On the stability of money demand: evidence from Madagascar

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Abstract

This paper seeks to determine the existence of a stable demand for money relation for the case of Madagascar. We use an Engle-Granger error correction model to be able to demonstrate that in the long-run, the demand for money is negatively explained by the opportunity cost and positively by real income and the proxy for financial innovation. The latter, when taken into account, produces a less stable demand than when real income and opportunity cost are only used. Hence, the real demand for money in Madagascar is considered as stable, but fragile. This situation justified the migration to a more forward-looking monetary policy regime.

Résumé

Cette étude cherche à déterminer l'existence de relation stable de la demande de monnaie pour le cas de Madagascar. Nous utilisons un modèle à correction d'erreur à la Engle et Granger pour montrer que sur le long-terme, la demande d'encaisse réelle est négativement expliquée par le coût d'opportunité et positivement par le revenu réel et la variable mesurant l'innovation financière. Cette dernière, lorsqu'elle est prise en compte, produit une demande moins stable, que lorsque seuls le revenu réel et le coût d'opportunité sont utilisés. Ainsi, la demande réelle de monnaie à Madagascar est considérée comme stable, mais fragile. Cette situation justifie le basculement vers un régime de politique monétaire plus proactif.

Keywords: money demand, financial innovation, cointegration, vector error-correction model.

Introduction

Monetary policy in Madagascar has recently shift towards a more forward-looking regime, that is an interest rate targeting. This migration occurred after years of monetary policy, considered as "discretionary" and targeting monetary aggregates. So far, no in-depth study on the demand for money has been conducted to support the choice for this precedent regime. In this regard, this paper aims to analyze the stability of money demand over a long period during the monetary aggregates targeting era. The objective is to understand one of the rationales behind the abandonment of the monetary aggregates as monetary policy anchor and the migration towards this more proactive regime.

This paper will begin with literature review on leading studies on the demand for money, according to the traditional view and the modern view [Rathnasiri (2021)]. The second part will analyze the demand for money using an Engle and Granger error correction model (1987). A first equation models the real demand for money, with three explanatory variables, including real income, opportunity cost and the proxy for financial innovation. A second one does not take into account this variable measuring the financial innovation. Subsequently, we will perform stability tests on the validated money demand functions. The demand for money is less stable with financial innovation, which leads us to endorse that generally speaking, the demand for money in Madagascar is stable, but fragile.

Selected Literature Review

The money demand equation has always been an important element of analysis in the conduct of monetary policy, and as such, is widely used by Central Banks (Beyer, 2009). Many authors have tried to determine and then estimate the money demand equation since Keynes (1936) formalized the motives for money demand, *namely*, transaction, precaution and speculation. For Keynes, money is required to settle transactions, to hedge against future risks and to take advantage of investment opportunities. Moreover, Keynes argued that economic agents have a preference for liquidity, which encourages them to hold money. In this sense, the money demand equation is an increasing function of income and a decreasing function of nominal interest rate. It is given by the following equation:

$$M^d = L(Y, i)$$

In 1956, Friedman refreshed the quantity theory of money, originally introduced by Fischer (1917), and challenged Keynes' liquidity preference theory as an explanatory factor of the demand for money. For the founder of the Chicago School, the demand for money should be stable and dot not explain in anyway the economic crises. In 1970, Friedman synthesized his various thoughts and proposed the demand for money as a function of permanent income. The latter is defined as the wealth accumulated throughout the life of the economic agent. According to this author, consumption is not a function of current income, which can vary, but of the general standard of living of this agent, *ie*, his permanent income. A stable relation on the demand for money is only obtained in this condition. Other factors can be added for the determination of the demand for money like the expected return on investments, the expected return on stocks, the expected return on securities, as well as the expected inflation rate. The money demand equation is written as follows:

$$\frac{M}{P} = f\left(y, w; r_m, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; u\right)$$

Laidler, in the 60s and 70s, undertook various pioneering works on the demand for money. He relied on the above-mentioned quantity theory of money to corroborate the Friedman's works. For this author, the real cash balance desired by economic agents is a function of permanent income, rates of

return on securities, both short and long term, and the rate of expected inflation. This demand for money is assumed to be stable. So, in the short term, the variation in money supply, which is supposed to be exogenous (function of the policy from the Monetary Authority and the banking system), can affect production. In the long run, any excess quantity of money with respect to this demand for money is only reflected in the price change.

Driscoll and Ford (1980) smoothed over the debates between Keynesians and monetarists on this subject, arguing that the stability of the demand for money is not as crucial. For them, the most important is the stability of the money multiplier, which would be stable if only if the demand for money is an exclusive function of income. If there are other variables, the money demand function should be unstable to acquire a stability of the money multiplier.

