	10.5
Real broad money (M2)	3.1	24.5	-7.4	0.4	3.9	17.6
Gross domestic product	-0.8	19.3	5.0	1.5	6.2	14.1
Consumer price index	54.5	43.6	70.2	54.1	16.6	5.8
Exchange rate (metical/rand)	39.4	75.1	19.8	53.5	-16.0	-2.9

The expansion in real money balances since end-1990 can be accounted for entirely by high-growth episodes during January–December 1993 and October 1996–December 1997. In the case of M2, growth was approximately 25 percent, in real terms, during each of these periods, while M1 expanded during the two periods by 22 and 19 percent, respectively. The period in between these growth episodes was characterized by ups and downs, although, ultimately both M2 and M1 declined by about 10 percent.

The changes in real money balances, and their timing, can be closely associated with changes in the economic environment and/or economic policies. As shown in Figure 1, for example, the annual growth of real money balances has been positively associated with GDP growth and negatively associated with the annual rate of inflation. In this connection, it is interesting to note that, while GDP expanded by over 30 percent during 1991–95, growth of almost 20 percent in 1993 accounted for close to two-thirds of this 5-year expansion, coinciding with the rapid expansion of M1 and M2 (Table 1). Moreover, the opportunity costs of holding cash balances, as measured by the inflation rate, decreased from 55 percent in 1992 to 44 percent in 1993. The rate of depreciation of the exchange rate with respect to the South African rand also declined during most of the year, from close to 40 percent in 1992 to about 16 percent in mid-1993; however, towards the end of the year the rate accelerated sharply.



The ensuing slowdown or contraction in monetary aggregates during 1994–95 also coincided with a slowdown in economic growth (with the latter dropping to 1.5 percent in 1995), and an increase in the opportunity costs of holding cash balances. The annual rate of inflation increased from 44 percent in 1993 to about 70 percent in 1994, and domestic interest rates (proxied by the rediscount rate) rose from 43 percent at end-1993 to almost 70 by late 1994. In addition, the rate of depreciation of the exchange rate with respect to the South African rand, after declining to about 20 percent in 1994, increased during 1995 to almost 55 percent. As a result, yields of foreign financial instruments (proxied by the South African treasury bill rate, converted to local currency with the expost exchange rate), followed a similar pattern.

The substantial expansion of real monetary aggregates beginning in mid-1996 was also closely associated with an acceleration in economic growth, significant reduction in inflation and interest rates and a slower depreciation (higher appreciation) of the metical vis-a-vis other currencies, including the U.S. dollar and the South African rand. The appreciation of the metical followed a change in monetary policy from a stance that accommodated price increases to one of more effective monetary controls.

GDP growth increased to 6.2 percent during 1996 and to over 14 percent during 1997. Meanwhile, a number of reforms, including the privatization of state banks and, in particular, the privatization of Banco Commercial de Mocambique in early 1996, allowed the central bank to implement its monetary program more effectively. The expansion of nominal M2, for example, dropped from 55 percent in 1995 to 21 percent in 1996—meeting, for the first time in the recent past, the targets set by the monetary authorities at the beginning of the year—and 24 percent in 1997. Annual growth of nominal M1 decelerated from 55 percent in 1995 to about 17 percent in both 1996 and 1997.

A recent study concluded that this marked tightening of monetary policy was the ultimate reason for the reduction in the inflation rate in Mozambique.[2] Measured by the annual change in the consumer price index, inflation declined from 54.1 percent in 1995 to 16.6 percent in 1996 and to 5.8 percent in 1997. This period was also characterized by a relatively stable, or appreciating, exchange rate. After depreciating by 60 percent during 1995 with respect to the U.S. dollar and close to 55 percent with respect to the South African rand, the metical depreciated by only 6.2 percent during the January 1996-December 1997 period, with respect to the U.S. dollar, and it appreciated by 18 percent with respect to the South African rand. This new price and exchange stability allowed the monetary authorities to gradually decrease their rediscount rate from 69.7 percent in late 1995 to 12.95 percent by end-1997. Retail (nominal) lending rates also declined during this period, although at a slower pace than both the rediscount rate and the inflation rate.

