Applied Economics Quarterly Vol. 60. N° 4 (2014)
Duncker & Humblot GmbH, 12165 Berlin

Economic Uncertainty, Monetary Uncertainty, and the Demand for Money in Africa

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Abstract

Due to economic and monetary uncertainty individuals are expected to allocate their portfolio towards holding money and alternative forms of assets. Following the literature on money demand, we test the impact of economic and monetary uncertainty on the demand for money in 21 African nations. By relying upon quarterly data, GARCH-based measures of uncertainty, and bounds testing approach we find that the impact of both measures are mostly transitory in many of the African countries and do not last into long run. Furthermore, by including the two uncertainty measures we found that the demand for money in every African nation is stable.

Key words: Money Demand, Output Uncertainty, Monetary Uncertainty, African Countries

JEL Classification: E41

1. Introduction

In 1979 when the Fed switched its policy of fixing interest rates to controlling monetary aggregates, it missed its inflation target. This led many to criticize the Fed and call for failure of the quantity theory of money and monetarism. The leader of the pack, Milton Friedman (1984) had to argue to the contrary by pointing out that a monetary policy should not only involve targeting monetary aggregates, but also achieving a steady and predictable growth rate of those aggregates. Since the later was not achieved by the Fed, Friedman identified volatility of the growth rate of the money supply as the source of the problem. He argued that exceptional volatility of monetary growth increases the degree of perceived uncertainty which leads to an increase in money holding by public and a decline in velocity of the money.[1] Choi

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Valuable comments of two anonymous referees are greatly appreciated. Remaining errors, however, are our own.

and Oh (2003), however, developed a theoretical model in which they showed that in addition to monetary volatility, output volatility can also affect the demand for money. They argued that since output uncertainty induces public to face with uncertain job prospects, they could allocate their assets more towards holding cash and less towards other uncertain assets. However, when they tested both hypotheses using the United States data, they found that while monetary uncertainty increased the demand for money in the U.S., economic uncertainty measured by the volatility of real GDP actually decreased it. They then argued that both uncertainty measures could also have negative effects on the demand for money depending upon degree of substitution between money and other less volatile assets.[2]

In estimating the demand for money, not many studies have included the two measures of uncertainty in their formulation of the money demand function. The demand for M3 measure of the money in Australia was considered by Bahmani-Oskooee and Xi (2011) who found that GARCH-based measures of real output volatility and nominal money supply volatility had short-run as well as long-run effects on the demand for M3 monetary aggregate in Australia. In another study Bahmani-Oskooee et al. (2012) considered the demand for M2 monetary aggregate in China and found that both uncertainty measures have short-run effects but not long-run effects. Finally, Bahmani-Oskooee et al. (2013) considered experiences of emerging countries and they found that that both measures of uncertainty had more short-run effects than long-run effects in most countries. By including both measures of uncertainty, they also found that the demand for money is stable in all countries.

As the above brief review indicates, the literature on the issue is very poor and there is plenty of room to expand. Therefore, in this paper we consider the experience of African countries. Previous studies pertaining to African nations, e.g., Domowitz and Elbadawi (1987), Simmons (1992), Fielding (1994), Ghartey (1998), Henstridge (1999), Fielding (1999), Randa (1999), Adam (1999), Anoruo (2002), Nell (2003), and Bahmani-Oskooee and Gelan (2009) did not include neither measure of uncertainties in their specifications. We close this gap by including the two measures in the money demand function of the same 21 countries that were included in Bahmani-Oskooee and Gelan's (2009) study. To that end, in Section II we outline the money demand specification and explain the estimation method. Our empirical results are reported in Section III followed by a summary in Section IV. Data definition and sources are provided in an Appendix.

1 See Friedman (1984, p. 399). Note that it is possible for nominal money supply to become endogenous and changes in the nominal supply of money may well reflect changes of the demand for money.

2 Bruggemann and Nautz (1997) who tested the hypothesis using data from unified Germany also supported the negative effect of monetary uncertainty on the demand for money.

2. The Money Demand Function and Estimation Method

The literature on the demand for money emphasizes the importance of two variables as main determinants of the demand for money, i.e., the level of economic activity or income as a scale variable accounting for the transaction demand and an interest rate measuring the opportunity cost of holding money. However, since financial markets in most African nations are not well developed, inflation rate replaces the interest rate. One additional variable that most studies have included in order to account for currency substitution is the nominal exchange rate. Therefore, the specification that we adopt in this paper includes those three variables as well as two measures of uncertainty as in equation (1):[3]

$$(1) \qquad LnM_t = a + bLnY_t + cLn(P_t/P_{t-1}) + dLnEX_t + eLnVY_t + fLnVM_t + \varepsilon_t$$

Following the literature, we expect an estimate of b to be positive and c to be negative. As for the exchange rate, it could carry a positive or negative coefficient. As the Appendix shows, the exchange rate is defined and constructed as the nominal effective exchange rate. As such a decline reflects a depreciation of domestic currency or appreciation of foreign currency. When foreign currency appreciates, that raises domestic currency value of foreign assets held by domestic residents leading to an increase in their wealth and eventually an increase in their spending and their demand for money. Hence a negative estimate for d is expected (Arango and Nadiri 1981). However, if appreciation of foreign currency increases expectation of further appreciation, domestic residents may increase their holding of foreign currency and reduce their holding of domestic currency. Therefore, a positive estimate for d could also be expected (Bahmani-Oskooee and Pourheydarian 1990). Finally, as discussed in the previous section both uncertainty measures reflected by the volatility of real GDP (*VY*) and volatility of nominal money supply (*VM*) are expected to have positive or negative effect on the quantity of money demanded.