According to Rathnasiri (2021), the literature on money demand can be classified into traditional view and modern view. The traditional approach defines the demand for money as a function of real income, the interest rate and wealth. The modern approach takes into account other factors like inflation, exchange rate, budget deficit, population, etc. In this regard, this author used the inflation rate, exchange rate, public spending, interest rate spread and economic crises as explanatory variables of the demand for money in Sri Lanka over the period 1977-2019. For the opportunity cost variable, he takes both short-term and long-term interest rate. As results, all the explanatory variables have significant relations with the demand for money. Whatever the aggregate used (M1 or M2), the author found stable demand functions over this period. This result indicates that these two aggregates are eligible as a monetary policy anchor, and the use of the broad money supply as an intermediate target for monetary policy is viable for Sri Lanka.

Recent studies on the demand for money are empirical ones, testing its stability of the relation for one or several countries. Most of these works are then categorized into the modern approach. For the case of Ghana, Nchor and Adamec (2016) found stability of the demand for money, both when using M1 and M2+. The level of demand for money is affected by real GDP in the long term and by the interest rate in the short term.

Swaray (2022) used an ARDL model to test the stability of the money demand for the case of Sierra Leone. A stable relation is verified over the long term for this country. He found that when M1 currency is used, income elasticity is high, indicating an important cash-based economy, which should be taken into account in the conduct of monetary policy.

Beyer (2009) used a VECM model to test the stability of money demand for the Euro Zone. He found that household wealth is an important explanatory factor in the demand for money in the Euro Zone. The financial crisis the world had just suffered at that time had no impact on the stability of the demand for money. The other variables used by this author are real GDP, inflation, interest rates.

Three official monetary aggregates were used by Sarwar et al. (2013), to test the stability for the case of Pakistan: *reserve currency M0, narrow money M1 and broad money M2*. This study used also an indicator measuring financial innovation, which is calculated by subtracting from the broad money, the the currency in circulation. These authors considered the obtained as the money in the banking system. By dividing this difference to the GDP, a ratio measuring the banking system efficiency is obtained. They use Johansen and Juselius cointegration as econometric technique, and found for the case of Pakistan, that the demand using narrow money is not stable, while the reserve currency and broad money provide stable demands. Broad money is best suited for the formulation of monetary policy. Financial innovation must also be taken into account in the formulation of the monetary policy because it plays an important role in individuals' demand for monetary assets.

Investigation of the money demand stability for the case of Madagascar

We will adopt the modern approach in the sense of Rathnasiri (2021) to test the stability of the money demand relation for the case of Madagascar. According to Niyimbanira (2013), the most-used econometric technique for studying the demand for money is cointegration. In this case, we will use the two-step algorithm error correction model introduced by Engle and Granger (1987). The first step consists of testing the integration order of the variables, as series must be integrated of the same order[1]. The second step is the estimation of the long-term relation and check whether the residual of this model is stationary. If so, one could consider that there is at least one cointegration relation between these variables. We can subsequently estimate the short-term dynamics between the differentiated variables, which will be adjusted by the error correction term.

In this study, we will compare two money demand equations, one using the proxy measuring financial innovation and the other without. Authors have used different indicators to proxy financial innovations, like values of Automated Teller Machines transactions, volume of points of sale, web banking, as well as mobile money banking transactions [Ovat et al. (2022), Oghenekvewe and Ezi (2023)]. For our case, in the absence of data, at least a sufficient long series, we take the economic sense of financial innovation advanced by Sarwar et al. (2013). They measure the efficiency banking system by subtracting from the broad money supply, the money in circulation. Efficiency is obtained by dividing this difference to GDP.

Variables

We are not going to use different monetary aggregates, but merely the broad money M3, even though studies have shown that narrower aggregates performed better in developing countries. However, Ericsson and Sharma (1996) demonstrated that broad money has better predictive power and is more appropriate for monetary policy. Our broad money includes the narrow one, composed of money in circulation and short-term deposits, the mid-long term deposits, the foreign currency deposits and bonds. The explanatory variables are real GDP (RGDP), the weighted average rate of return of T-bills[2] (TBTA) which will be our proxy for opportunity cost, as well as the above-defined financial innovation (FI). The data is in annual frequency over the period 1997-2023. These data were taken from the IMF's World Economic Outlook and official websites of the Ministry of the Economy and Finance and the Central Bank. The availability of data on T-bill rates limits the number of observations to 27. The real cash balance (RM3) is obtained by deflating the broad money by the consumer price index. Finally, two dummy variables correcting the 2002 and 2009 political crises are taken into account.