III. MODEL SPECIFICATION

Money demand is characterized in this study as a choice between alternative real and financial assets available to economic agents, that is, real money balances are selected within a portfolio framework. In this context, wealth is assumed to comprise money, real domestic assets, and domestic and foreign financial assets. A slight modification of the standard portfolio balance model of the monetary sector, as originally developed by Kouri and Porter (1974) and Branson (1977), yields the following equation:

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[2]See Ubide (1997).

$$\frac{M}{P}=A+\beta_0 Y+\beta_1 \Pi^e+\beta_2 i+\beta_3 i^*+\beta_4 W \qquad (1)$$

$$i^*=[(1+i^f)(1+e^e)]-1 \qquad (2)$$

where:

M	= stock of M1 or M2
P	= consumer price index
Y	= real value of transactions in economy
Π^e	= expected inflation rate
i	= domestic nominal interest rate
i^f	= foreign interest rate
W	= wealth
e^e	= expected depreciation of the metical

In equations (1) and (2), the allocation of wealth to money balances depends on the level of demand for transactions and the opportunity cost of holding domestic money, that is, the expected yield of competing assets. The expected inflation rate and domestic interest rates are intended to represent the opportunity costs with respect to holding physical assets and domestic financial assets, as well as the expected yield on domestic investments. Expected yields on foreign assets include the level of foreign interest rates and the expected rate of depreciation of the metical.

Empirical research on money demand, however, has evolved substantially since the portfolio balance approach was extended to the open economy during the mid-1970s. Granger and Newbold (1974) showed that econometric estimation using nonstationary series often leads to spurious correlation, inflated R^2 and incorrect t- and F-statistics. This finding altered subsequent work on money demand since most relevant series have consistently been found to be integrated to the first order. To resolve this problem, most researchers resorted to estimating their econometric equations using first-differenced time series. Such an approach, however, neglects valuable information regarding the long-run relationship between the variables, which is obviously a serious concern if the series used exhibit a long-run relationship.

The issue of integrating short-term dynamics with the long-run equilibrium was first addressed by Granger (1981), and subsequently by Engle and Granger (1987). The *Granger representation theorem* states that if two or more variables are co-integrated, that is, if there is a long-run relationship between them, then the short-term dynamics can be described by an error-correction model (ECM). This approach has become the standard empirical approach during the last decade.

A modified representation of our money demand equation along the lines of an error-correction model is:

$$(\frac{M}{P}) = B + \alpha_1 \Delta Y + \alpha_2 \Delta \Pi + \alpha_3 \Delta i + \alpha_4 \Delta i^* + \alpha_5 \Delta W + \alpha_6 ECM_{t-} \qquad (3)$$

and

$$CM = \frac{M}{P} - A - \beta_0 Y - \beta_1 \Pi - \beta_2 i - \beta_3 i^* - \beta_4 \qquad (4)$$

Note that the error correction term, *ECM*, corresponds to deviations from long-term equilibria. Therefore, equation (3) is meaningful only if the series included have a long-term relationship, that is, if they are cointegrated. This requires not only that all the series exhibit the same order of integration but also that the residual (*ECM*) be a stationary series. The inclusion of this term in the equation allows the integration of short-term dynamics with the long-term equilibria.

IV. Statistical Properties of the Data

The meaningful study of money demand in many developing countries is often precluded by serious data limitations, including inadequate monetary records and lack of high-frequency (e.g. monthly or quarterly) indicators of economic activity. In this study for Mozambique, we deal with these problems by restricting our sample to the post-1990 period—when substantial improvements in monetary records were achieved—and by constructing our own high-frequency indicators of economic activity. In order to have a sufficiently long sample for econometric estimation, we have compiled a monthly database for the period 1991:01–1997:09.

A. Sources and Definitions

With the exception of the variable representing wealth, for which a suitable "proxy" was not available, we were able to test all of the series proposed in the specification of our model. Sources included publications from the Bank of Mozambique (BM), the National Institute of Statistics (INE), the Ministry of Planning and Finance (MPF), and the *International Financial Statistics (IFS)* of the IMF, as follows:

- *M1* and *M2* are stocks of narrow and broad money, including domestic and foreign currency-denominated instruments, obtained directly from BM records.

- *CPI* is the consumer price index, obtained from INE for 1994:01-1997:09, and extrapolated back to 1991 based on the rates of change of the old CPI calculated by the Directorate of Planning of the MPF.