Clearly, coefficient estimates of equation (1) by any mean only yield long run estimates. However, in many countries uncertainty measures could only have short-run effects. To distinguish short-run effects from long-run effects we need to express (1) in an error-correction modeling format as in (2):

[3] Indeed, without uncertainty measures, our specification follows Bahmani-Oskooee and Gelan (2009). Note that including volatility measures in the long-run specification does not imply they are significant determinant. It is just a theoretical conjecture and the empirical results will signify their position as long-run or only short-run determinants.

$$\begin{aligned}(2)\qquad \Delta LnM_t = \alpha + \sum_{i=1}^{n1}\beta_i\Delta LnM_{t-i} + \sum_{i=0}^{n2}\delta_i\Delta LnY_{t-i} + \sum_{i=0}^{n3}\gamma_i Ln(P_t/P_{t-1})_{t-i} \\ + \sum_{i=0}^{n4}\eta_i\Delta LnEX_{t-i} + \sum_{i=0}^{n5}\lambda_i\Delta LnVY_{t-i} + \sum_{i=0}^{n6}\mu_i\Delta LnVM_{t-i} \\ + \rho_0 LnM_{t-1} + \rho_1 LnY_{t-1} + \rho_2 Ln(P_t/P_{t-1})_{t-1} + \rho_3 LnEX_{t-1} \\ + \rho_4 LnVY_{t-1} + \rho_5 LnVM_{t-1} + \varepsilon_t\end{aligned}$$

The error-correction model outlined by equation (2) is similar to Engle and Granger (1987) representation theorem in spirit in that the lagged error term from (1) has been replaced by linear combination of lagged level variables[4]. Pesaran et al. (2001) propose this substitution and suggest using the F test for their joint significance as a sign of cointegration. However, they also propose new critical values for the F test which take into consideration integrating properties of variables. By assuming all variables in a model to be integrated of order one or I(1) they provide an upper bound critical value. A lower bound critical value is provided when all variables are I(0). They then demonstrate that the upper bound critical value could be used even if some variables are I(1) and some I(0). This method is relatively more suitable for our model since in most instances volatility measures are I(0) and this is the main advantage of this method. Once cointegration is established, long-run effects are derived by normalizing estimates of ρ_1–ρ_5 on ρ_0. The short-run effects are judged by the size and significance of coefficient estimates attached to first-differenced variables.[5] We estimate equation (2) for 21 countries in Africa in the next section.

3. Empirical Results

The error-correction model outlined by equation (2) is estimated for each of the 21 countries for which we were able to collect quarterly data over the period 1971I – 2011IV.[6] The list includes:

Burkina Faso, Burundi, Cameroon, Côte d'Ivoire, Egypt, Ethiopia, Gabon, Ghana, Kenya, Madagascar, Mauritius, Morocco, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Tanzania, and Togo. As the Appendix indicates, both volatility measures are constructed using the GARCH method. In order to see the movements of these two volatility measures over time, we plot them along with

4 They are actually the same if we solve equation (1) for the error term and lag the solution by one period.

5 For other applications of this approach see Bahmani-Oskooee et al. (2005), Halicioglu, F., (2007), Narayan et al. (2007), Tang (2007), Mohammadi et al. (2008), Wong and Tang (2008), De Vita and Kyaw (2008), Payne (2008), and Bahmani-Oskooee and Gelan (2009).

