American Journal of
Economics
(AJE)

The Demand for Real Money Balances in Zimbabwe: An Error Correction Estimation

Joseph Mverecha

AJP

American Journal of Economies
ISSN 2520 - 0453 (Online)
Vol. 8, Issue 3, pp 36 – 55, 2024
www.ajpojournals.org

The Demand for Real Money Balances in Zimbabwe: An Error Correction Estimation

Joseph Mverecha

Article history
Submitted 29.03.2024 Revised Version Received 05.05.2024 Accepted 06.06.2024

Abstract

Purpose: The purpose of the study is to examine the stability of the money demand function in Zimbabwe. Understanding, the money demand function is a prerequisite for effective monetary policy formulation and understanding the monetary transmission process and shocks propagation in the economy.

Materials and Methods: The study employs the error correction modeling methodology to investigate the money demand function for Zimbabwe using quarterly data from 2017q2 – 2023q2. The analysis is expanded to characterize the monetary transmission mechanism following a shock to the price level and how the demand for real money balances responds to both single period and multiple shocks.

Findings: The findings confirm a stable long run money demand function that is subject to short run dynamics. In addition, real money demand responds positively to real GDP (Scale factor) and inversely related to the price level (inflation). Short term dynamics (particularly inflation expectations) compound real money demand collapse in response to rising inflation.

Implications to Theory, Practice and Policy: Monetary Policy must aim to collapse inflation expectations through a tight monetary control program and a functioning interbank market for foreign exchange to avoid surging parallel market activity.

Keywords: *Real Demand, Money, Short Run Dynamics, Long Run, Multiple Shocks*

1.0 INTRODUCTION

Effective monetary policy formulation and implementation requires Monetary Authorities to have a view of how the demand for real money balances is evolving in the economy, regardless of the whether the Central Bank adopts reserve money targeting or the exchange rate as the nominal anchor. Therefore, it is important to examine money demand to get an understanding of the relationship between money demand and its determinants and how this relationship evolves over time or following shocks to the economy. Demand for money is the desire to hold financial assets either in the form of cash or interest bearing near cash assets. Typically, economic agents, in particular individuals and corporate entities usually choose to hold money for various motives that include transaction, precautionary and speculative reasons.

Money has many functions in the economy, including facilitating exchange, a store of value, store of wealth, but also provides liquidity to economic agents and can also earn interest. The demand for money usually stems from the trade-off between the liquidity benefit of holding money and the interest benefit of holding noncash assets (Handa, 2009). The demand for real money balances is influenced by several macroeconomic economic factors such as inflation, income, savings, financial innovations and interest rate (Musimbi & Mose, 2023). Financial innovations in many advanced economies have often been associated with a breakdown in the stability of the money demand function.

Several money demand studies have been undertaken in many Sub-Saharan countries over the past decade and earlier. In most cases the results confirmed money demand stability, unsurprisingly as developing economies in the region have not experienced substantial innovation advances as to destabilise the money demand function in many developing countries. Zimbabwe has experienced elevated macroeconomic instability including hyperinflation in 2007/8. The hyperinflation wiped out all monetary balances. Pensions and insurance companies were particularly most severely affected. Post hyperinflation, the country adopted multicurrency following the demise of the Zimbabwean dollar. The migration to multicurrency accelerated sharply in the last quarter of 2008, when the public rejected the new I trillion-dollar bank note.

Nearly two decades since the hyperinflation, the public has elevated fears of inflation resurgence and local currency savings remain low relative to foreign currency savings in the Multicurrency environment. The local currency was formally introduced in 2016, through the Bond Notes and eventually the RTGS dollar was introduced in 2019.

Problem Statement

The formulation and implementation of effective monetary policy requires a clear understanding of how the demand for real money balances interacts with the scalar and opportunity cost variables in Zimbabwe. Further, it is critically important to have an appreciation of how the multilayered interaction cascades in the economy following a shock. The gap exists, particularly with the later. The study explores the money demand function and how this responds particularly to price level shocks, for the economy and Zimbabwe has experienced highly volatile inflation over the past decade. The objective is to ascertain the pace of adjustment towards long run equilibrium following a shock. This is important for guiding monetary policy timing for optimal outcomes.

Theoretical Review

The demand for money function has been the subject of extensive empirical studies, particularly reflecting the central role of money demand analysis in the formulation and implementation of monetary policy for inflation control, seigniorage, and other important macroeconomic policy considerations. Significant research has been done on whether the demand for money function is stable and predictable, as necessary to enhance policy efficacy and effectiveness.

Money demand theory originated from the Keynesian Liquidity preference theory of holding money and the contributions from the monetarists such as Milton Friedman (1956). Additionally, the inventory theory8 also contributed to the extensions of the Keynesian Liquidity preference theory of holding money (Nyong, 2014). Keynes Liquidity preference theory postulates that there are three motives for holding real money balances: transaction demand for money, the precautionary and speculative demand for money. The transaction demand for money relates to the amount of money required to sustain transactions while the precautionary demand for money relates to the amount of money required for unforeseen circumstances. The speculative demand for money is the holding of money balances for speculation based on future interest rates. According to Keynes, all three types of demand are affected by inflation, in particular expected inflation.

Keynes proposed that in an environment of high inflation (and high expected inflation) the demand for transactions balances increases, as the cost for each basket of goods and services increases. Similarly, the precautionary for unforeseen circumstances also increases with expected inflation. It is the precautionary demand for money that decreases with expected inflation, in anticipation of higher interest rates in the future. Keynes believed that money does not earn any interest because it is a perfectly liquid asset, while bonds and treasury bills earn interest.

Several authors (Baumol, 1952; Tobin, 1956; Friedman, 1956) contributed to theoretical literature by outlining distinctions between the transactions demand and the asset motive. Theoretically, real GDP positively affects the demand for money whilst interest rates and the price level negatively affect the demand for real money balances. In the case for Zimbabwe, while positive real GDP growth has occasioned an increase in transactions and therefore transactions demand for money, high and variable inflation has been consistently inversely related to demand for real money balances. Local deposit rates have had no meaningful or significant impact on the demand for real money balances.

