

Measuring the Stability of Money Demand in Algeria: An Empirical Study Over the 1980–2016 Period

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Abstract
It is well known in the literature that instability in demand for money can be attributed to a number reasons, such as financial innovation, the deregulation of the financial markets, an alteration in the exchange rate regime, an unexpected jump in oil prices, and currency substitution prompted by a rapid depreciation in the existing currency under a floating exchange rate system. In this study, we take annual data from Algeria for the 1980–2016 period and apply CUSUM and CUSUMQ tests combined with Johansen's cointegration technique, error correction model, and impulse response analysis to show that the demand for money is stable in Algeria.
Keywords: Money Demand, Stability, Error-Correction Model, Cointegration Test, Impulse-Response.
JEL Classification: E41

1. Introduction

This research paper was designed with the aim of investigating the stability of money demand in Algeria. Few studies have attempted to test the consistency or stability of the long-run, as well as short-run, coefficients within a VAR analysis. This paper details how VECM can be implemented for data from Algeria.

In unstable countries, depreciation induces expectation of further depreciation, triggering many people to reduce the amount of domestic currency they hold. This currency substitution can make the demand for money unstable and thus reduce the effectiveness and predictability of monetary policy.

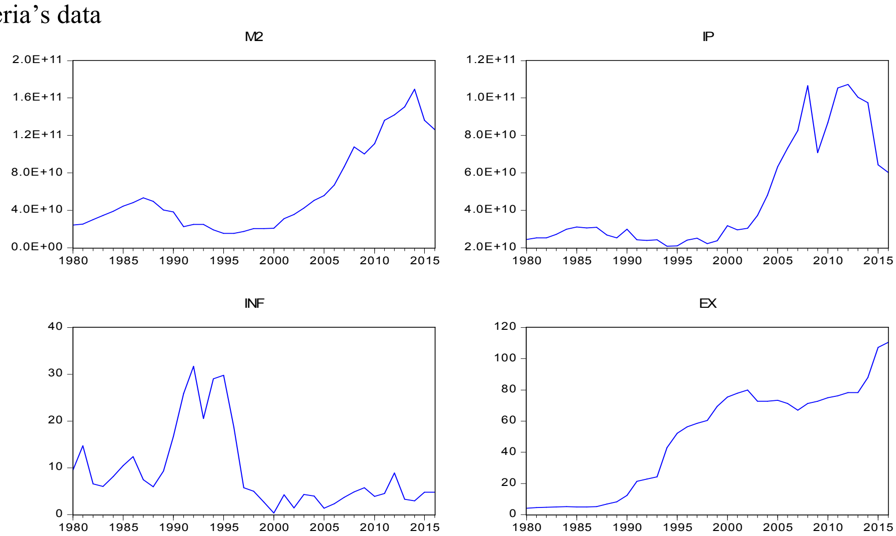
It is known in the literature that analyzing the demand for money in an economy involves attempting to discover the aims that inspire agents to favor the holding of liquidity over other assets. Such kind of analysis assumes a good knowledge of the portfolio structure available to economic agents. Also, it gives a clear idea of what they could gain or lose by holding capital in a form other than cash.

The function of the demand for money is a crucial element of monetary policy. Indeed, a decent knowledge of the variables that significantly influence preferences for liquidity helps to inform policymakers about the best way to manage the money supply without causing economic alterations.

Likewise, a good understanding of agents' aptitude to regulate their demand for money in response to shockwaves suggests that there is a certain efficiency to their interventions. However, for the results to act as a dependable basis, the estimated function should be stable.

Figure 1 shows the behavior of the considered variables over time in order to measure the stability of the money function in Algeria.

Figure 1: Algeria's data



Two unique features of this study stand out. First, no previous study has estimated the demand for money using VECM for Algerian data. Second, unlike the previous research, variance decomposition and impulse response analysis were applied.

Also, the CUSUM and CUSUMQ stability tests were undertaken using full information estimates obtained from Johansen's cointegration and error-correction modeling.

The rest of this research paper proceeds as follows: Section 2 covers the literature review, while section 3 details the empirical analysis. Section 4, meanwhile, provides the summary and conclusions of the study.