- *Y* is the indicator for transaction demand, or indicator of economic activity, constructed as a weighted sum of commercialized agricultural production (i.e. nonsubsistence production) and industrial output. The agricultural series was constructed based on annual records kept by product at the MPF and expert opinion on the monthly seasonality for each product. The industrial indicator was compiled from quarterly records kept for over 300 products at the MPF. Industrial production was subsequently interpolated to monthly frequency with the use of the "spline" option available in the Aremos software package.

- *i* is the domestic interest rate, obtained from records of the BM. In our econometric estimation, we tested the BM's rediscount rate and commercial banks' deposit rates for 180 and 360 days, respectively.

- i^* is the foreign interest rate, obtained from *IFS*. For our purposes, we tested the South African treasury bill (TB) and money market interest rates.

- e^e and Π^e are the expected depreciation rate of the metical and the expected inflation rate, respectively. We tested both forward- (expost) and backward-looking specifications. A forward-looking specification would be consistent with a rational expectations hypothesis. A backward-looking specification would be consistent with an adaptive expectations framework. In the case of the exchange rate, we tested the rates with respect to both the U.S. dollar and the South African rand. Exchange rates were obtained from BM's records. The inflation rate was obtained from the INE.

B. Unit Root Tests

We performed Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests on all of the series compiled in this study, although we report only on a subset of these series, including those that were subsequently included in our equations. Table 2 shows the results for real narrow money, real broad money, economic activity, inflation, the domestic rediscount rate, the South African TB rate adjusted by the expected annual change in the metical-rand exchange rate (under an adaptive expectations framework), and the annual depreciation of the metical versus the U.S. dollar. The tests were carried out in levels and first differences and were performed by including both a constant and a deterministic trend in the regressions. The critical values for the DF tests at the 1 percent and 5 percent confidence levels are -3.467 and -4.007. The critical values for the ADF tests at the 1 percent and 5 percent confidence levels are -3.478 and -4.101.

Note that neither the DF nor the ADF tests reject the hypothesis of nonstationarity for any of the variables tested in levels. After first differencing, both the DF and ADF tests reject the hypothesis of non-stationarity. With the exception of the ADF test for the depreciation of the exchange rate, which rejects the null of nonstationarity at the 5 percent confidence level, all other series under both the DF and ADF tests reject the null at the 1 percent confidence level.

Table 2. Tests of Nonstationarity (Unit Roots)

	Dickey-Fuller (DF)		Augmented Dickey-Fuller (ADF)	
	Levels	First Difference	Levels	First Difference
M1	-0.8345	-7.954**	-1.9944	-5.6620**
M2	-1.6370	-7.739**	-1.8128	-5.3162**
Y	-3.3820	-9.296**	-2.7171	-4.4520**
π	-0.8345	-6.802**	-1.0379	-4.7125**
i	1.4440	-6.335**	-0.2450	-4.1595**
i*	-2.1260	-5.585**	-2.5445	-4.2262**
e	-0.9083	-5.678**	-2.5787	-3.8190*

Notes: These tests were performed by including both a constant and a deterministic trend in the regressions. The ADF test was performed using the longest lag at which the conventional *t*-statistic was significant. The critical values for the DF tests at 5 percent and 1 percent confidence levels are -3.467 and -4.077. The critical values for the ADF test at the 5 and 1 percent confidence values are -3.478 and -4.101.

(**) means that the nonstationarity hypothesis is rejected at the 1 percent confidence level.

(*) means that the nonstationarity hypothesis is rejected at the 5 percent confidence level

M1 corresponds to nominal M1 divided by the CPI; *M2* corresponds to nominal M2 divided by the CPI; *Y* is our monthly calculation of gross output (indicator of economic activity); π is the annual inflation rate; *i* is the domestic interest rate, as represented by the rediscount rate; *i** is the South African TB interest rate, expressed in meticais (i.e. adjusted by changes in the metical-rand exchange rate); and e is the annual depreciation of the metical versus the U.S. dollar.

Our finding that all of our series are stationary to the first order implies that we can test a possible co-integration relationship between real money balances and their explanatory variables as represented by our chosen series.