6 Exceptions are noted in the Appendix.

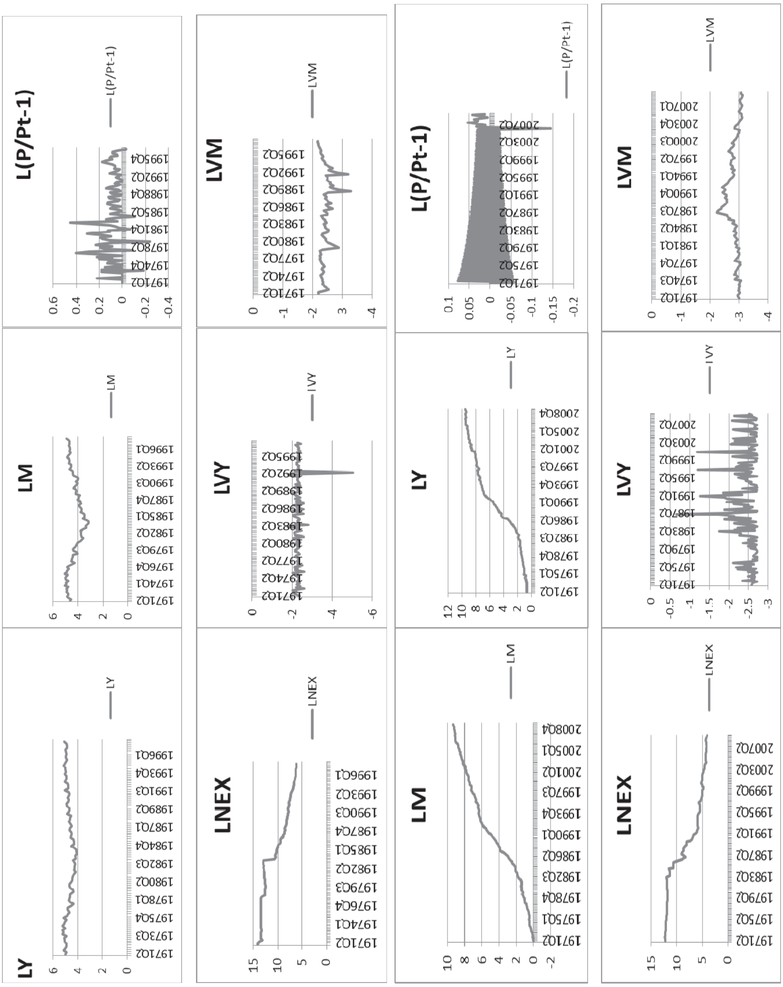

Figure 1: Plot of all variables for Ghana (first six plots) and Sierra Leone (second six plots)

all other variables for one high inflation country of Ghana and one low inflation country of Sierra Leone. As can be seen, the volatility measures as well as the rate of inflation cross their means too often, indicating the I(0) properties of these variables. However, this is not the case for other variables, justifying bounds testing approach.[7]

In order to estimate error-correction model (2), following the literature we impose a maximum of four lags on each first-differenced variable and use Akaike's Information Criterion to select the optimum number of lags. The results from each optimum model are reported in Table 1.

Due to volume of the results, for each country we report them in three panels. In Panel A we report the short-run coefficient estimates. In Panel B we report the long-run coefficient estimates. Finally, diagnostic statistics are reported in Panel C. Concentrating on short-run results and two variables of concern, i.e., output volatility and money volatility we gather that there is at least one significant coefficient obtained for each variable in most countries. More precisely, output volatility has short-run effects on the demand for money in thirteen countries of Burundi, Côte d'Ivoire, Egypt, Gabon, Madagascar, Mauritius, Morocco, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, and Tanzania. Similarly, monetary volatility has short-run effects on the demand for money in Burundi, Cameroon, Côte d'Ivoire, Ghana, Kenya, Madagascar, Mauritius, Morocco, Niger, Senegal, and Tanzania. Do these short-run effects last into the long run?[8]

From the long-run coefficient estimates reported in Panel B it is clear that output volatility has significant long-run effects on the demand for money only in six countries. While its effects are positive in the results for Côte d'Ivoire, Rwanda, and Seychelles, they are negative in the results for Egypt and South Africa. As for the volatility of nominal money supply, it also has significant long-run effects in six countries. It has positive effects on the demand for money in Madagascar, Morocco, and Senegal, and negative effects on the demand for money in Ethiopia, Rwanda, and Tanzania. Thus, it appears that in most countries effects of output uncertainty and monetary uncertainty are transitory.

As for the long-run effects of other three variables, clearly the level of economic activity or income seems to be the most important variable in the long run, for it carries a highly significant and positive coefficient in all countries, supporting the transaction demand for money. The income elasticity in most countries is greater than one, implying some diseconomies of scale in African nations. A 1% economic growth requires more than 1% increase in money supply. The second important long-run determinant seems to be the inflation rate, for it carries a significantly negative coefficient in 10 countries. Therefore, in these 10 countries the real assets are considered to be close substitute for cash. Finally, the nominal effective exchange

7 Similar graphs for all other countries are available from authors upon request.

8 Note that while income and inflation rate do have short-run effects on the demand for money in almost all countries, the nominal effective exchange rate has short-run effects only in seven countries.

rate carries a significant long run coefficient in nine countries. The positive coefficient in the cases of Côte d'Ivoire, Ethiopia, Seychelles, South Africa, and Tanzania signifies the wealth effect as foreign currencies appreciate, since domestic currency value of foreign assets held by domestic residents rise, public in these countries try to spend more by holding more of domestic currency. On the other hand, the exchange rate elasticity is significantly negative in the cases of Burkina Faso, Burundi, Kenya, and Rwanda, implying that as foreign currencies appreciate (especially the reserve currency), market participants in these countries expect further appreciation, inducing them to hold more of foreign currencies and less of domestic currency.

If the above long-run coefficient estimates are to be not spurious, we must establish cointegration. The results of the F test to determine joint significance of lagged level variables in each optimum model along with other diagnostics are reported in Panel C. Given the upper bound 5% critical value of 3.79 from Pesaran et al. (2001, Case III, p. 300) it is clear that our calculated statistic is greater than 3.79 in 12 countries, supporting cointegration among the six variables included in our money demand specification. In the remaining countries we need to adhere to an alternative test (e.g., Bahmani-Oskooee and Tanku 2008). Using long-run normalized coefficient estimates and equation (1) we calculate the error term and call it *ECM*. We then shift to equation (2) and replace the linear combination of lagged level variables by ECM_{t-1} and estimate each model after imposing the same optimum lags. A significantly negative coefficient obtained for ECM_{t-1} will support movement toward long-run equilibrium and cointegration. As can be seen, indeed ECM_{t-1} carries significantly negative coefficient in all cases, implying adjustment toward long-run equilibrium.[9]