2. Literature Review

An early study by Goldfield (1973) investigated the stability of money demand for the United States, and this, in turn, triggered other studies that sought to identify factors that could contribute to instability in the money demand function. For example, Enzler, Johnson, and Paulus (1976) attributed a shift in money demand to a financial innovation in the US that resulted in ratchets on interest rates and income.

Boughton (1981), meanwhile, attributed instability in money demand to a shift in the exchange rate regime. Similarly, Arango and Nadiri (1981), argued that a change in the exchange rate regime, caused by the closing down of the foreign exchange market in the wake of the OPEC oil embargo, caused the instability.

In a similar vein, Gorden (1984) stated that "some of the post-1973 instability in the short-run money demand function may be the side effect of shifts in the Phillips curve that occurred as a result of supply shocks in 1973–75."

Finally, Girton and Roper (1981) showed that currency substitution creates instability in the sense that shifts in the expected rate of exchange rate lead to more substantial movements in the exchange rate.

Although the factors mentioned above have been mostly identified in the context of testing the stability of money demand in the United States, other countries have also experienced some or all of these factors. With advancements, econometric techniques (e.g., cointegration and error-correction models), measuring the stability of money demand has received a renewed attention.

Early studies interpreted cointegration among the variables for the money demand function as an indication of a stable demand for money. Among those studeis, such studies, Miller (1991), Hafer and Jansen (1991), Hoffman and Rasche (1991), McNown and Wallace (1992) for the US; Karfakis and Parikh (1993) for Australia, Adams (1991), Johansen (1992) for the UK, Muscatelli and Papi (1990) for Italy, Bahmani-Oskooee and Shabsigh (1996) for Japan, Melnick (1990) for Argentina, Frenkel and Tylor (1993) for Yugoslavia, Bahmani-Oskooee and Rhee (1994) for Korea, Hafer and Kutan (1994) for China, Bahmani-Oskooee for Iran, Bahmani-Oskooee and Barry (2000) for Russia, Anouruo (2002) for Nigeria, Muhd-Zulkhibri and Majid (2005) for Malaysia, Alhakimi (2008) for Yemen, and Ahmed (2015) for Algeria.

However, as the cointegration literature progresses, we realize that the existence of cointegration among a set of variables does not necessarily indicate the long-run stability of the estimated coefficients. A few more recent studies have therefore followed Hansen and Johansen's (1993) method by carrying out a sequence of likelihood ratio tests to test the constancy of the long-run parameters or the constancy of the cointegration space (Hoffman et al., 1995; Bahmani-Oskooee et al., 1998). Also, others, (e.g., Ahmed, 2015) have used CUSUM and CUSUMQ tests to determine the stability of money demand.

3. Empirical Analysis

3.1The Empirical Model (The Money Demand Function)

It is now well established that any money demand function must include a scale variable (e.g., income) and a variable reflecting the opportunity cost of holding money (e.g., interest rate, exchange rate) to take account of currency substitution. However, in countries with relatively high rates of inflation, the inflation rate itself is said to be a more appropriate measure of opportunity cost.

This phenomena is mostly because in high-inflation economies, especially in developing countries like Algeria, the financial markets are not well developed. This means that real assets are considered more attractive than financial assets.

In such countries, in the absence of a well-developed stock market, people speculate by investing in land, housing, and durable goods (Bahmani-Oskooee, 1996; Chen 1997).

This study implements the following money demand function for Algeria:

$$LnM_t = \partial + \beta LnIP_t + cLnINF_t + dLnEX_t + \varepsilon_t \qquad \text{.........(1)}$$

Where,

M2: represents the real money supply,

IP: is a measure of economic activity (using real industrial production as a proxy),

INF: is the rate of inflation according to the consumer price index,

EX: is the exchange rate (number of Dinars per dollar),

ε : is an error term, and Ln the natural logarithm.

Following the literature, it is anticipated that the estimate of industrial production elasticity, β ,will be positive, and the inflation rate elasticity, c, will be negative. As the inflation rate rises, it reflects an increasing opportunity cost of holding money, so people tend to stay less of it. If depreciation of the Dinar (i.e., an increase in EX) is to induce currency substitution away from the Dinar, the estimate of d should be negative.