V. Estimation Results

Although we previously defined the general form of our equations to be estimated, there remain several specification and other issues that can be resolved only at the empirical level. In trying to answer some of these questions and/or to validate our assumptions, we first adopted a baseline case and subsequently conducted a number of tests and tried alternative specifications. In this section, we describe our baseline case, in which we estimated money demand equations for *M1* and *M2* as a function of income (proxied by gross production in agriculture and industry) and opportunity costs (both domestic and external). In subsequent sections, we then try to answer whether (1) we could validate the aggregation of *M1* and quasi money into the *M2* equation; (2) agriculture and industry may have different weights in explaining money demand; and (3) it is reasonable to aggregate foreign and domestic currency–denominated instruments in the estimation process. In addition, we conducted a number of tests to achieve one of the objectives of this study, that is, to determine whether there was a structural break in money demand during 1996–97.

To estimate our model, we first tested whether there was a long-term relationship among our chosen variables, that is, whether they were co-integrated. The estimated residual of our static or long-term equation (lagged) was then included as an explanatory variable in the estimation of our money demand equation. In addition to using several standard diagnostic tests to evaluate our estimated equation, we assessed the appropriateness of our model during the estimation process by judging whether (1) co-integration existed and the coefficients could be interpreted as long-term elasticities; (2) the ECM term proved statistically significant and the estimated coefficient implied reasonable speeds of adjustment to long-term equilibria; and (3) the magnitude and sign of the estimated (short-term) coefficients could be intuitively interpreted according to standard economic theory.

A. Co-integration

When estimating our static regressions, we found that the estimated residual was not a stationary series when all of the initially chosen explanatory variables were included. This finding held for both the *M2* and *M1* equations. We also found that our estimated equations improved significantly when a proxy variable was added to capture the increase in economic transactions during the period of implementation of the peace agreement. This increase in transactions can be explained by the heavy presence of foreign personnel in Mozambique, the demobilization of most of the armed forces, the resettlement of the displaced population and the holding of national elections. Although we tested alternative proxies, in the end a dummy variable covering the period 1992:10–1995:03 performed better than the other candidates, both in terms of its power to explain long-run changes in money demand and, more importantly, in producing a stationary *ECM* series.

The static equations (Table 3) retained, in addition to a constant and the dummy variable mentioned above, our indicator of economic activity (Y) and the South African interest rate, expressed in meticais after adjusting for the expected change in its exchange rate vis-a-vis the rand (i^*). The joint explanatory power of the variables included, as indicated by the χ^2 Wald tests, is statistically significant at the 1 percent level of confidence. The introduction of dummy variables in the equations means, of course, that the critical values for the DF and ADF tests are not standard; however, it is likely that the estimated *ECM* series are stationary given that the calculated values for these tests are substantially higher than the standard critical values at the 1 percent confidence level.

The estimated coefficients for the dummy variable, Y and i^* all have the expected signs. The coefficients for Y in both *M1* and *M2* of about 0.5-0.6 are consistent with the results of other studies and can be readily interpreted as long-term elasticities. It should, however, be highlighted that, while this result does not appear to be consistent with the standard quantitative theory of money demand (the Fischer equation), which implies a unit elasticity, it is consistent with the Baumol-Tobin framework, which implies an elasticity of 0.5. The coefficient for i^* of -0.015 for *M1* and of -0.07 for *M2*, suggests that, in the long run, longer-term deposits are more sensitive to yields of foreign instruments and to expected changes in the exchange rate. This is a result easily accepted on the grounds that *M1* can be more closely associated with balances needed to conduct transactions, while term deposits (the difference between *M2* and *M1*) are more likely to be associated with speculative demand and, hence, more subject to portfolio shifts. We conclude, therefore, that co-integration exists among the variables in both of our equations.

B. Estimated Equations

In our econometric estimation, with the exception of wealth *(W)* for which there is no data or a suitable proxy, we initially included all variables suggested by equation (3), our theoretical model, allowing for up to eight lags. The inflation variable did not prove significant, particularly when included with i and i^*. This finding can be explained, in part, by high multicollinearity among the inflation rate, nominal domestic interest rates, and the rate of depreciation of the exchange rate. It may also reflect that during the sample period the substitution between money and financial instruments (foreign and domestic) played a more important role than the substitution between money and real assets. These results were true for both the *M1* and *M2* equations.