Several other diagnostic statistics are also reported in Panel C. The Lagrange Multiplier (LM) test which has a $\chi 2$ distribution with four degrees of freedom is used to test for serial correlation among residuals of each model. Given its critical value of 9.48, clearly residuals are autocorrelation free only in the cases of Burundi, Egypt, Ghana, Madagascar, Mauritius, Nigeria, Rwanda, Senegal, Seychelles, and Tanzania. Is each optimum model correctly specified? We report Ramsey's RESET test statistic to answer this question. It is distributed as $\chi 2$ but with one degree of freedom only. Our calculated statistic is less than the critical value of 3.61 in 10 countries, implying correctly specified models. We also apply the well-known CUSUM and CUSUMSQ tests to the residuals of each optimum error-correction model to determine stability of short-run and long run coefficient estimates. As can be seen, all models seem to be stable. Finally, as the size of adjusted R^2 reflects, most of the estimated models enjoy a good fit. A high size of the adjusted R^2 reflects fitted values are close to actual values, like the case of Cote d'Ivoire (adjusted $R^2 = 0.90$). However, they do not trace each other well when adjusted R^2 is low, like the case of South Africa (adjusted $R^2 = 0.50$). For demonstrative purpose we plot the values for these two countries in Figure 2.

9 The exception is Egypt.

Table 1

Full Information Estimate of Equation (2)

MODEL	BURKINAFASO	BURUNDI	CAMEROON	COTE D'VOIRE	EGYPT	ETHIOPIA	GABON
Panel A: Short-run Estimates							
$\Delta \ln M_{t-1}$	–	0.11[0.87]	*0.29[5.98]	*0.18[4.12]	*–0.52[6.61]	0.01[0.13]	0.09[1.22]
$\Delta \ln M_{t-2}$	–	*–0.29[3.20]	–0.07[1.35]	–0.00[0.07]	*–0.24[3.53]	*–0.28[4.12]	0.09[1.46]
$\Delta \ln M_{t-3}$	–	–0.11[1.68]	*0.12[2.53]	*0.15[3.76]	–		–
$\Delta \ln M_{t-4}$	–	–	–		–		–
$\Delta \ln Y_t$	*0.32[5.99]	*0.32[8.81]	*0.69[15.84]	*0.83[25.27]	*0.27[6.86]	*0.31[7.61]	*0.33[10.08]
$\Delta \ln Y_{t-1}$	–0.09[1.48]	*–0.25[3.14]	–	–	*0.37[9.21]	–	–
$\Delta \ln Y_{t-2}$	*–0.14[2.62]	*–0.19[4.03]	–	–	*0.33[7.23]	–	–
$\Delta \ln Y_{t-3}$	–0.95[1.85]	–	–	–	*0.21[4.90]	–	–
$\Delta \ln Y_{t-4}$	0.05[1.08]	–	–	–		–	–
$\Delta \ln (P_t/P_{t-1})_t$	*–0.72[7.26]	*–0.44[2.84]	0.04[0.44]	*–0.42[4.35]	*–0.84[12.12]	*–0.64[10.00]	*–0.60[05.49]
$\Delta \ln (Pt/Pt-1)_{t-1}$	–	*0.53[2.77]	*0.19[2.06]	*–0.29[2.67]	0.16[1.31]	*0.18[2.16]	–
$\Delta \ln (Pt/Pt-1)_{t-2}$	–	0.31[1.94]	–	*–0.21[2.03]	0.19[1.78]	*–0.15[2.63]	–
$\Delta \ln (Pt/Pt-1)_{t-3}$	–	–	–	–	*0.40[5.42]		–
$\Delta \ln (Pt/Pt-1)_{t-4}$	–	–	–	–	–		–

Δln REX$_t$	–0.11[1.33]	0.01[0.09]	0.01[0.34]	0.04[1.30]	–0.00[0.32]	0.00[0.40]	0.01[0.15]
Δln REX$_{t-1}$	–	–	–	–	–0.03[1.79]		–
Δln REX$_{t-2}$	–	–	–	–	–0.03[1.40]	–	–
Δln REX$_{t-3}$	–	–	–	–	–0.03[1.44]	–	–
Δln *REX*$_{t-4}$	–	–	–	–		–	–
Δln *VY*	–0.00[0.09]	*0.18[4.49]	0.02[1.32]	0.00[0.12]	*0.02[4.47]	0.01[1.00]	0.05[0.45]
Δln *VY*$_{t-1}$	–	*0.14[3.10]	–	*–0.06[2.68]	*–0.02[2.21]		*0.36[3.10]
Δln *VY*$_{t-2}$	–		–	*–0.06[3.28]	*–0.00[1.86]	–	–
Δln *VY*$_{t-3}$	–	–	–	*–0.05[2.41]		–	–
Δln *VY*$_{t-4}$	–	–	–	–		–	–
Δln *VM*	0.30[0.98]	–0.03[0.11]	*0.21[2.84]	*0.09[3.46]	0.00[0.34]	0.03[1.49]	–0.00[0.12]
Δln *VM*$_{t-1}$	–	*0.87[3.12]	*0.16[2.29]	0.01[0.34]	–	–	–
Δln *VM*$_{t-2}$	–	–	–	–0.05[1.87]	–	–	–
Δln *VM*$_{t-3}$	–	–	–	–	–	–	–
Δln *VM*$_{t-4}$	–	–	–	–	–	–	–
Panel B: Long-run Estimates							
Constant	*–6.10[4.06]	*10.53[2.88]	0.39[5.98]	10.98[1.18]	*–5.70[2.21]	*–6.33[2.81]	–1.07[0.24]
ln *Y*	*1.16[7.09]	*1.29[3.63]	*1.28[6.40]	*1.18[4.34]	*1.53[7.17]	*1.40[10.98]	*1.01[5.96]
ln (Pt/Pt–1)	*–5.81[3.09]	–10.62[1.45]	0.20[0.08]	1.89[0.64]	*28.54[2.63]	*–19.12[3.47]	*–2.83[2.16]