Statistical properties of the variables

The descriptive statistics of the natural logarithmic of these variables are given by the table below. Generally speaking, the variables used are normally distributed, according to Skewness, Kurtosis and Jarque-Bera statistics.

Table 1. Descriptive statistics of the variables

	lrm3	**lrgdp**	**ltbta**	**lfi**
Mean	11.10815	9.706778	2.247954	5.083460
Median	11.06279	9.724927	2.192753	5.071109
Maximum	11.67344	10.05164	3.052345	5.380704

[1] Reason why the NEER was excluded because it is stationary in level.

[2] Short-term T-bills, with maturities of 4, 12, 36 and 52 weeks. The rate used in this study is the weighted average rate of these different maturities over one year.

Minimum	10.51983	9.326010	1.739219	4.830561
Std. Dev.	0.348192	0.219977	0.335879	0.154785
Skewness	0.091975	-0.170057	0.661361	0.447478
Kurtosis	1.986165	1.841075	2.880170	2.526919
Jarque-Bera	1.194411	1.641133	1.984446	1.152848
Probability	0.550348	0.440182	0.370752	0.561904
Sum	299.9200	262.0830	60.69476	137.2534
Sum Sq. Dev.	3.152174	1.258133	2.933186	0.622917
Observations	27	27	27	27

Source : author

ADF unit root tests show that all variables are non-stationary in level. The statistics of these tests are given by the following table.

Table 2. Unit root tests

Variable	***t-statistic***	***p-value***
lrm3	-2.839788	0.1973
lpbir	-3.500806	0.0602
ltbta	-3.764782*	0.0362
lfi	-2.830204	0.1998

** not signifiance at 1%*
Source : author

The residual from the estimation of these non-stationary variables is stationary [-5.070854 (0.0020)], indicating the existence of at least one cointegration relation between these variables. Besides, Trace test indicates the presence of two cointegration equations at the 5% level.

Table 3. Trace test

Nb of coint eqn.	**Trace stats.**	**Critical value 0,05**	**Prob.****
None*	54.33849	40.17493	0.0011
At most 1*	25.38217	24.27596	0.0362
At most 2	10.95878	12.32090	0.0837
At most 3	2.211168	4.129906	0.1616

** denote rejection of the hypothesis at 0,05 level*
***MacKinnon-Haug-Michelis (1999) p-values*
Source: author

Money demand equations

In this configuration, the following equation is considered as a long-term relation of money demand for the case of Madagascar:

$$lrm3_t = -2.96 + 0.98lrgdp_t - 0.02ltbta_t + 0.90lfi_t + 0.08dum2002 - 0.06dum2009 + \varepsilon_t$$
$$(-7.37)\ (13.96) \quad (-0.91) \quad (9.13) \quad (1.98) \quad (-1.89)$$
$$R^2=0.99\ DW=2.05$$

All the coefficients signs are as expected. Real income as well as financial innovation positively explain real cash balances, while the rate of T-bills explains it negatively. Real income impacts demand for money to almost unity. This coefficient is quite high, but not surprising for a developing country. This situation reflects a high cash-based economy. The coefficient related to financial innovation explains the demand for money positively and with a quite high elasticity. An efficient banking system seems

to be a preferred channel for increasing demand for money in Madagascar. On the other hand, the T- bills rate reduces the real demand for money, even if the coefficient is weakly significant. An increase of 1 point in the weighted average rate of this public security reduces the real demand for money by 0.02 point. The low statistical significance of this coefficient is also a sign of a shallow money market.

The second step of Engle and Granger (1987) modeling consists of estimating the short-term equation with error correction term. The following table gives the results of the estimation.