The theory underpinning monetary targeting frameworks has its foundation in the doctrine of the quantity theory of money first postulated by Milton Friedman in the 1970s. The theory (or its variants) has been widely tested over the decades by many scholars and widely applied for monetary policy analysis in both developed and developing economies.

The theory commences with the quantity theory of money, which gained flows from the equation of exchange, credited to Irving Fisher in the early 19th century. Milton Friedman described the quantity theory as a money demand function with restricted set of variables assumes a stable money demand function. He made an explicit disaggregation of the quantity theory in terms of nominal quantity of money and real quantity of money. The nominal quantity of money is based on the units of measurement that is assigned to money for the purchase of a set of quantity of goods and services, while the real quantity of money is based on the quantum of goods and services that money can purchase.

Fisher describes the quantity theory as the key determining factor of the price level in the economy. According to Fisher, a change in the quantity of money generates an equal change in the price level – this would later evolve as the monetary neutrality theory, which states that monetary growth only affects nominal variables in the economy (prices, nominal exchange rate, nominal wages) with no effect on real variables in the long run.

Fisher used the equation of exchange as follows:

$MV = PQ$ (1)

Where P is the price level, Q is total quantity of goods and services in the economy that are exchanged for transactions purposes, M is total quantity of money, V is total velocity of money in circulation in the economy. The quantity theory assumes that; for a given level of quantity of goods and services, if the velocity of money remains stable, then any change in money supply affects the price level. This means that changes in money supply in the economy, overtime, only impact on prices and hence inflation. Implying that controlling money supply implicitly means controlling nominal income (P*Q) and by extension controlling inflation.

By extension, the quantity theory suggests that what matters most to holders of money is the real quantity of goods and services (not the nominal quantity) that they are happy to be in possession of a particular quantity of money at any point in time. In the case for Zimbabwe, the real quantity of goods and services is most important for holders of money (real demand for money balances) because the experience of the 2007/08 hyperinflation and the recurring bouts of inflation over the past 8 years, have created a psychology of inflation expectations in the public mindset.

Milton Friedman expanded on the Fisher equation of exchange to say that the most important version of the quantity theory of money is the transactions component of money holding that was an integral part of the Fisher equation of exchange. This has been augmented by many scholars over time, as the transactions demand for money. The modified form of the equation of exchange has been presented in the following form:

$Md = f(PQ)$ (2)

Md is the amount of money households demand as a function the nominal income (PQ).

The fundamental assumption for the above equation of exchange is that interest rate has a negligible influence in the determination of the demand for money. However, Keynes argued that interest rate plays an important role in the demand for real money balances. The modification by Keynes permeates into the modern money demand function where demand for real money balances is a function of real GDP (scalar variable) and interest rate (as an opportunity cost variable), as below:

$Md = f\,(Y^{+,}\ i^{-})$ (3)

The demand for real money balances is positively related to income (real GDP) and negatively related to the interest rate. Extension of equation (3) to represent a small open economy (thus, incorporate international trade of goods and services and capital flows) yields the expanded equation below:

$M/P = \alpha + \beta_1 Y_t + \beta_2 i + \beta_3 infld + \beta_4 nexr + \beta_5 USffr + \mu_t$ (4)

Where:

i. M/P is the real demand for money;
ii. Y_t is real GDP;
iii. infld is inflation differential between the US and the small open economy;
iv. nexr is the nominal exchange rate *(expressed as the small open economy's currency per US dollar);*
v. USffr is the US Federal Funds rate;
vi. $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are parameter coefficients to be estimated and
vii. μ_t is a stochastic error term (*serially uncorrelated, independently distributed error term)*

The stability of the money demand function is an area that has been extensively researched, even in Sub Saharan Africa, particularly because the stability of the money demand is part of monetary targeting framework for monetary policy formulation and implementation. Many studies have applied the cumulative sum of recursive residuals and the cumulative sum of square of recursive residuals to establish the stability of the money demand function. Early money demand function studies in Sub-Saharan Africa include Kallon who investigated the demand for money in Ghana using two-stage least squares technique. He applied quarterly data spanning from 1966q1 to 1986q4 on real cash balances, real GNP, discount rate, real money balances (M1), foreign interest rate and inflation. The results found no evidence of the effect of foreign interest on real money balances. However, inflation exhibited a negative and significant effect on the demand for money.

Bahmani-Oskooee & Wang estimated the stability of the money demand function for China using quarterly data from 1983q1 to 2002q4 on monetary aggregates in real terms, narrow and broad money (M1 and M2), real GDP, domestic and foreign interest rates and the nominal effective exchange rate. The results show significance coefficients with the expected signs of M1 and M2 against their determinants. However, the stability test results show stability in the money demand function when M1 was used as the dependent variable and material instability when M2 was used as the dependent variable.

Owoye and Onafowora confirmed the stability of the money demand function for Nigeria using quarterly data for the period 1986q1 to 2001q4. Drama and Yao found no evidence of money demand stability for Cote d'Ivoire. They estimated broad money demand model using annual data for the period 1980 to 2007 on real GDP and interest rate. However, when they estimated narrow money demand for the same period, they found that a stable relationship existed between narrow money and its explanatory variables. They also found that the narrow money demand model was stable.

Dagher and Kovanen (2011 IMF Working Paper) re-examined the stability of the money demand function in Ghana using the bounds test approach to cointegration. Quarterly data spanning from 1990q1 to 2009q4 was used on broad money (M2+), inflation, real output, domestic deposit interest rate, domestic and US treasury bill rates, nominal effective exchange rate and US dollar LIBOR rate. The long-run results show that real output and exchange rate were the main drivers of money demand in Ghana. The short-run results show an income elasticity of money demand that was closed to unity. The study confirmed the stability of the money demand function in Ghana.