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Table 1 (continued)

MODEL	BURKINAFASO	BURUNDI	CAMEROON	COTE D'VOIRE	EGYPT	ETHIOPIA	GABON
ln *NEX*	*–0.43[2.65]	*–0.26[2.03]	0.14[0.38]	0.43[1.95]	–0.14[1.30]	*0.16[2.80]	0.24[1.25]
LVY	0.00[0.02]	1.34[1.16]	0.28[0.58]	1.05[1.81]	*–0.99[2.25]	0.20[1.05]	0.26[0.14]
LVM	0.11[0.32]	–0.08[0.15]	0.46[0.97]	1.79[1.16]	0.00[0.02]	*–1.47[2.20]	–0.07[0.39]
Panel C: Diagnostics Test							
F at Optimum	4.94	5.97	0.91	1.78	16.75	10.64	3.0
EMC_{t-1}	*–0.10[5.45]	*–0.11[6.10]	*–0.05[2.32]	*–0.07[3.33]	*0.03[10.00]	*–0.04[8.09]	*–0.11[4.35]
LM	4.96	12.87	1.09	1.68	14.59	8.57	3.85
RESET	2.42	0.04	17.96	0.63	31.87	0.02	0.85
CUSUM	Stable	Stable	Stable	Stable	Unstable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Adj. R^2	0.55	0.59	0.70	0.91	0.82	0.77	0.63

Notes: Numbers inside the brackets next to each coefficient are absolute values of t-ratios. * indicates significance at 5% or 10% level.
LM = Lagrange multiplier test of residual serial correlation. It is distributed as χ^2 (4).
RESET = Ramsey's test for function form. It is distribute as χ^2 (1).
CUSUM = Cumulative Sum of Recursive Residuals Test for coefficient stability.
CUSUMSQ = Cumulative Sum of Squares of Recursive Residuals test for coefficient stability.

MODEL	GHANA	KENYA	MADAGASCAR	MAURITIUS	MOROCCO	NIGER	NIGERIA
Panel A: Short-run estimates							
$\Delta \ln M_{t-1}$	–0.09[1.51]	*0.15[2.73]	–	*–0.17[2.05]	–0.15[2.24]	0.16[2.03]	–

Δln M_{t-2}	–	–	–		0.11[1.69]	–	–
Δln M_{t-3}	–	–	–			–	–
Δln M_{t-4}	–	–	–			–	–
Δln Y_t	*–0.69[15.85]	*0.44[7.07]	*0.57[12.84]	*0.69[18.98]	*0.41[10.10]	*0.72[14.35]	*0.25[5.03]
Δln Y_{t-1}	–	–	0.12[1.96]	–0.04[0.60]	–	–0.10[1.40]	*0.13[2.51]
Δln Y_{t-2}	–	–	–	–0.04[0.89]	–	–	–
Δln Y_{t-3}	–	–	–	*0.10[2.50]	–	–	–
Δln Y_{t-4}	–	–	–	–	–	–	–
Δln (Pt/Pt–1)t	*–0.40[7.35]	*–0.70[5.75]	*–0.42[4.88]	*–0.72[0.30]	*–0.58[5.07]	0.03[0.12]	*–0.79[7.00]
Δln (Pt/Pt–1)t–1		–	–	–0.04[1.50]		–	
Δln (Pt/Pt–1)t–2		–	–	–0.21[1.92]		–	–
Δln (Pt/Pt–1)t–3		–	–	–0.24[0.44]		–	–
Δln (Pt/Pt–1)t–4		–	–	–		–	–
Δln REX_t	–0.00[0.25]	*–0.10[2.38]	–0.00[0.09]	*–0.024[1.06]	0.02[0.48]	0.11[1.70]	*0.28[2.97]
Δln REX_{t-1}		–0.07[1.51]	–	–	–	–	–
Δln REX_{t-2}		*0.10[2.40]	–	–	–	–	–
Δln REX_{t-3}		–	–	–	–	–	–
Δln REX_{t-4}		–	–	–	–	–	–

Continued next page

Table 1 (continued)