3.2 Testing the Series for Stationarity

To investigate whether the time series is stationary or not, we apply two sets of unit root tests for stationarity, namely the Augmented Dickey-Fuller (ADF) and the Philips-Perron (PP) tests (Dickey and Fuller, 1979; Phillips and Perron, 1988). The outcomes are shown in table 1 below.

Table 1: Unit Root Tests for Stationarity

ADF UNIT ROOT TEST					
Variable		ADF value (constant included)		ADF value (constant and linear trend included)	
		Level	First differenced	Level	First differenced
M2		-2.121228	-4.541764	-3.835209	-4.526162
IP		-1.198933	-6.022070	-5.670921	-5.937043
INF		-1.787538	-5.470039	-2.070280	-5.378607
EX		0.392558	-4.029169	-2.006186	-4.013873
Critical values	1%	-3.646342	-3.632900	-4.296729	-4.243644
	5%	-2.954021	-2.948404	-3.568379	-3.544284
	10%	-2.615817	-2.612874	-3.218382	-3.204699
PP UNIT ROOT TEST					
Variable		PP value (constant included)		PP value (constant and linear trend included)	
		Level	First differenced	Level	First differenced
M2		-0.420641	-4.615123	-1.343807	-4.574086
IP		-1.246443	-6.022196	-1.769326	-5.937037
INF		-1.898013	-5.482381	-2.195088	-5.393868
EX		0.090246	-4.029169	-1.776100	-4.042097
Critical values	1%	-3.626784	-3.632900	-4.234972	-4.243644
	5%	-2.945842	-2.948404	-3.540328	-3.544284
	10%	-2.611531	-2.612874	-3.202445	-3.204699

Source: Eviews 9

Notes: * indicates significance at one percent or a rejection of the null of no unit root at the one percent level.
** indicates significance at five percent or a rejection of the null of no unit root at the five percent level.
*** indicates significance at ten percent or a rejection of the null of no unit root at the ten percent level.
Optimal lags based on Schwartz information criterion are given in curly brackets and the optimal Newey-West bandwidths are given in square brackets. The critical values come from Osterwald-Lenum (1992).

The findings of the unit root tests for the stationarity of the individual time series are reported in table 1 above. The PP tests are non-parametric unit root tests that are modified so that serial correlation does not affect their asymptotic distribution. The PP tests reveal that all variables are integrated of order one, both with and without linear trends and with and without intercept terms.

A review of the results shows that each series is first difference stationary at the one percent level using the PP test. This means that we cannot reject the presence of a unit root for any of the variables under the PP tests. However, the ADF test results are not so clear-cut, because only the growth variable passed the differenced stationarity test at the one percent level. We, therefore, rely solely on the PP test results as the basis for a cointegration test among all stationary series of the same order.

3.3 Testing for Cointegration (the Johansen approach)

This study now investigates the existence of any unique equilibrium relationship(s) among the stationary variables of the same order of integration. The Johansen methodology is a VAR-based approach, and results based on VARs are sensitive to the lag length used. This fact compelled the researchers to devote considerable time to selecting an appropriate lag structure. The variables' lag lengths were, then, selected by minimizing the Akaike information criterion. The chosen lag lengths were, therefore, those that reduced autocorrelation in the model. The results of the lag selection processes are displayed in table 2 below.

Table 2: Results of the cointegration tests (Johansen technique) for M2, IP, INF, and EX.

Panel A: The results of the trace tests

TRACE TEST				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	Prob. **
None*	0.479048	48.27874	47.85613	0.0456
At most 1	0.382610	26.10745	29.79707	0.1255
At most 2	0.216723	9.710820	15.49471	0.3036
At most 3	0.040501	1.405684	3.841466	0.2358
Trace test indicates 1 cointegrating eqn.(s) at the 0.05 level *denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				

Source: Eviews 9

Panel B: The results of the Maximum Eigenvalue Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.479048	22.17129	27.58434	0.2117
At most 1	0.382610	16.39663	21.13162	0.2025
At most 2	0.216723	8.305136	14.26460	0.3485
At most 3	0.040501	1.405684	3.841466	0.2358

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The eigenvalues are presented in the second column of Panel A, while the third column (Likelihood Ratio) gives the LR test statistics. Q_r represents the so-called trace statistic and is the test of/against $H_{1(k)}$:

$$Q_r = -T\sum_{i=r+1}^{k}\log(1-\lambda_i)$$

for r = 0, 1,…, k-1,

where, λ_i is the i^{th} largest eigenvalue.