Table 4. Elasticities of the short-term equation

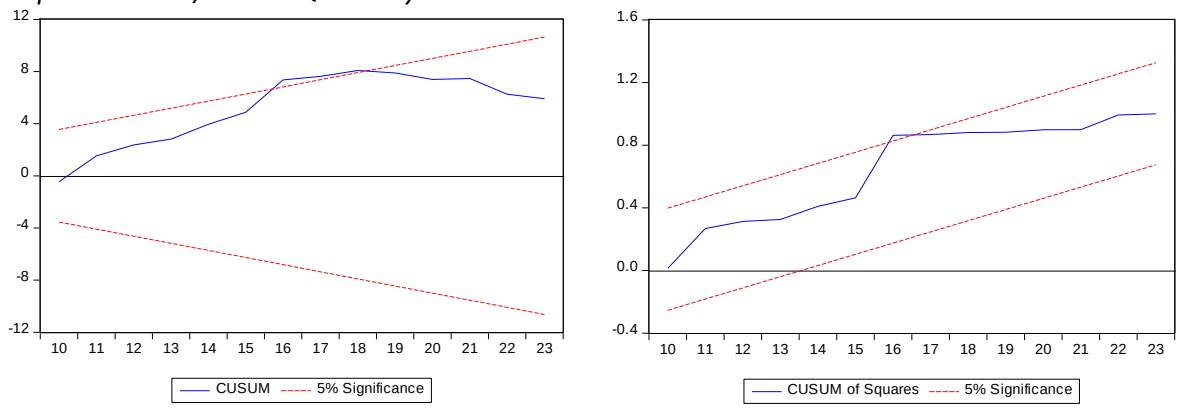
	Dependent variable : Δlrm3			
	Coeff.	*Stand. Err.*	*t-statistic*	*Prob.*
Intercept	0.009189	0.008142	1.128648	0.2718
Δlrgdp	0.757090	0.145917	5.188507	0.0000
Δltbta	-0.022208	0.026725	-0.830957	0.4153
Δlfi	0.792333	0.123269	6.427654	0.0000
ect (-1)	-0.679327	0.231796	-2.930717	0.0080
		R^2 = 0.75		
		DW = 1.48		
		Obs. : 26 after adjustments		

Source: author

The results don't deviate to the long-term relation ones. Real income and financial innovation strongly explain real demand for money, although the magnitude has diminished. The coefficient relating to the T-bills rate remains negative. The error correction term is negative and statistically significant. The speed at which the divergences of the variables are corrected to tend towards the long-term equilibria is quite high, of the order of 68%. According to the half-life formula, it takes just one year for the convergence to equilibrium, after a deviation induced by shocks.

Following these results, the long-term relation presented previously is a candidate for the stability test. Authors who worked on this topic have mostly used the CUSUM and CUSUMQ to test the stability of the money demand. The CUSUM test has higher power if the break is at the origin of the regression equation, while the CUSUMSQ test has higher power if the structural change involves a slope coefficient. These tests have the advantage of not specifying breakpoints *a priori*. The graphs below show the results of the two tests.

Graph 1. CUSUM/CUSUMQ stability tests



Source: author

The demand for money is stable as the relation is generally included in the 5% confidence interval. Also, the Chow test indicates the absence of break in the series, even if in 2016, the corresponding point falls outside this interval.

Stability without the financial innovation

In this section, we will estimate the real demand for money without the use of the financial innovation proxy. The equation below gives the long term relation:

$$lrm3_t = -3.57 + 1.52lrgdp_t - 0.06ltbta_t + 0.21dum2002 + 0.14dum2020 + \varepsilon_t$$
$$(-4.53)\ (20.43)\quad (-1.19)\quad (3.07)\quad (2.13)$$
$$R^2=0.97\ DW=1.16$$

This relation shows again that real demand for money is strongly explained by real income in the long term. The corresponding coefficient is greater compared to the equation with financial innovation. The elasticity exceeds unity that is a common case in Africa, according to Omar and Hussein (2020). They summarized the coefficients of the money demand equation for some African countries in the table below and found that most of them exceed unity. For Swaray (2022), a high value of the real income coefficient is a sign of cash-based economy and the preponderance of informal sector. In this configuration, the demand for money, even if it is stable, is fragile. Changes in the financial system could lead to its instability. The T-bill rate coefficient rose to -0.06, but remained weakly statistically significant.

Table 5. Summary of income and interest rate elasticity in Africa

Author	Country	Monetary aggregates : Period	Methodology	Income	Interest rate	Stability
Nchor and Adamec (2016)	Ghana	M1 : 1990-2014	ECM	2.43 (0.574)	-0.81 (0.66)	Stable
Kapingura (2014)	South Africa	M3 : 1995Q1-2012Q4	JML & VECM	5.013 (1.090)	0.073 (0.024)	Not stable
Kumar and al. (2013)	Nigeria	M1 : 1960-2008	ECM	0.90 (4.52)	-0.19 (3.16)	Stable
Herve and Shen (2011)	Ivory Coast	M1 : 1980-2007	JML	5.31 (6.16)	-0.19 (0.24	Not stable
Akinlo (2006)	Nigeria	M2 : 1970Q1-2004Q4	JML	1.09 (43.8)	-0.09 (1.91)	Stable
Nell (2003)	South Africa	M3 : 1965-1997	JML	1.27 (6.5)	-0.006 (-2.6)	Not stable
Darrat (1986)	Kenya	M1 : 1969Q1-1978Q4	OLS	1.843 (8.91)	-0.169 (3.40)	Stable

Source : Omar et Hussein (2020), p. 18

For the short-term equation, real income continues to have a positive influence on short-term money demand, but the coefficient has fallen below unity. Likewise, the T-bills rate coefficient remained negative, with approximately the same magnitude. An interesting fact is that this coefficient relating to the interest rate has become significant at 10% level. Without the financial innovation variable then, investment in the public securities market is an alternative to the demand for real cash balance in the short term. The error correction term remained significantly negative, but the coefficient decreased to -0.41, signifying that it takes 1.7 years to regain equilibrium, after a deviation induced by a shock.