MODEL	GHANA	KENYA	MADAGASCAR	MAURITIUS	MOROCCO	NIGER	NIGERIA
Δln VY	0.01[1.16]	–0.03[0.74]	*–0.08[3.25]	0.02[1.09]	–0.00[0.09]	0.03[0.79]	0.06[1.12]
Δln VY_{t-1}		–	–	–0.01[0.52]	*–0.02[2.11]	–	–
Δln VY_{t-2}		–	–	0.01[4.16]		–	–
Δln VY_{t-3}		–	–	*0.05[–0.13]	–	–	–
Δln VY_{t-4}		–	–	–	–	–	–
Δln VM	*–0.15[4.12]	0.05[0.88]	*0.19[2.90]	–0.00[3.94]	*0.02[3.43]	*0.26[2.92]	0.02[0.76]
Δln VM_{t-1}	*–0.08[2.47]	–0.00[0.02]	–	–		–0.07[0.98]	–
Δln VM_{t-2}	*–0.08[2.26]	–0.03[0.63]	–	–		–0.01[2.22]	–
Δln VM_{t-3}	*–0.13[3.62]	*0.15[3.44]	–	–	–	*–0.17[2.68]	–
Δln VM_{t-4}			–	–	–	–	
Panel B: Long-run Estimates							
Constant	–2.65[1.26]	*5.41[2.61]	–0.75[0.19]	–1.64[1.03]	*6.16[2.54]	1.14[1.02]	5.42[1.04]
ln *Y*	*2.05[6.60]	*0.49[2.09]	*2.07[2.65]	*1.52[12.19]	*1.76[13.45]	1.77[0.38]	2.82[1.92]
ln (Pt/Pt–1)	*–5.94[2.01]	*–5.73[3.04]	*–7.51[2.26]	–3.62[1.59]	*–13.02[2.42]	62.77[1.02]	–24.07[1.62]
ln *NEX*	–0.01[0.40]	*–0.16[3.07]	0.19[1.23]	–0.00[–0.01]	0.16[0.61]	1.72[0.56]	0.77[1.09]
LVY	0.16[0.57]	0.18[0.98]	*–0.94[2.18]	0.11[1.00]	–0.64[1.36]	0.14[0.07]	1.33[1.08]
LVM	0.72[1.41]	0.18[1.11]	*2.01[2.24]	–0.06[0.59]	0.28[1.71]	4.12[0.38]	1.14[0.87]

Panel C: Diagnostics Test							
F at Optimum	6.57	6.33	5.73	2.48	3.52	1.56	10.09
EMC$_{t-1}$	*–0.07[6.43]	*–0.11[6.27]	*–0.06[5.93]	*–0.10[3.94]	*–0.05[4.54]	*–0.01[1.00]	*–0.03[7.74]
LM	10.65	4.64	13.48	11.51	0.52	6.52	9.69
RESET	6.38	5.54	5.31	23.35	16.13	12.11	3.11
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Adj. R2	0.89	0.62	0.66	0.82	0.53	0.60	0.51

Notes: Numbers inside the brackets next to each coefficient are absolute values of t-ratios. * indicates significance at 5% or 10% level.
LM = Lagrange multiplier test of residual serial correlation. It is distributed as χ^2 (4).
RESET = Ramsey's test for function form. It is distribute as χ^2 (1).
CUSUM = Cumulative Sum of Recursive Residuals Test for coefficient stability.
CUSUMSQ = Cumulative Sum of Squares of Recursive Residuals test for coefficient stability

MODEL	**RWANDA**	**SENEGAL**	**SEYCHELLES**	**SIERA LEONE**	**SOUTH AFRICA**	**TANZANIA**	**TOGO**
Panel B: Long-run Estimates							
Δln M_{t-1}	*–0.15[3.30]	–	–0.14[1.58]	0.08[1.27]	–	–0.14[1.83]	*0.12[2.21]
Δln M_{t-2}	*–0.14[3.07]	–	–0.08[1.11]	*–0.16[2.74]	–		*0.19[3.31]
Δln M_{t-3}	–	–	*–0.27[3.33]	–	–		
Δln M_{t-4}	–	–	–	–	–		–

Continued next page

Table 1 (continued)

MODEL	RWANDA	SENEGAL	SEYCHELLES	SIERA LEONE	SOUTH AFRICA	TANZANIA	TOGO
Δln Y_t	*0.67[18.10]	*0.83[19.19]	*0.51[10.17]	*0.40[10.10]	*0.03[3.86]	*0.72[19.19]	*0.65[14.44]
Δln Y_{t-1}	–	*0.11[2.60]	0.00[0.00]	–	*–0.05[6.55]	–0.09[1.41]	–
Δln Y_{t-2}	–	–	0.03[0.49]	–	*–0.03[3.56]	*–0.25[4.63]	–
Δln Y_{t-3}	–	–	*0.24[3.45]	–	*–0.02[2.75]		–
Δln Y_{t-4}	–	–	–	–	–		–
Δln (Pt/Pt–1)t	*–0.36[4.84]	*–0.34[4.51]	*–0.42[5.67]	–0.53[4.59]	*–1.02[6.64]	0.14[1.7]	–0.13[1.23]
Δln (Pt/Pt–1)t–1	0.13[1.95]	–		–	–	–	*–0.24[2.06]
Δln (Pt/Pt–1)t–2	–	–		–	–	–	–
Δln (Pt/Pt–1)t–3	–	–		–	–	–	–
Δln (Pt/Pt–1)t–4	–	–		–	–	–	–
Δln REX	–0.02[0.84]	0.04[0.92]	0.06[1.41]	–0.03[1.63]	–0.02[1.56]	–0.01[0.25]	0.07[0.62]
Δln REX_{t-1}	–	–	–	*–0.05[2.53]	–	–0.02[0.46]	*–0.13[0.06]
Δln REX_{t-2}	–	–	–	–0.03[1.34]	–	0.01[0.26]	–
Δln REX_{t-3}	–	–	–	–	–	*0.30[6.51]	–
Δln REX_{t-4}	–	–	–	–	–		–
Δln VY	*0.17[2.75]	–0.01[0.30]	–0.00[0.02]	0.00[0.45]	*–0.09[9.18]	–0.02[1.97]	–0.17[0.48]
Δln VY_{t-1}	–	0.01[0.40]	*–0.14[5.76]	–0.00[0.19]	–0.01[0.92]	*0.04[3.29]	–