In our final equations we retained only statistically significant lags. The estimated coefficients for all of the included explanatory variables, that is, Y, i, i^*, and *ECM[-1]*, had the expected sign. The coefficient for *ECM*[-1] implies a speed of adjustment of about 8-9 percent per month of the difference between actual and long-term equilibrium real money balances (Table 4). The t-statistics imply that this variable is statistically significant at the 1 percent confidence level. Note that the coefficients are very similar in both equations. They represent moderate speeds of adjustment as they imply that, after an initial deviation with respect to long-term equilibria, about 8 months are needed for 50 percent of the full adjustment to take place.

Our series representing the level of economic activity, Y, entered the equation with two- and five-period lags. With t-statistics above 3.25 for the variable lagged two periods and above 4.1 when lagged five periods, this variable proved highly significant, exceeding critical values at the 1 percent confidence by wide margins. While the variable representing the domestic interest rate, i, was only weakly significant, the expected yield of foreign assets, i^*, was statistical significant at the 1 percent confidence level. This finding highlights the importance of exchange rate expectations and, more generally, of yields of foreign money and instruments in explaining changes in real balances in Mozambique during the sample period. This is not a surprising result, given the high instability of the metical until the first months of 1996. Note that i^* entered only with a six-period lag, indicating, perhaps, a slow adjustment of exchange rate expectations.

Table 3. Co-integrating Equations

Equations	Monthly sample	ADF (*ECM*)	Wald (χ^2)	Constant	Peace and elections	ln (*Y*)	ln (*i**)
ln (***M1***)	1991:01-1997:09	-7.3593	78.581**	0.0285	0.1641	0.5729	-0.0148
				(1.292)	(0.025)	(0.090)	(0.045)
ln (***M2***)	1991:01-1997:09	-7.4544	135.190**	-0.5812	0.1785	0.6253	-0.0698
				(1.165)	(0.228)	(0.081)	(0.041)

Notes: *ECM* is the residual or error term remaining after estimating the static long run equation. *Y* is our monthly estimator of economic activity; and *i** is the South African interest rate adjusted for the expected change of the metical-rand exchange rate.

The introduction of dummy variables (peace and elections) in these equations means that the critical values for the Augmented Dickey-Fuller (ADF) test will not be standard. It is likely, however, that the ECMs are stationary, given that the calculated values for the tests are substantially higher than the standard critical values at the 1 percent confidence level.

(**) means that the test rejected the hypothesis that the explanatory variables are not jointly significant at the 1 percent confidence level.

(*) means that the test rejected the hypothesis that the explanatory variables are not jointly significant at the 5 percent confidence level.

The dummy variable allowed a higher intercept during 1992:10-1995:03, a period of exceptionally high foreign activity in Mozambique related to the implementation of the peace accord, the demobilization of most of the armed forces, the resettlement of displaced population and the holding of national elections. This variable is not intended to capture a structural break in the series, but rather, an increase in transactions in the economy related to the implementation of these programs.

Table 4. Money Demand Estimation Results

	Δ ln(M1)	Δ ln(M2)
Constant	**-0.0237**	**-0.0239**
SE	0.0075	0.007
t-statistic	-3.145	-3.263
Δ ln(Y_{t-2})	**0.1533**	**0.1608**
SE	0.0470	0.0451
t-statistic	3.262	3.564
Δ ln(Y_{t-5})	**0.1165**	**0.1154**
SE	0.0282	0.0278
t-statistic	4.124	4.145
Δ ln(i_{t-1})	**-0.0767**	**-0.0917**
SE	0.0500	0.0493
t-statistic	-1.533	-1.859
Δ ln(i^*_{t-6})	**-0.0787**	**-0.0805**
SE	0.0291	0.0291
t-statistic	-2.708	-2.769
ECM ($_{t-1}$)	**-0.0879**	**-0.0802**
SE	0.0405	0.0370
t-statistic	-2.168	-2.166
R^2	0.56	0.58
DW	1.97	1.99
***F*-statistic**	5.53	5.86

Notes: Seasonal dummies and impulse variables for 1992:07-8 and for 1995:08 were included in the estimation. *ECM* is the error-correction term; *Y* is our monthly indicator of economic activity; *i* is the domestic rediscount rate; and *i** is the South African interest rate adjusted by the expected change in the metical-rand exchange rate.