Table 6. Elasticities of the short-term equation without financial innovation

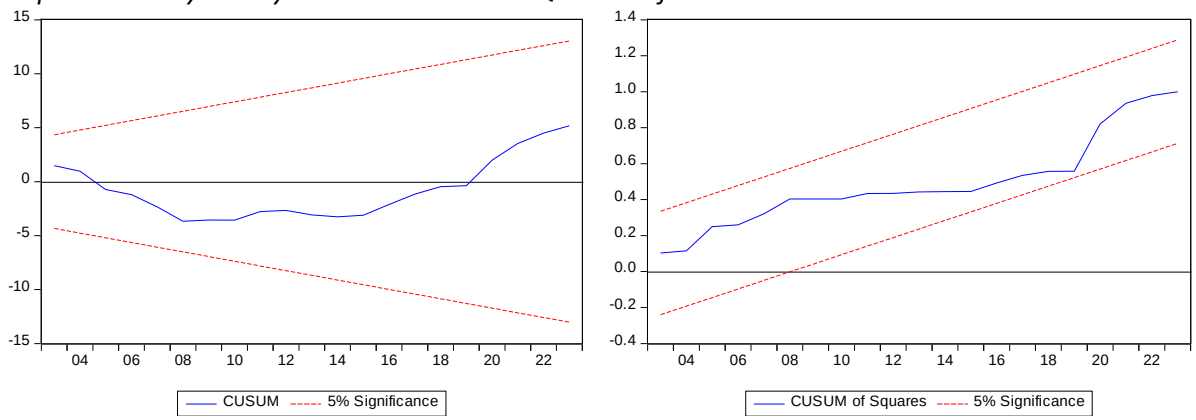
	Dependent variable : Δlrm3			
	Coeff.	*Stand. Err.*	*t-stat.*	*Prob.*
Intercept	0.031400	0.010456	3.003091	0.0065
Δlrgdp	0.464145	0.197651	2.348302	0.0283
Δltbta	-0.063631	0.036298	-1.753044	0.0935
ect (-1)	-0.414751	0.151773	-2.732710	0.0122

	R^2 = 0.44
	DW = 1.76
	Obs. : 26 after adjustments

Source : author

Once again, as long as the cointegration mechanism is verified, the long-term relationship described above is a candidate for the CUSUM and CUSUMQ stability tests.

Graph 2. Stability test by CUSUM and CUSUMQ without financial innovation



Source: author

Following these graphs, the demand for money is absolutely stable, because at no point, neither the CUSUM nor the CUSUMQ does leave the 5% confidence interval. It could mean that the demand for money explained by financial innovation is more unstable, and can even be described as fragile. However, financial innovation is essential and will continue. With digitalization, the efficiency of the banking system will further improve and impact the real demand for money, which would become increasingly unstable.

The period of instability displayed by the tests on the long-term relation using financial innovation proxy seems to coincide with the breakthrough of mobile money in Madagascar. According to official statistics, the number of active mobile money accounts increased from 646,000 in 2016 to 2,080,000 in 2019. The total volume of transactions almost trebled and the corresponding value increased 10- times during this period[3]. The International Finance Corporation describes this period as a mobile payment boom in Madagascar[4]. The proliferation of mobile money continues in Madagascar and other innovations will certainly affect the financial landscape.

Conclusion

In conclusion, we would argue that the demand for money in Madagascar is generally stable, but fragile. The adoption of broad money as an intermediate objective of monetary policy was justified, but did not appear to be sustainable for the period ahead. Significant changes to the monetary system and the financial landscape, induced by financial innovations, would jeopardize this delicate stability of the demand for money. Therefore, the switch to a proactive monetary policy regime, targeting variables more anchored to inflation is acceptable. The Monetary Authority is encouraged to move forward and consider a more inflation-anchored policy in its fight against inflation, like the inflation targeting regime.

[3] Central Bank of Madagascar.

[4] https://www.ifc.org/en/stories/2023/madagascars-mobile-money-boom

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