To find out the number of cointegrating associations r, subject to the predetermined assumptions made about the trends in the series, we can proceed sequentially from r = 0 to r = k-1 until we fail to reject. The first row in table 2 tests the hypothesis of no cointegration, while the second row tests the hypothesis of one cointegrating relation. The third row then tests the hypothesis of two cointegrating ties, and this continues to the alternative hypothesis of full rank, meaning that all series in the VAR is stationary.

The results revealed that the null hypothesis of no cointegration is rejected because the value of the value of trace statistic is higher than the critical value. However, the null hypotheses of one, two, and three cointegrating vectors cannot be rejected because the values of the trace statistics are smaller than the critical values, thus favoring r = 3. There are therefore three vectors among the variables of the money function.

The results from the money equation indicate, in a temporal sense, the existence of cointegration, suggesting the presence of a causal relationship in at least one direction between or among the cointegrating variables. Fortunately, the details of this causation can be determined through the vector error correction model (VECM), so we proceed by examining this.

3.4 The Vector Error Correction Model

All the variables in the cointegrating equation are assumed to be endogenous in a VAR structure. The VECM builds on this by making use of differenced data and lagged differenced data for the chosen variables in a VAR structure. An essential element of the VECM is the error correction term or factor.

The coefficient of the error-correction term is theoretically expected to be negatively expressed with a value between zero and one. This result ensures that the equilibrium in the error correction within the system over time will be at least meaningful.

The results also reveal that Cointegration implies causality in at least one direction, and this may be further determined by employing a vector error correction model (VECM).

A typical VECM in its simplest form appears as shown in equation (2):

$$\Delta M2_t = a_0 + \sum_{i-1}^{n} b_i \Delta M2_{t-i} + \sum_{i-1}^{n} c\Delta IP_{t-i} + \sum_{i-1}^{n} d\Delta INF_{t-i}$$

$$+ \sum_{i-1}^{n} f\Delta EX_{t-i} + \sum_{i-1}^{n} gEC_{t-i} + \varepsilon_t \text{...}(2)$$

where EC_{t-i} is the lagged error-correction term based on the estimates from Table 3 – Panel B.The OLS estimates of the error-correction model in equation (4) are presented in Table 3 below.

Table 3: Estimates of the error-correction model, where the dependent variable is $\Delta M2_{t-1}$

Regressors	Coefficient	t-Ratio
$\Delta M2_{t-1}$	-0.577303	[-2.34771]
$\Delta M2_{t-2}$	-0.228241	[-0.91504]
ΔIP_{t-1}	-0.466597	[-2.38968]
ΔIP_{t-2}	-0.111679	[-0.64184]
ΔINF_{t-1}	0.112217	[2.47407]
ΔINF_{t-2}	0.052811	[1.58241]
ΔEX_{i-1}	-0.977713	[-4.44946]
ΔEX_{i-2}	-0.233172	[-0.77690]
Constant	0.219916	[3.22995]
EC (-1)	-0.633631	[-4.69446]
R-squared	0.737239	
F-statistic	7.481971	
AIC	-1.398710	

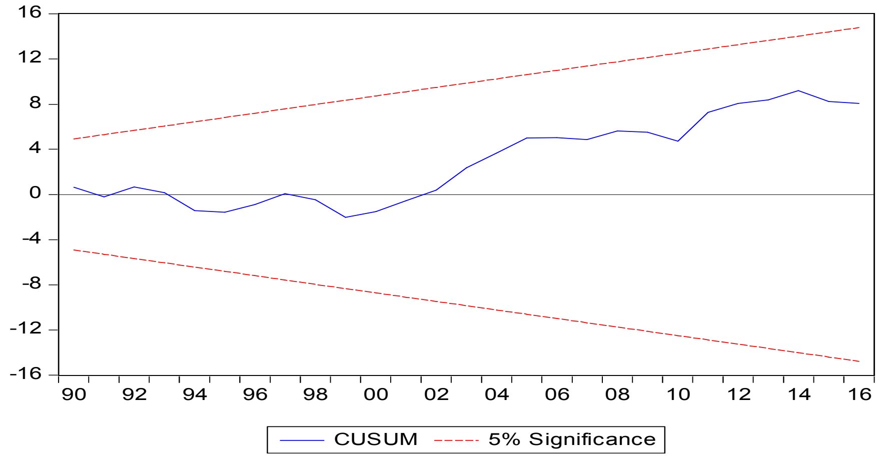
Source: Eviews 9
NOTE: EC is the error-correction term determined from the corresponding cointegration reported in Table 2 – Panel B.