VI. Structural Stability and Money Demand in 1996–97

The second major objective of the study is to assess whether the substantial growth in real money balances from October 1996 through September 1997 can be associated with a structural break in the demand for money balances. The alternative case would be that the increase in money demand can be explained by the acceleration in economic activity and by the reduction in the opportunity costs of holding money. To shed some light on this question, we conducted three sets of tests, (1) reestimating our equations and making out-of-sample forecasts, (2) performing Chow tests, and (3) including dummy variables to our baseline estimated equations.

The periods that we tested were (1) 1996:07–1997:09, (2) 1996:10–1997:09, and (3) 1997:01–1997:09. The first break, that of mid-1996, was chosen because Ubide (1997) suggested that there was a structural change in his CPI equation at this time. The second break was chosen we noticed that the large increase in real money balances began in the last quarter of 1996 (see description of data in Section II). The third break was chosen so as to assess whether the structural change took place later than visual inspection suggested (we conducted similar tests for every quarter of 1997 which we are not reporting here).

Table 5 shows the tests performed for the out-of-sample forecasts and for the Chow tests. Notice that in all three subperiods neither the χ^2 nor the Chow tests can reject the null hypothesis of stability. This result holds true for both equations even when we relaxed α (the confidence level) substantially. Table 6 shows the results after including dummy variables for the periods tested but maintaining the original estimation period. Note again that the *t*-statistics cannot reject the hypothesis that the coefficient of the dummy variables is zero.

Table 5. Stability Tests 1: Out-of-Sample Forecasts and Chow Tests

		$\Delta \ln(M1)$	$\Delta \ln(M2)$
Out-of-Sample Forecast		1996: 07 – 1997: 09	
Forecast	$\chi^2(15)$	5.8007	4.8153
Chow	F(15,45)	0.3037	0.2577
		1996: 10 – 1997: 09	
Forecast	$\chi^2(12)$	3.7238	3.5000
Chow	F(12,48)	0.2657	0.2333
		1997: 01 – 1997: 09	
Forecast	$\chi^2(9)$	2.0352	1.2214
Chow	F(9,51)	0.1929	0.1161

Our results are quite robust as all tests accept the hypothesis of stability. This suggests that, contrary to expectations, there was no structural break in money demand during 1996-97. The large increase in money balances appear to be explained by the acceleration of economic activity and the lower opportunity costs of holding money, particularly the yield of foreign instruments (expressed in local currency).

Table 6. Stability Tests 2: Dummy Variables

	$\Delta\ln(M1)$	$\Delta\ln(M2)$
Dummy variable	**1996: 07 – 1997: 09**	
Coefficient	-0.0135	-0.0075
SE	0.0103	0.0102
t-statistic	-1.310	-0.740
Dummy variable	**1996: 10 – 1997: 09**	
Coefficient	-0.0117	-0.0033
SE	0.0150	0.0147
t- statistic	-0.778	-0.222
Dummy variable	**1997: 01 – 1997: 09**	
Coefficient	-0.0027	0.0052
SE	0.0118	0.0115
t-statistic	-0.227	0.454

VII. Alternative Specifications

In order to validate our estimated equations, we tried a number of alternative specifications. Specifically, we tried to answer whether (1) demand for quasi money (*QM*) is explained by the same variables (and similar coefficients) as the demand for *M1*, (2) output from different sectors have similar weights in explaining money demand, and (3) money demand for foreign and domestic currency-denominated instruments are explained by different variables. These alternative formulations aim at assessing some key assumptions made in our baseline equations, namely, that we could lump together *M1* and *QM* into a single equation for *M2*, use a single output (income) variable, as opposed to different variables for industrial and agricultural output, and estimate a single money demand equation for both foreign and domestic currency instruments.

A. Demand for Quasi Money

Equation (1) in Table 7 summarizes our estimation results for an equation on *QM*. We do not present the estimated coefficients of the co-integrating equation but include in the table the ADF test performed on its residual, the error-correction term (*ECM*). Notice that, at -3.67, the ADF test is far from being as conclusive as the tests performed on the residuals for *M1* and *M2*. This result held even when we tried several alternative formulations and explanatory variables.