Mansaray and Swaray investigated the stability of the money demand function in Sierra Leone using the ARDL cointegration on annual data spanning from 1981 to 2010. They focused on broad money, real GDP, exchange rate, inflation, 91- day treasury bill rate and foreign interest rate. The stability of the money demand model was ascertained. Kumar et al. (2010) assessed the stability of the money demand function in Nigeria using annual data for the period 1960 to 2008 on real GDP, nominal interest rate, real effective exchange rate and inflation. The results showed a stable money demand function.

Niyimbanira investigated the stability of the money demand function in South Africa using quarterly data for the 1990q1 to 2007q4 on real money demand, real GDP, 91-day treasury bills rate, inflation and exchange rate. There was no evidence of stability of the money demand function according to the study.

Zgambo and Chileshe [25] tested the stability of the money demand function using the autoregressive distributed lag (ARDL) cointegration modeling framework. Quarterly data spanning from 1995q2 to 2013q3 were used on real money balances, real GDP, consumer price index, treasury bill rate, and nominal exchange rate. Plots of the cumulative sum of recursive residuals and cumulative sum of square residuals indicate that the latter did not lie within the critical bounds, indicating some instability in the money demand function.

Kiptui estimated the money demand model for Kenya using quarterly data for the 2000q1 to 2013q4 on monetary aggregates (comprising M1, M2 and M3), inflation rate, real income, nominal deposit rate, 91-day treasury bills rate, nominal exchange rate and measure of volatility (variations in inflation rate, interest rate, exchange rate and stock market). The bounds testing approach to cointegration was applied. The long run results confirm stability of relationship between the respective monetary aggregates and their determinants. The coefficients of income elasticity in the long run were in conformity with theory. Stability of the models was confirmed using CUSUM and CUMSUMSQ plots for each of the model.

Nchor and Adamec investigated the stability of the money demand function in Ghana using annual data from 1990 to 2014 on narrow money (M1), broad money (M2), real GDP and the 91-day treasury bills rate. Stability was confirmed in both models using the CUSUM and CUSUMSQ stability plots. The Chow test was also performed to test for structural breaks in the model. The results show the existence of long-run and short-run relationships among narrow money, broad money and their determinants. Boucekkine et al. investigated the stability of the long-run money demand in Algeria using annual data from 1979 to 2019 on real GDP, inflation, treasury bills rate and exchange rate. They estimated three monetary aggregate measures including narrow money (M1), broad money (M2), fiat money and the money demand function was stable.

Peter N. Mumba and Emmanuel Ziramba investigated the money demand stability for Zambia. They analyzed the money demand function using annual time series data for the period 1978 – 2018. The study employed the Gregory Hansen cointegration technique. The study also employed Hendry's General to Specific technique to estimate the error correction model by obtaining a parsimonious model. The results of the Gregory Hansen test confirmed the presence of a cointegrating relationship. The results also determined 1994 as the break year in the money demand function. Other interesting results obtained by the study suggest that inflation and interest rate are the robust determinants of real money demand both in the short and long run. The results of the CUSUM and CUSUMSQ confirm the stability of the money demand function in Zambia.

Naraya applied panel data techniques (Naraya et al. 2009) to investigate the money demand function for five South Asian countries between 1974 and 2002. The study employed panel cointegration tests and established that money demand is cointegrated with its determinants. These include real exchange rates, income, and both the short-term domestic and foreign interest rates.

Hamdi et al. (2015) also made a similar inquiry in the Gulf Cooperation Council Countries between 1980Q1 and 2011Q4. The study applied panel cointegration tests. The results reveal that there is cointegration in the model. The results suggest a stable long-run money demand function. Vega (1998) estimated the money demand stability for Spain using structural stability tests in regressions with variables integrated of order one between 1979 and 1995. This study also used the error correction model. The results indicate that financial system openness affects the long-run stability of the money demand function.

Lestano et al. (2011) estimated the stability of narrow money demand in Indonesia between 1980Q1 and 2004Q4 making use of an Autoregressive Distributed Lag (ARDL) model. The findings suggest that broad and narrow money demand equations are cointegrated. The results also reveal that the narrow money demand is stable, whereas the converse is true for broad money demand. Cziraky and Gillman (2006) used monthly data to estimate the money demand for Croatia from 1994 to 2002. A two equation cointegrated system was used and evidence shows that there is a stable money demand that rapidly convergences back to equilibrium after-shocks.

Other studies also used the unrestricted error correction model such as Al Rassai (2016) for Saudi Arabia, who assessed the stability of money demand between 1993Q1 and 2015Q3. The study applied the Johansen cointegration test and the findings suggest stability of money demand in the long run. Likewise, the results also suggest that the long-run estimates are consistent with theoretical expectations.

Kjosevski (2013) investigated the determinants and stability of money demand in Macedonia. This study employed monthly data from January 2005 to October 2012. The results of the VECM provide evidence that exchange rate and interest rates explain most long-run variations of money. A few studies have used estimation techniques that allow for structural changes. Omotor (2011) used the Gregory and Hansen procedure to analyze the demand for money in Nigeria considering structural breaks for the period 1960 - 2008. The study determined that 1994 was the endogenous break date. Like previous studies, the findings of this study also suggest a stable money demand function for Nigeria.

Kumar, Webber and Fargher (2013) also made use of the same methodology to determine the level and stability of narrow money demand in Nigeria for the same period. However, unlike the results obtained by Omotor (2011), the findings of this paper suggest that the improved the scale economies of money demand to a less extent and money demand is stable. These results agree with those obtained by Nduka (2014) who also made use of the same methodology by analyzing the behavior of money demand in India between 1953 and 2008. The results of this study confirm the presence of cointegration and money demand stability with a structural break in 1965 and Kumar et al. (2013).

Similarly, Nyong (2014) estimated the demand for money in the Gambia between 1986Q1 and 2012Q4 in light or regime shifts. The findings show that there exists a cointegrating relationship between money and its determinants namely income, inflation, exchange rate and interest rate. The results further suggest a structural break in 1995Q1. The results also suggest the instability of money demand. However, the stability results are contrary to the findings for Omotor (2011) mainly due to the military coup in the Gambia and fall in foreign aid during the period. Very few studies on the stability of the money demand function have been done in Zambia.