First, the fact that ECt-1 carries a significantly negative coefficient supports cointegration and thus a long-run relationship among the variables of the money demand function. Second, since the estimated coefficient of the ECt-1 is rather small (-0.633), adjustments in the Algerian money market are very slow, indicating some inefficiency.

Finally, we question whether the short-run coefficient estimates, taken together with the long-run estimates reported in table 3, are stable over time? To answer this question, we rely upon the CUSUM and CUSUMQ tests proposed by Brown et al. (1975). The CUSUM test is based on the cumulative sum of recursive residuals based on the first set of r observations.

The CUSUM statistic is updated recursively and is plotted against the break-points. Should the plot of the CUSUM statistic stay within the 5% significance level, as portrayed by two straight lines whose equations are provided by Brown et al. (1975, section 2.3), then the coefficient estimates are said to be stable. A similar procedure is similarly applied in the CUSUMQ test, which is based on the squared recursive residuals. A graphical presentation of these two tests is presented in Figures 2 and 3.

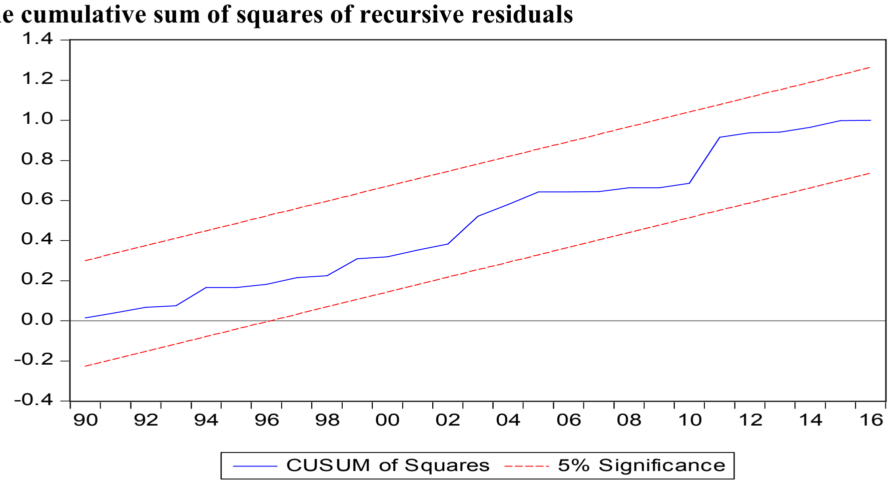
Figure 2: Plot of the CUSUM statistics



The straight lines represent the critical bounds at a 5% significance level

Figure 3: Plot of the CUSUMQ statistics

The plot of the cumulative sum of squares of recursive residuals



The straight lines represent the critical bounds at a 5% significance level

As can be seen in Figures 2 and 3, the plots for both the CUSUM and CUSUMQ statistics do not cross the critical bounds, indicating stability in the Algerian money demand function.

3.5 Impulse Response Analysis

Previous empirical studies have established that the ordering of variables affects impulse response functions. In the absence of any theory that would mandate a specific order for the series, it seems sensible to undertake some sensitivity analysis. In what follows, we, therefore, present the impulse response functions in the figures below.

We apply one positive standard deviation shock to each error term to establish how the variables react to each other. The ordering of the variables is an essential consideration in the calculation of impulse responses and variance decompositions. In practice, however, the error terms are likely to be correlated across VAR equations to some extent, and a failure to assume this would lead to a misrepresentation of the system dynamics.