Δln VY_{t-2}	–	0.02[0.69]	–0.06[1.98]	–0.00[0.06]	*–0.03[3.36]		–
Δln VY_{t-3}	–	*–0.06[2.24]	–	*0.02[2.58]	–	–	–
Δln VM	–0.07[0.70]	0.03[0.74]	0.01[0.64]	–0.07[1.18]	0.02[0.31]	*–0.09[2.70]	–0.02[0.52]
Δln VM_{t-1}	–	–0.04[0.94]	–	–	–	*0.31[5.54]	–
Δln VM_{t-2}	–	–0.02[0.52]	–	–	–	*0.13[3.54]	–
Δln VM_{t-3}	–	*–0.14[3.71]	–	–	–	*0.41[1.64]	–
Δln VM_{t-4}	–	–	–	–	–	–	–
Panel B: Long-run Estimates							
Constant	*7.79[8.61]	–2.24[0.71]	*–8.00[5.47]	–27.98[0.19]	–2.24[0.25]	–8.46[1.81]	–7.52[0.64]
ln Y	*1.14[4.64]	*2.23[3.74]	*1.85[13.09]	7.28[0.19]	*1.27[9.80]	*1.85[6.16]	1.01[1.28]
ln (P_t/P_{t-1})	*–4.38[4.64]	–2.47[0.71]	*–6.52[3.20]	–184.3[0.16]	*–22.14[–4.91]	–1.96[0.82]	–7.16[1.00]
ln NEX	*–0.17[3.83]	0.19[0.40]	*2.36[4.48]	6.53[0.16]	*0.21[3.45]	*0.16[2.77]	0.24[0.46]
ln VY	*1.22[4.20]	–0.89[1.47]	*0.55[2.86]	5.8[0.15]	*–0.91[7.21]	0.14[1.18]	–2.58[0.46]
ln VM	*–0.91[2.43]	*1.15[2.16]	0.08[0.45]	10.60[0.15]	0.27[0.25]	*–6.44[2.79]	–0.11[0.12]
Panel C: Diagnostics Test							
F at Optimum	6.96	1.03	9.56	0.99	14.28	9.92	1.01
EMC_{t-1}	*–0.12[6.57]	–0.04[2.50]	*–0.09[7.75]	*–0.00[2.42]	*–0.06[9.43]	*–0.09[5.14]	*–0.03[2.33]
LM	10.91	15.90	16.75	6.11	0.54	9.00	4.19
RESET	7.38	0.10	0.100	5.14	0.50	14.10	2.67

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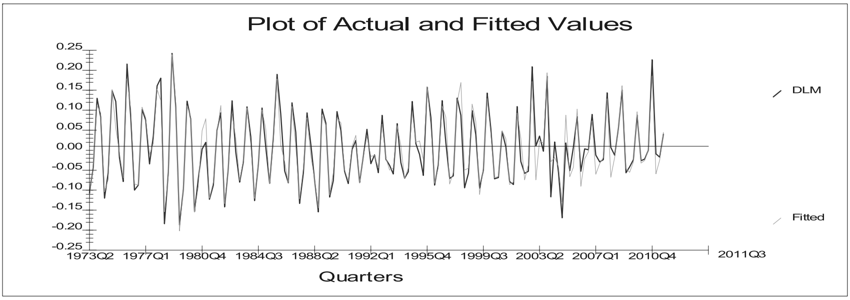
Table 1 (continued)

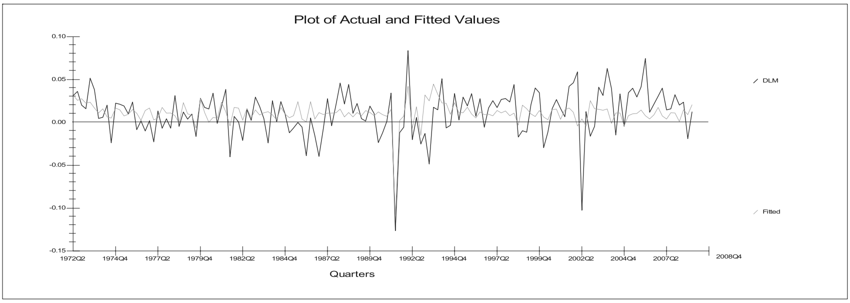
MODEL	RWANDA	SENEGAL	SEYCHELLES	SIERA LEONE	SOUTH AFRICA	TANZANIA	TOGO
CUSUM	Stable	Stable	Stable	Stable	Stable	Stable	Stable
CUSUMSQ	Stable	Stable	Stable	Stable	Stable	Stable	Stable
Adj. R^2	0.81	0.78	0.69	0.70	0.50	0.90	0.62

Notes: Numbers inside the brackets next to each coefficient are absolute values of t-ratios. * indicates significance at 5% or 10% level.
LM = Lagrange multiplier test of residual serial correlation. It is distributed as χ^2 (4).
RESET = Ramsey's test for function form. It is distribute as χ^2 (1).
CUSUM = Cumulative Sum of Recursive Residuals Test for coefficient stability.
CUSUMSQ = Cumulative Sum of Squares of Recursive Residuals test for coefficient stability.