Zgambo and Chileshe (2014) modelled the money demand function in Zambia using the Autoregressive Distributed Lag (ARDL). The findings indicate that exchange rates, treasury bills rates and real income affect the money demand function in the long-run while inflation plays a similar role in the short-run. The findings also show that the money demand function stable and this iterates the relevance of monetary aggregates in the implementation of monetary policy in Zambia.

Mutoti et al. (2012) in a similar study established that income, exchange rate and 90 days Treasury bill rate all affect money demand. The study also shows that the time trend which was used as a proxy for financial liberalization is positively related to money demand. The study also established that Zambia's demand for money function is stable. All these results confirm the finds of Zgambo and Chileshe (2014).

Another study by Adam (1999) analyzed monetary policy reforms in Zambia. The findings of the study suggest a stable money demand function with a break in the long run. These results are in agreement with the results of other studies like Zgambo and Chileshe (2014) and Mutoti et al. (2012). The findings suggest that there is an increase in the variation of money demand around 1989, but it begins to reduce around 1994. Edwin Kipchirchir and Naftaly Mose employed panel estimation technique to examine the major determinants for money demand in East Africa for the period 2007 to 2020. The study considered mobile money transactions, ATMs, inflation, interest rates and economic growth variables. The result of the pooled ordinary least squares estimator identified mobile money, ATMs, and economic growth as having a positive influence on money demand while interest rates negatively influenced the money demand function.

Adil, Hatekar and P. Sahoo applied the linear ARDL approach to cointegration developed by Pesaran, Shin and Smith (2001) to estimate the money demand. They applied quarterly data from 1996: Q2 to 2016:Q3. The study finds that there is a stable long-run relationship among variables, such as real money balances, and the scale and opportunity cost variables. The study also assesses the relative importance of financial innovation variables in the money demand equation and finds that financial innovation plays a very significant role in the money demand specification and stability.

Since the mid-1980s, money demand functions in many countries, particularly in advanced economies have often exhibited instability, particularly reflecting financial innovations which led to permanent shifts in demand for real money balances. Dollarisation, particularly in Latin America and parts of Sub-Saharan Africa led to marked currency substitution, with *transactions conducted in foreign currency.* This leads to an increase in the velocity of the domestic money stock that often appear to be irreversible (Arrau, De Gregorio, Reinhart, & Wickham, 1995, quoted Guidotti & Rodriguez, 1992).

Lungu et al. (2012) analyzed the money demand function for Malawi during the period of 1985–2010 using monthly data. Cointegration test results indicated a stable long run relationship between the real money balances, prices, income, exchange rate, treasury bill rate and financial innovation. Bhatta (2013) applied the ARDL cointegration modeling to examine the long-run stability of money demand function in Nepal using the annual data set of 1975–2009. The bounds test showed that the existence of a long run cointegrating relationship between demand for real money balances, real GDP and interest rate for both narrow and broad monetary aggregates. Both the narrow and broad money demand functions were stable.

Dharmadasa and Nakanishi (2013) investigated the long run money demand function for Sri Lanka using error correction ARDL model. They found that narrow money (M1) was highly cointegrated with the real income, real exchange rate and short-term domestic and foreign interest rates. They concluded that Sri Lanka exhibited a stable money demand function despite the economic uncertainty that arose due to international financial crisis.

Sheefeni (2013) examined the demand for money in Namibia using the ARDL model on quarterly data for the period 2000: Q1 to 2012: Q4. They found no cointegration between the real demand for money and real income, inflation, and interest rate. Kapingura (2014) examined the stability of the money demand function for South Africa using quarterly data from 1994 to 2012. He applied the Johansen co-integration tests and the vector error correction modelling. The results showed that there exists a long-run relationship between the money demand function and its determinants in South Africa. However, the study found that the South African money demand function was unstable over the period from 2003 to 2007.

Research Gaps

The study seeks to fill some gaps identified, particularly:

i. To characterize the transmission of shocks to real money demand and how shocks cascade in the economy overtime;
ii. To quantify the pace of adjustment to a new equilibrium following a price level shock to the demand for real money balances

The Demand for Real Money Balances

Data Analysis and Unit Root Tests

The Engle Granger Error Correction Model (ECM) is followed in this analysis, allowing for the examination of a long run relationship between money (M0, M1 or Broad money), the exchange rate, prices and hence inflation. The process entails data collection, data analysis and unit root tests to identify the order of integration of the series. Though individually, the series are a unit root process, the linear combination of the variables is stationary – i.e. variables are jointly trending overtime.

The variables are nonstationary in levels (require first differencing to achieve stationarity).

The model estimation follows the normal Engel Granger process:

1. Determining the variables order of integration.
2. Stationarity and unit root tests
3. Single Step Engle Granger ECM Estimation
4. Specification and Diagnostics Tests
5. Identify the long run parameters and short run dynamics; and
6. Simulation (Impulse responses)

Identifying the Order of Integration

It is important to identify the series order of integration, as part of measures to avoid spurious regressions (highly correlated but nonsensical regression results)

The variables of interest are:

1. Reserve money, (RM);
2. Narrow money, (M1);
3. Broad money, (M3);
4. Parallel market exchange rate (NPER);
5. Price Level (CPI); and some dummy variables

The data is quarterly and all the variables are integrated of Order 1, thus I(1) variables. The log transformation was performed. The unit root tests seek to explore the nature of the data generating process, which can be one of the following three forms:

1. A Pure Random Walk;
2. A Random walk with a Drift; or
3. A Random Walk with a Drift and trend

As highlighted, the objective is to establish whether the variables have a long run relationship, notwithstanding that they are nonstationary in levels (not mean reverting). Time series data typically exhibit, upward or downward drift patterns overtime. The objective of the study is to establish whether the linear combination yields a stationary underlying long-term relationship, though individually, the series are non-stationary.