The typical approach, in this case, involves generating orthogonalized impulse responses while considering the sensitivity of the results at every stage.

The results of the impulse response analysis are reported graphically in figures 4 and 5 below.

Figure 4: Impulse response in (VECM)-Order I

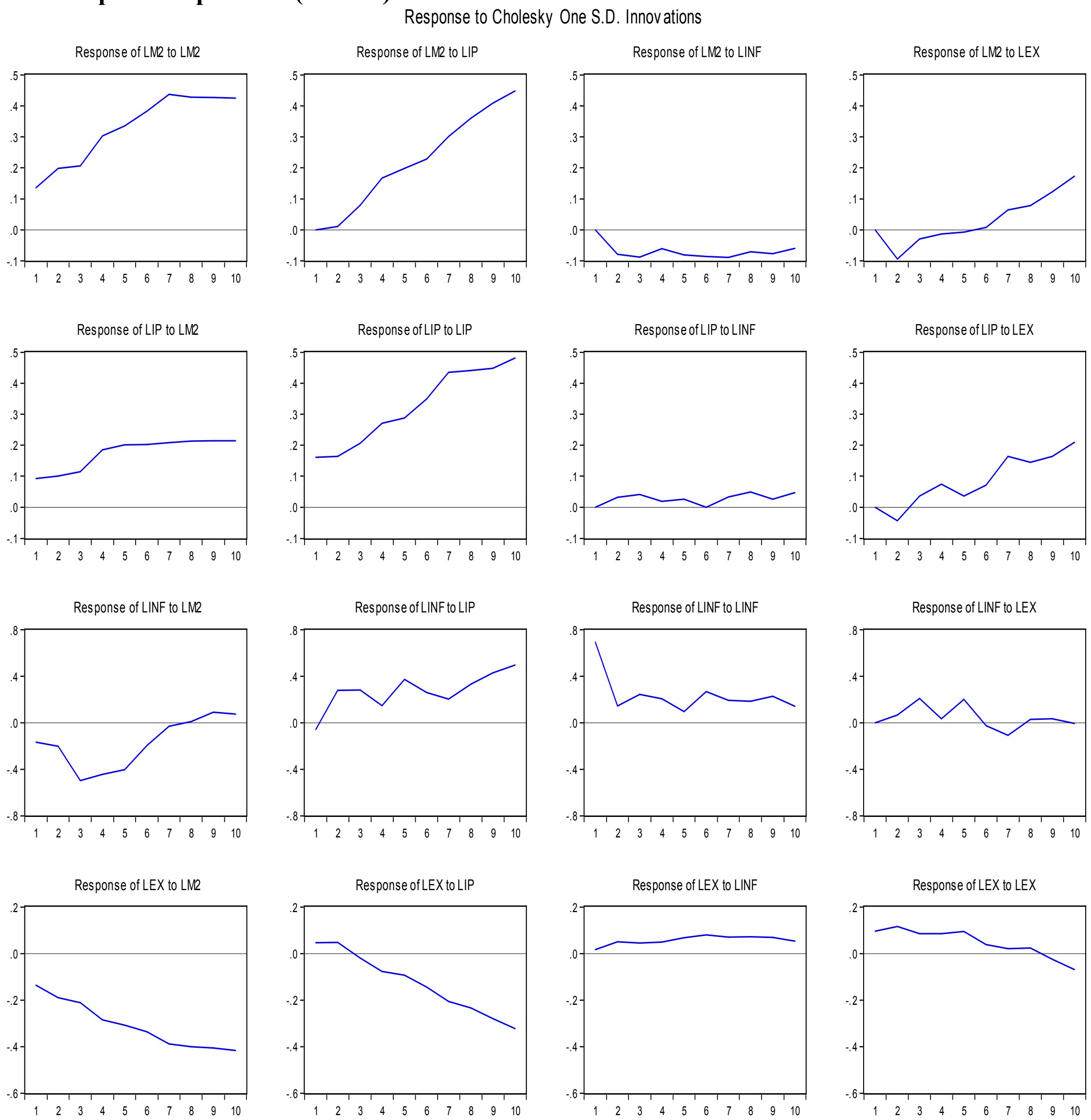
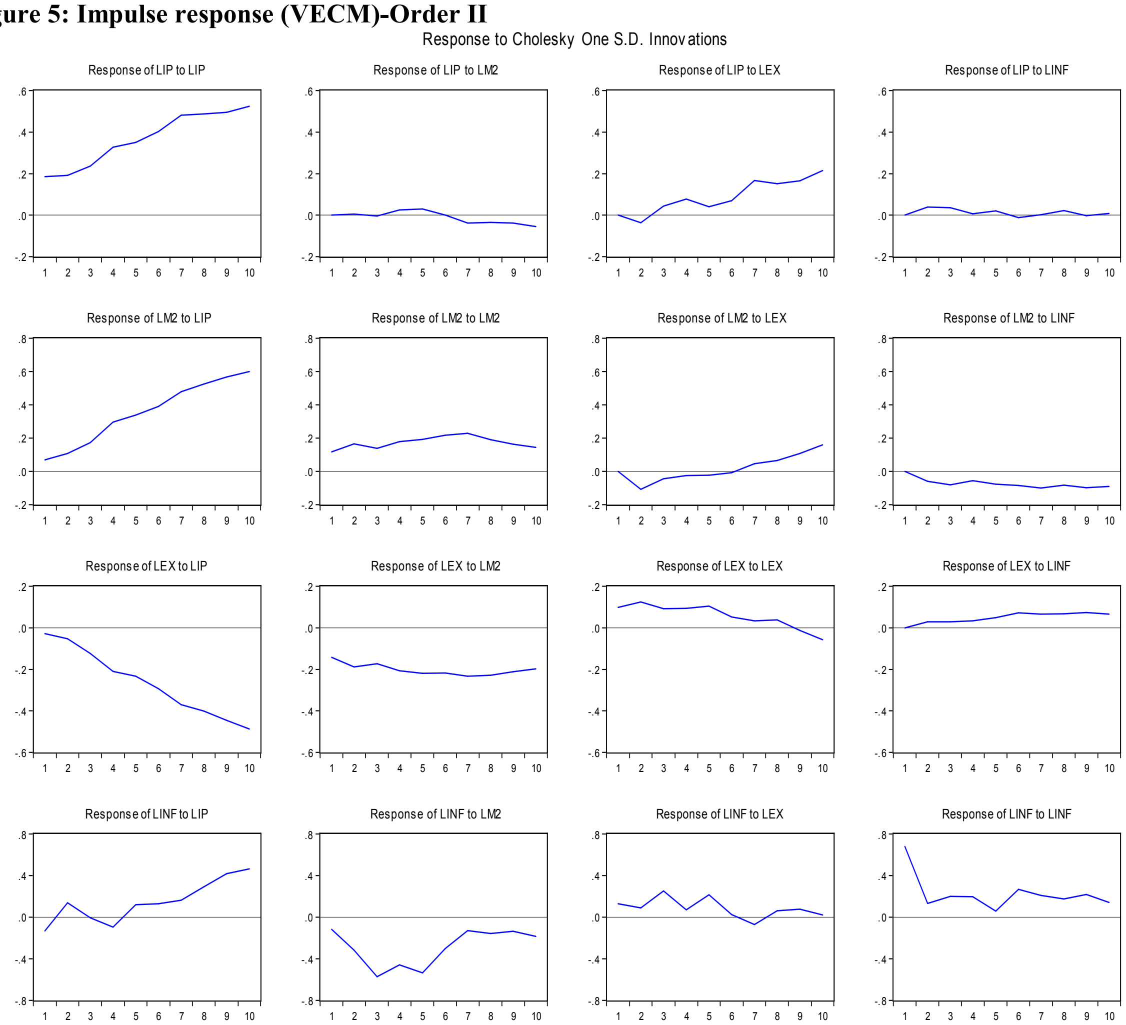