Cote d'Ivoire



South Africa



Figue 2: Fitted Values versus Actual Value for Two Countries

4. Concluding Remarks

Traditionally, standard specification of the demand for money in any country includes income as scale variable and interest rate or rate of inflation as the opportunity cost of holding money. As time passes and more unexpected economic events occur, we think of incorporating them into economic models including the demand for money. When international monetary system changed from fixed to flexible exchange rate system, some thought of the exchange rate as another determinant of the demand for money which accounts for currency substitution. And when the Fed switched its policy from fixing interest rates to targeting monetary aggregates, since it missed its inflation target monetarism was criticized. Milton Friedman came to rescue by arguing the volatility of money supply as a determinant of velocity or demand for money. If monetary uncertainty or volatility could be a determinant of the demand for money, why cannot economic uncertainty serve as another determinant? A theoretical model was developed to show that indeed, monetary uncertainty and economic uncertainty could influence public's desire to hold more or less money.

Unfortunately, a money demand function that includes all determinants mentioned above has only been estimated for a few developed countries, including the U.S. Developing countries have not received much attention. Previous studies that estimated the demand for money in developing countries included only income, inflation rate and the exchange rate as determinants of the demand for money. No study has included measures of monetary uncertainty and economic uncertainty in their specification. In this paper we fill this vacuum by estimating a money demand function that includes monetary and economic uncertainty variables for each of the 21 countries from Africa. Quarterly data and bounds testing approach to cointegration and error-correction modeling are used to carry out the empirical exercise. The results reveal that in most African countries the impact of monetary uncertainty and economic uncertainty are transitory and do not last into long run. This could be due to public's expectations adjusting to uncertainties created by output and monetary growth volatility. If expectations do not adjust to economic conditions created by either uncertainty, clearly their effects will last over longer period of time. Furthermore, by including the two uncertainty measures we found that the demand for money in every African nation is stable. One policy implication of finding stable money demand is that central bank will be in a better position to predict the impact of money growth on inflation and output since stable money demand implies a stable velocity.

Appendix

All data are quarterly and are collected from the following two sources:

a. International Financial Statistics of the IMF.

b. Direction of Trade Statistics of the IMF.

Depending upon data availability, study period differed from one country to another as follows:

Burkina Faso (1971I–2008IV), Burundi (1971I–2008IV), Cameroon (1971I–2009IV), Côte d'Ivoire (1971I–2011IV), Egypt (1971I–2008IV), Ethiopia (1971I–2008IV), Gabon (1971I–2000IV), Ghana (1971I–1997IV), Kenya (1971I–2009III), Madagascar (1971I–2010IV), Mauritius (1971I–2008IV), Morocco (1971I–2009II), Niger (1971I–2011IV), Nigeria (1971I–2008IV), Rwanda (1971I–2005IV), Senegal (1971I–2011IV), Seychelles (1971I–2008IV), Sierra Leone (1971I–2009IV), South Africa (1971I–2008IV), Tanzania (1971I-2007IV) and Togo (1971I–2011).

Variables:

M: Real money measured by M2. Nominal money supply is deflated by the Consumer Price Index (CPI) to obtain real values. CPI is the only price index available for most African countries. All data come from source a.

Y: Real Income. Quarterly figures for this variable were not available for any of the countries in our sample except South Africa. Therefore, we had to generate quarterly data from annual data through interpolation following the method in Bahmani-Oskooee (1998, p. 142). The quarterly generated figures were then deflated by the CPI to arrive at real figures. All necessary data came from source a.

Ln (P_t/P_{t-1}): Inflation Rate. CPI is used to measure P. Again, the CPI data come from source a.

EX: Nominal Effective Exchange Rate. Since the nominal effective exchange rate is not available for any of the countries in our sample, we constructed it following the method in Bahmani-Oskooee and Gelan (2007). For each country we included top 20 trading partners. While exchange rate data came from source a, the trade shares in 2005 that are used as weights came from source b.[10] Note that even if some countries have followed different exchange rate policies such as pegging to a major currency or belonging to a monetary union, none can avoide fluctuation in its effective exchange rate due to fluctuation in major currencies and arbitrage activities. For details of exchange rate policies in Africa see Qureshi and Tsangarides (2012).

VY = GARCH-based volatility measure of real income, Y.

VM = GARCH-based volatility measure of nominal M2.[11]

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10 The list of trading partners is available upon request.

11 For all countries a GARCH (1,1) specification was assumed. See Bahmani-Oskooee and Xi (2011) for details. As explained in detail in Bahmani-Oskooee et al. (2010), when a GARCH (p,q) specification is used to generate the volatility measure, square of conditional variance of the residuals from a first-order autoregressive model of output or money supply is regressed on p lags of the squared residuals themselves and q lags of their conditional variance. The order of lags is judged by the significance of the lags. In most cases GARCH (1,1) yielded significant order.

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