The table below shows the unit root Tests:

Table 1: Unit Root Tests

Variable	Unit Root Tests in Levels			Unit Root Tests, First Difference		
LCPI	ADF t Statistic		-0.2576	ADF t Statistic		-5.9195
	Test Critical Values	1%	-4.42	Test Critical Values	1%	-2.65
		5%	-3.62		5%	-1.95
		10%	-3.25		10%	-1.60
LM3	ADF t Statistic		-1.2667	ADF t Statistic		-5.4708
	Test Critical Values	1%	-4.31	Test Critical Values	1%	-2.66
		5%	-3.57		5%	-1.95
		10%	-3.22		10%	-1.60
LM1	ADF t Statistic		-1.2344	ADF t Statistic		-2.4686
	Test Critical Values	1%	-4.28	Test Critical Values	1%	-2.65
		5%	-3.56		5%	-1.95
		10%	-3.22		10%	-1.60
LNPER	ADF t Statistic		-2.1995	ADF t Statistic		-6.17
	Test Critical Values	1%	-4.33	Test Critical Values	1%	-2.66
		5%	-3.58		5%	-1.95
		10%	-3.23		10%	-1.60

Data Sources and Transformation

The table below shows the data variables and source:

Table 2: Data and Data Sources

Variable	Source	Notes
Monetary Aggregates (M3, M1 and M0)	Reserve Bank Monthly	RBZ Weekly Reserve money
Price Level (CPI)	Zimstats	
Parallel Market exchange rate	Parallel market Tracking Statistics	Regular Internal Tracking of Parallel market

Log transformation was carried on the variables in levels and first differences as part of unit root tests and determining the order of integration.

The Money Demand Function for Zimbabwe

The money demand function follows the traditional methodology where the demand for money is a function of real GDP (scalar factor) and several opportunity costs variables (interest rate, exchange rate (as a proxy for foreign prices) and the price level. The equation characterising demand for real money balances in Zimbabwe, since the introduction of the bond note, has both long run and short run dynamics, as below:

Single Step Engle Granger Estimation

The Single Step Engle Granger estimation process which is followed in this paper, combines both the long run and short run dynamics in a single equation.

The Single Step Estimation process follows the following specification.

$\Delta Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \beta_3 \Delta Y_{t-1} + \beta_4 \Delta X_t + \mathcal{E}_t$

Where:

β_1 Is the coefficient of adjustment

Y_t is the endogenous variable; (Cpi).

X_t is the explanatory variable; (exchange rate); and

$\mathcal{E}_t$ is the serially uncorrelated, stochastic error term.

The equation estimation, model compilation and simulation were undertaken in E-Views.

DLOG(RMD3ZW) = C(1)*LOG(RMD3ZW(-1)) + C(2)*LOG(GDP(-1)) + C(3)*LOG(CPI(-1)) + C(4) + C(5)*DLOG(CPI) + C(6)*DUM20Q1 + C(7)*DUM19Q1 + $\mathcal{E}_t$

Where RMD3ZW is demand for money balances adjusted for inflation; and

The equation output is below:

Dependent Variable: DLOG(RMD3ZW)				
Method: Least Squares				
Date: 06/05/24 Time: 21:34				
Sample (adjusted): 2017Q2 2023Q2				
Included observations: 25 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LOG(RMD3ZW(-1))	-0.710210	0.146780	-4.838597	0.0001
LOG(GDP(-1))	2.113130	0.755522	2.796913	0.0119
LOG(CPI(-1))	-0.109258	0.027262	-4.007792	0.0008
C	-7.506407	2.432917	-3.085353	0.0064
DLOG(CPI)	-0.700704	0.110691	-6.330263	0.0000
DUM20Q1	-0.327722	0.085418	-3.836667	0.0012
DUM19Q1	-0.267536	0.087799	-3.047148	0.0069
R-squared	0.783159	Mean dependent var		-0.025007
Adjusted R-squared	0.710879	S.D. dependent var		0.145617
S.E. of regression	0.078298	Akaike info criterion		-2.025089
Sum squared resid	0.110351	Schwarz criterion		-1.683804
Log likelihood	32.31362	Hannan-Quinn criteria.		-1.930431
F-statistic	10.83504	Durbin-Watson stat		1.605715
Prob(F-statistic)	0.000038			

The estimation results show that this is a co-integrating error correction model, with a Coefficient of Adjustment of -0.7102. Following a shock to the demand for money, about 71.0% of the deviation from long run is cleared every quarter, thus a quick adjustment process.

American Journal of Economies
ISSN 2520 - 0453 (Online)
Vol. 8, Issue 3, pp 36 – 55, 2024
www.ajpojournals.org

Checking Residuals Stationarity

The graph below shows actual, fitted and residual (error term)

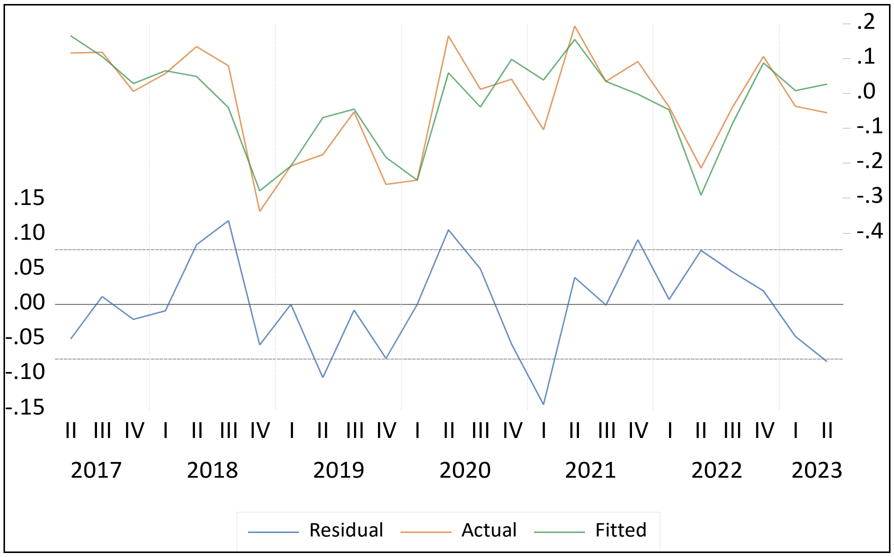

Figure 1: Actual, Fitted and Residuals

Residuals Stationarity Tests

Table 3: Residuals Unit Root Tests

Null Hypothesis: RESRMD3ZW has a unit root Exogenous: None Lag Length: 0 (Automatic - based on SIC, maxlag=5)			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		-3.973028	0.0003
Test critical values:	1% level	-2.664853	
	5% level	-1.955681	
	10% level	-1.608793	
*MacKinnon (1996) one-sided p-values.			