It is interesting to note that, in terms of its structure, our estimated money demand equation for *QM* is practically identical to our baseline equations for *M1* and *M2*. Moreover, the estimated coefficients for $\Delta \ln(Y)$, $\Delta(i)$, and $\Delta(i^*)$ are generally very close to those estimated for both *M1* and *M2*. For example, the coefficient for income (adding both lags) for *QM* is not statistically different from 0.267 or 0.276, the coefficients for income in the *M1* and *M2* equations in Table 4 (the *t*-statistic would be well below 0.5). Similar findings apply to the interest rate and foreign bond yield.

The coefficient for *ECM* in the *QM* equation does differ substantially from those in our *M1* and *M2* equations. While in the former case the speed of adjustment is equivalent to some 3 percent per month, our baseline equations indicate a speed of adjustment of 8–9 percent per month. However, given the weak co-integration results obtained for *QM*, we feel that the coefficient for *ECM* cannot be considered reliable and that *QM* equation does not provide better information on the speed of adjustment and than that provided by the *M1* and *M2* equations.

We conclude that the coefficients for *QM* are consistent with the previous estimates obtained for *M1* and *M2* and, as a result, we can safely aggregate *M1* and *QM* into a single equation for *M2*. Perhaps more important, while the separation of *QM* produces weak co-integration results, the evidence of co-integration is more solid in the case of *M2*.

B. Weights for Industry and Agriculture

In order to test the hypothesis that the different sectors of the economy may have different weights in explaining money demand, we replaced the composite variable of real economic activity by its two components, gross industrial production and commercialized agricultural production, to find whether the coefficients for agriculture and industry were statistically different. In our estimated equations, we find that while the agriculture index is highly significant for several lags, the industrial index does not prove significant for any lags, even at the 90 percent confidence level ($\alpha = 10\%$). As shown in Table 7, alternative equations (2) and (3), our agricultural index is significant at the 99 percent confidence level ($\alpha = 1\%$) for lags 2, 3, 4, and 5; we did not retain the industrial indicator.

These results appear to suggest that the agricultural sector continues to have a larger weight than industry in explaining money demand in Mozambique. However, although we cannot reject the hypothesis that the coefficient for industry is zero, we also cannot reject the hypothesis that the coefficient is similar to the estimated coefficient for the agricultural sector.

This means that the restrictions imposed by including a composite indicator of economic activity in our baseline case are consistent with our findings. Choosing then, between our baseline equations and the equations with the agricultural indicator, will depend on evaluating the statistical properties of both sets of equations.

Our baseline equations (see Table 4), which include a composite variable of both agriculture and industry, perform better than the equation that retains only the agricultural variable. For example, they increase the *F*-statistic for *M1* from 4.21 to 5.53 and for *M2* from 4.81 to 5.86, while reducing the number of estimated parameters. In addition, the Durbin-Watson statistic moves closer to 2 for both baseline equations. Interestingly, the estimated coefficients for the composite indicator of economic activity (after adding all relevant lags) were consistently higher than the coefficients for the agricultural variable.

C. Demand for Foreign Versus Domestic Currency-Denominated Instruments

We attempted to study the demand for these two sets of monetary liabilities separately, to assess whether the explanatory variables and associated estimated coefficients would be different in the two cases. Our results were not encouraging either in terms of co-integration or in terms of the estimated coefficients and statistical properties of the money demand equation (estimated in first differences). One possible explanation for this problem is that, as an appropriate breakdown between foreign and domestic instruments was available only from the second quarter of 1993, the estimation period was substantially shorter than in our baseline.

To resolve this complication, presumably brought about by the shortened estimation period, we attempted to extend the series on domestic instruments by assuming that before 1993 all instruments were denominated in local currency (the proportion of foreign assets was small inearly 1993). Alternatively, we assumed that the proportion of foreign liabilities during 1991–92 was the same as the level observed in early 1993. Unfortunately, our results were still not encouraging, suggesting either that (1) the extension of the series was not appropriate or that (2) money demand in Mozambique is better represented by including both foreign and domestic instruments in one equation.