The Test Result Shows That Residuals Are Stationary in Levels

Following the residuals test for stationarity, the conclusion is that the money demand function is a co-integrating and has both the long run and short run dynamics.

The adjustment towards long run is subject to distributed lags following a shock.

Adjustment to Long Run Equilibrium

The adjustment to long run following a shock is quick. Financial markets adjust rapidly towards a new equilibrium following a shock.

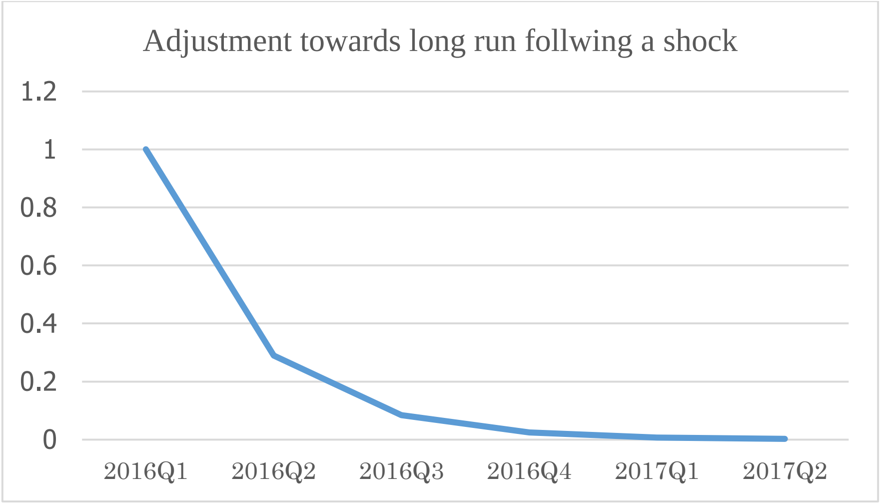

Figure 2: Adjustment to Long Run, Following a Shock

Real Demand for Money Equation: Long Run Coefficients

The long run Coefficients is extracted as below:

Table 4: Long Run Coefficients

	Coefficient	Long Run Parameters
LOG(RMD3ZW(-1))	-0.71021	
LOG(GDP(-1))	2.11313	3.0
LOG(CPI(-1))	-0.10926	-0.15
C	-7.50641	
DLOG(CPI)	-0.7007	-1.0

Interpretation

The interpretation is that a 1% increase in real GDP leads to a 3% increase in real demand for money while a 1% increase in the price level reduces the demand for real money balances by 0.15% in the long run. However, in the short run, a 1% increase in the price level leads to a 1% decrease in the demand for real money balances. This means that the short run dynamics are a powerful determinant of the evolution of demand for real money balances in Zimbabwe.

Adjustment to Long Run

A model of the demand for real money balances is constructed, to which a baseline scenario is built and a 1% shock to the exchange rate is carried out for the alternative scenario 1.

A 1% Shock to The Exchange Rate, Impact on the Price Level

Tracing the single period shocks as they cascade in the economy characterises the propagation of shocks to demand for money pass through and transmission mechanism.

The pass-through transmission mechanism is below:

Table 5: The Monetary Transmission Mechanism

2017Q4	**(CPI_1/CPI_0-1)*100**	**(RMD3ZW_1/RMD3ZW_0-1)*100**	
2018Q1	1	-0.69	450.9%
2018Q2	1	-0.31	201.3%
2018Q3	1	-0.20	128.9%
2018Q4	1	-0.17	107.9%
2019Q1	1	-0.16	101.8%
2019Q2	1	-0.15	100.0%

The pass through from the price level shock to real demand for money is summarised below:

The pass through following a shock indicates a quick adjustment to a new equilibrium;

1. A 1% increase in the price level leads ***instantly*** to a 1% decrease in the demand for real money balances (*perfect asset substitution in preference for US dollar)*;
2. Thereafter, the adjustment to long run takes about 6 quarters;
3. The economy is however subject to continuous shocks.

The graph below shows the transmission of the single period shock.

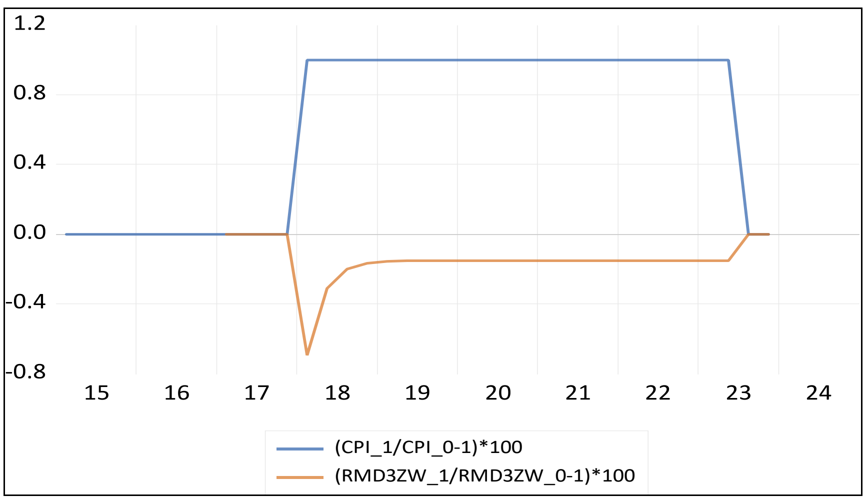

Figure 3: Transmission of the Single Period Shock

Specification and Diagnostic Tests

Table 6: Correlogram of Squared Residuals

<table>
<tr><td colspan="7">Date: 06/06/24 Time: 11:52</td></tr>
<tr><td colspan="7">Sample (adjusted): 2017Q2 2023Q2</td></tr>
<tr><td colspan="7">Included observations: 25 after adjustments</td></tr>
<tr><th>Autocorrelation</th><th>Partial Correlation</th><th></th><th>AC</th><th>PAC</th><th>Q-Stat</th><th>Prob</th></tr>
<tr><td>.**| . |</td><td>.**| . |</td><td>1</td><td>-0.217</td><td>-0.217</td><td>1.3216</td><td>0.250</td></tr>
<tr><td>. *| . |</td><td>.**| . |</td><td>2</td><td>-0.156</td><td>-0.213</td><td>2.0373</td><td>0.361</td></tr>
<tr><td>. |**. |</td><td>. |* . |</td><td>3</td><td>0.222</td><td>0.148</td><td>3.5466</td><td>0.315</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>4</td><td>-0.203</td><td>-0.165</td><td>4.8716</td><td>0.301</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>5</td><td>-0.025</td><td>-0.047</td><td>4.8929</td><td>0.429</td></tr>
<tr><td>. *| . |</td><td>.**| . |</td><td>6</td><td>-0.084</td><td>-0.219</td><td>5.1435</td><td>0.526</td></tr>
<tr><td>. | . |</td><td>. | . |</td><td>7</td><td>0.071</td><td>0.069</td><td>5.3301</td><td>0.620</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>8</td><td>-0.071</td><td>-0.144</td><td>5.5318</td><td>0.700</td></tr>
<tr><td>. *| . |</td><td>. *| . |</td><td>9</td><td>-0.091</td><td>-0.085</td><td>5.8840</td><td>0.751</td></tr>
<tr><td>. |**. |</td><td>. |* . |</td><td>10</td><td>0.305</td><td>0.179</td><td>10.068</td><td>0.435</td></tr>
<tr><td>. *| . |</td><td>. | . |</td><td>11</td><td>-0.067</td><td>0.055</td><td>10.284</td><td>0.505</td></tr>
<tr><td>. *| . |</td><td>. | . |</td><td>12</td><td>-0.102</td><td>-0.052</td><td>10.829</td><td>0.544</td></tr>
</table>

Table 7: LM Test for Serial Correlation

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.403645	Prob. F(2,16)	0.6745
Obs*R-squared	1.200804	Prob. Chi-Square(2)	0.5486

The LM test shows that the residuals have no serial correlation.

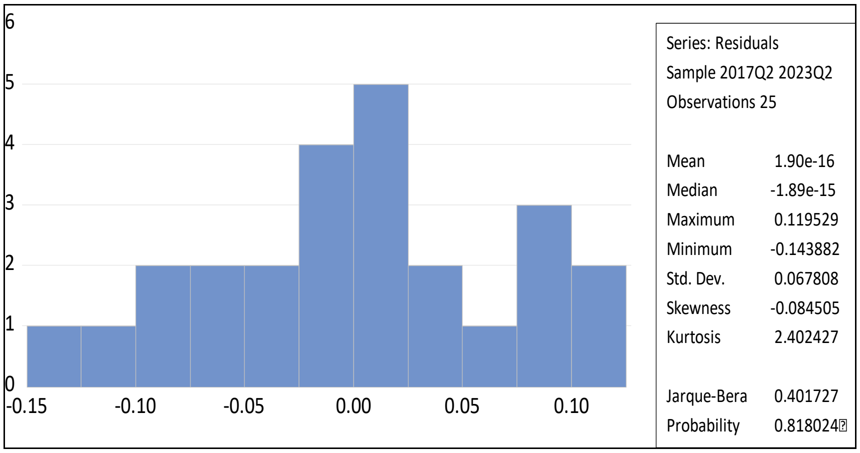

Figure 4: Histogram and Normality Tests

The test results show that the residuals are normally distributed.

Table 8: Heteroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	0.396310	Prob. F(6,18)	0.8717
Obs*R-squared	2.917210	Prob. Chi-Square (6)	0.8192
Scaled explained SS	1.060433	Prob. Chi-Square (6)	0.9832

The Heteroscedasticity test results show that the residuals have no multiple variances.

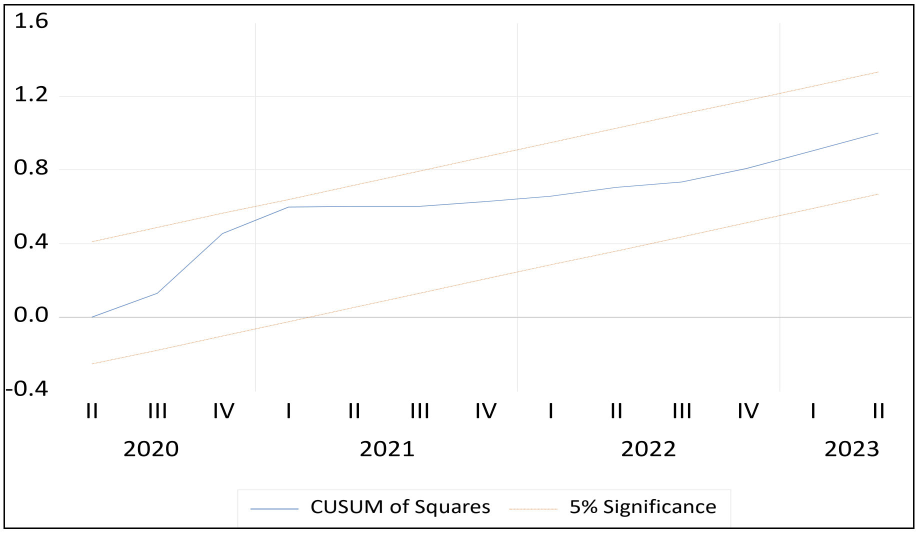

Figure 5: Stability Test

The Cusum of Squares Test shows that the model is stable overtime.