The evidence is therefore inconclusive; however, the question of whether foreign and domestic could have different explanatory variables would be an interesting area for future research. Given the improvements in the availability of monetary data in Mozambique, this is an issue that could be reopened in the near future.

Table 7. Alternative Equations

	Lag	Alternative 1 $\Delta\ln(QM)$	Alternative 2 $\Delta\ln(M1)$	Alternative 3 $\Delta\ln(M2)$
$\Delta\ln(Y)$	t-2	0.1658		
SE		0.0526		
t-statistic		3.152		
$\Delta\ln(Y)$	t-5	0.0752		
SE		0.0377		
t-statistic		1.998		
$\Delta\ln(Agr)$	t-2		0.0224	0.0258
SE			0.0070	0.0063
t-statistic			3.200	4.095
$\Delta\ln(Agr)$	t-3		0.0163	0.0174
SE			0.0062	0.0051
t-statistic			2.629	3.412
$\Delta\ln(Agr)$	t-4		0.0212	0.0201
SE			0.0070	0.0051
t-statistic			3.029	3.941
$\Delta\ln(Agr)$	t-5		0.0395	0.0357
SE			0.0149	0.0097
t-statistic			2.651	3.680
$\Delta\ln(i)$	t-1	-0.1076	-0.0945	-0.1035
SE		0.0698	0.0539	0.0518
t-statistic		-1.543	-1.756	-2.000
$\Delta\ln(i^*)$	t-6	-0.1083	-0.0723	-0.0768
SE		0.0403	0.0302	0.0295
t-statistic		-2.687	-2.394	-2.603
ECM	t-1	-0.0311	-0.1250	-0.1031
SE		0.0128	0.0408	0.0356
t-statistic		-2.430	-3.064	-2.902
ADF (*ECM*)		-3.668	-6.597	-7.174
R^2		0.57	0.52	0.53
DW		1.51	2.16	2.21
F-statistic		5.65	4.21	4.81

Notes: Y is our monthly indicator of economic activity; Agr is our indicator of agricultural production; i is the domestic rediscount rate; and i^* is the South African interest rate adjusted by the expected change in the metical-rand exchange rate.

VIII. Conclusions

In this study we have been able to achieve our two major objectives, namely, to estimate a cointegrating error-correction model of money demand for Mozambique and to assess whether t he increase in money demand of 1996–97 represents a structural break from the past. Moreover, in contrast with several studies for countries of a similar level of development as Mozambique, we did not rely exclusively on financial indicators to explain money demand, as we successfully included indicators of economic activity among our explanatory variables. We made this possible, in part, by compiling our own indicator of economic activity based on official records. In addition, our work was greatly facilitated by the substantial improvement in the quality of monetary information produced by the Bank of Mozambique since 1991.

Our successful inclusion of a foreign financial yield variable, which combines the effect of both foreign interest rates and the expected rate of depreciation of the Metical, suggests that there is or has been substitutability between domestic currency (or domestic financial instruments) and foreign deposits or financial instruments. In line with Ubide (1997), we found that the exchange rate that proved relevant was that between the metical and the South African rand.

In this connection, our equations suggest that the high growth in money demand during 1996–97 can be explained by both the high economic expansion and by lower yields of foreign instruments, expressed in local currency, resulting from the lower (higher) depreciation (appreciation) of the exchange rate. Indeed, in all of our stability tests conducted for 1996–97, the hypothesis of a structural break is consistently rejected.

To validate some of the implicit assumptions made in our estimated equations, we tested a number of alternative specifications. Among the latter, we were able to confirm that the aggregation of *M1* and *QM* into a single equation for *M2* was not rejected by the data. In addition, we found in alternative specifications that, while the coefficient for agriculture was highly significant, we could not reject the hypothesis the coefficient for industry was zero. This finding is consistent with the notion that agriculture continues to play a predominant role in explaining money demand in Mozambique. Interestingly, however, we could not reject the hypothesis that the coefficients for agriculture and industry were the same. This means that our aggregation of industry and agriculture into a composite indicator was also not rejected by the data.

The choice, therefore, between the equation that had the composite indicator of economic activity (our baseline) and the equation containing only agricultural production was an empirical one. The former equation was deemed superior not only because it performed better, but also because it did so with a smaller number of estimated coefficients.

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