Extensions of the Model: From Single Shock to Multiple Shocks

The economy is continually subjected to price level (inflation) shocks, emanating from exchange rate depreciation, in addition to other demand and supply shocks.

The table below shows the impact of multiple shocks to inflation (12 quarters).

Table 9: Multiple Shocks to the Price Level, Impact on Demand for Real Money Balances

Quarters	1	2	3	4	5	6	7	8	9	10	11	12
2016Q1	-0.7007											
2016Q2	-0.2031	-0.7007										
2016Q3	-0.0588	-0.2031	-0.7007									
2016Q4	-0.0171	-0.0588	-0.2031	-0.7007								
2017Q1	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007							
2017Q2	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007						
2017Q3	-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007					
2017Q4		-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007				
2018Q1			-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007			
2018Q2				-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007		
2018Q3					-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007	
2018Q4						-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031	-0.7007
2019Q1							-0.0004	-0.0014	-0.0049	-0.0171	-0.0588	-0.2031
2019Q2								-0.0004	-0.0014	-0.0049	-0.0171	-0.0588
2019Q3									-0.0004	-0.0014	-0.0049	-0.0171
2019Q4										-0.0004	-0.0014	-0.0049
2020Q1											-0.0004	-0.0014
2020Q2												-0.0004

The table above shows cumulative single period shocks to the price level sustained over 12 quarters. The cumulative impact is distributed over 15 quarters as shown below. The cumulative impact rapidly dissipates once the cpi shocks cease after the 12th quarter. This shows that there is potential for real demand for money to recover rapidly once inflation expectations are collapsed. Demand for local currency balances quickly recovers positive trajectory once expectations are anchored. It takes only one quarter for real demand for money to recover once price level shocks cease.

The cumulative impact is shown in the table below:

Table 4: Cumulative Impact on Demand for Real Money Balances

	Total	Quarters
2016Q1	-0.7	1
2016Q2	-0.9	2
2016Q3	-1.0	3
2016Q4	-1.0	4
2017Q1	-1.0	5
2017Q2	-1.0	6
2017Q3	-1.0	7
2017Q4	-1.0	8
2018Q1	-1.0	9
2018Q2	-1.0	10
2018Q3	-1.0	11
2018Q4	-1.0	12
2019Q1	-0.3	13
2019Q2	-0.1	14
2019Q3	0.0	15

Demand for Real Money Balances and Asset Substitution

The analysis shows that the demand for real money balances is characterised by perfect asset substitution (complete flight from ZWL local currency to US dollars). For every ZWL one dollar injection, the flight to US dollars is 100% guaranteed, for as long as elevated price level shocks and inflation expectations persist. However, once collapsed, demand for real money balances recovers rapidly once inflation expectations are collapsed leading to price level stability.

The graph below shows the cumulative impact:

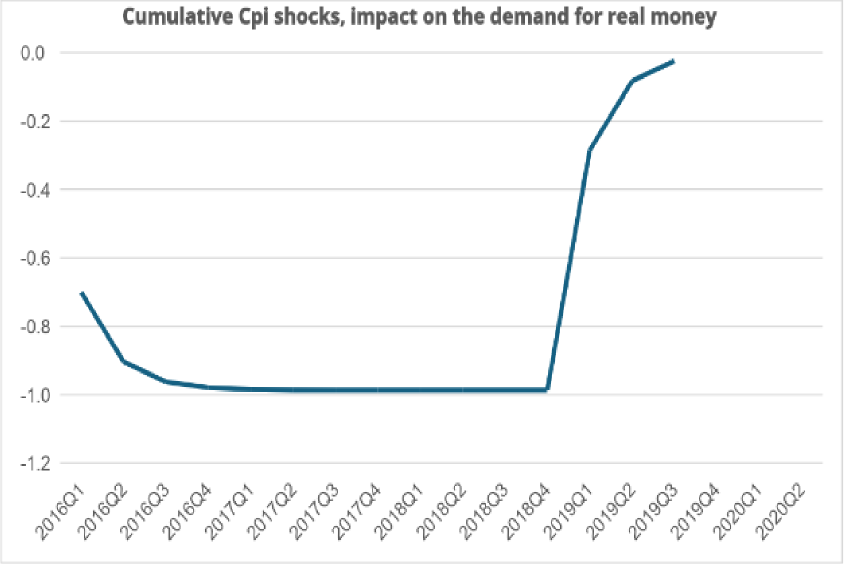

Figure 6: Cumulative CPI Shocks, Impact on Demand for Real Money Balances

2.0 FINDINGS

The study findings are summarised below:

1. Notwithstanding the high and variable inflation, the demand for real money balances is stable in Zimbabwe. There is a predictable, cointegrating long run relationship between real money balances, real GDP and the price level in Zimbabwe;
2. As expected, the Real demand for money balances is inversely related, 1:1 with the price level;
3. The demand for real money balances also responds to dynamics of adjustment, particularly inflation expectations.
4. The collapse in the demand for local currency real money balances in Zimbabwe mainly reflected sustained inflation and inflation expectations;
5. For every 1% increase in inflation, real demand for money decreases by 1% instantly, a sign of complete asset substitution in favour of foreign currency.
6. Demand for real money balances however recovers rapidly once price level stability is achieved.

3.0 CONCLUSIONS AND RECOMMENDATIONS

In light of the foregoing, collapsing inflation expectations is a prerequisite for inflation stabilisation in Zimbabwe. Monetary policy formulation and implementation must anchor inflation expectations (collapse inflation expectations). To achieve durable price and inflation stability, monetary policy must anchor inflation expectations and expectations of exchange rate depreciation.

This is achieved through sustained reserve money control (targeting single digit annual growth in reserve money) and creating conditions for an efficient interbank market for foreign exchange.