Figure 5: Impulse response (VECM)-Order II



Figures 4 and 5, which use two different orderings, reveal the effects of a one standard deviation shock on each of the variables over time. The impulse responses do not appear to be very sensitive to the ordering of variables. What is more, a striking feature is how in both orders, the shocks seem to settle down during the early stages and only become more pronounced later on. A total of 16 impulse responses could be calculated based on the four variables in the system.

Considering the signs of the responses in figures 4 and 5, unexpected movements in LM2 produced little or no reaction in the other three variables under consideration until the forecast at year seven. Exceeding this period, a one standard deviation shock to LM2 triggered a significant negative response in LIP, LINF, LEX and LM2 itself. The reaction in LM2 was positive during the same forecast period, however. Similar explanations can be implemented to the other variables in both figures.

4. Conclusion and Remarks

This study sought to examine the stability of the money function over time using data for Algeria. A cointegration test was performed to verify association (long-run movement) among the variables. Besides, an error correction analysis was applied to establish the speed that the adjustment of money took place to restore equilibrium. Furthermore, the CUSUM and CUSUNQ tests were used to show the stability of money over time.

Finally, an impulse response analysis was carried out to measure the impact of one standard deviation change (shock) in one variable on the other variables, as well as itself. Based on the available data, the empirical evidence reveals that the money function is stable in Algeria. Also, the dynamic interaction among money (M2), industrial production (IP), inflation (INF), and exchange rate (EX) was also investigated using the concept of impulse response analysis.

The findings from the responses of the four variables to one standard deviation shocks were, on average, found to be unpronounced in the early stages of the out-of-sample forecast period. However, all variables demonstrated distinct responses after roughly six years into the forecast period.

It is therefore essential to note here that policy shocks to the money supply, inflation, and exchange rate in Algeria do not show immediate responses in the desired direction.

The study suggests that policymakers should consider placing more emphasis on industrial production combined with more action to control inflation.

References

Adam, Christopher S. (1991). Financial Innovation and the Demand for M3 in the U.K. 1975-86.Oxford Bulletin of Economics and Statistics, 53, 401-423.
Ahmed, Zenagui S. (2015). Empirical Analysis of Money Demand Function in Algeria: 2003-2014. Journal of Empirical Economics, 4(6), 313-323.
Alhakimi, Saif S. (2008). Measuring the Stability of Money Demand in Yemen. ShoaonAlaser, 28, 01-16.
Arango, Sebastian,and Nadiri, M. Ishaq (1981). Demand for Money in Open Economics. Journal of Monetary Economics, 7, 69-83.
Anoruo, Emmanuel (2005). Stability of the Nigerian M2 Money Demand Function in the SAP Period. Economics Bulletin, 14 (3), 1-9.
Bahmani-Oskooee, Mohsen (1996). The Black Market Exchange Rate and Demand for Money in Iran. Journal of Macroeconomics, 18, 171-176.
Bahmani-Oskooee, Mohsen, and Hyun-Jae Rhee (1994). Long-Run Elasticities of the Demand for Money in Korea: Evidence from Co-integration Analysis. International Economic Journal, 8,83-93.
Bahmani-Oskooee, Mohsen, and Ghiath Shabsigh (1998). The Demand for Money in Japan: Evidence from Co-integration Analysis. Japan and the World Economy, 8, 1-10.
Bahmani-Oskooee, Mohsen, Miquel-Angel Galindo Martin, and Farhang Niroomand (1998). Exchange Rate Sensitivity of the Demand for Money in Spain. Applied Economics, 30, 607-612.
Bahmani-Oskooee, Mohsen, and Michael Barry (1998). Does Russian Ruble Follow the Monetarist Path? Economic Notes, 27, 287-298.
Bahmani-Oskooee, Mohsen, and M.Barry (2000). Stability of the Demand for Money in Unstable Country: Russia. Journal of Keynesian Economics, 22 (4), 619-629
Boughton, James M. (1981). Recent Instability of the Demand for Money: An International Perspective. Southern Economic Journal, 47, 579-597.
Brown, R. L., J. Durbin, and J. M. Evans (1975). Techniques for Testing the Constancy of Regression Relations Over Time. Journal of the Royal Statistical Society, Series B, 37, 149-163.
Chen, Baizhu (1997). Long –Run Money Demand and Inflation in China. Journal of Macroeconomics, 19, 609-617.
Enzler, Jared; Johanson, Lewis and Paulus, John (1976). Some Problems of Money Demand. Brooking Papers on Economic Activity, 1, 261-280.
Frankel, Jacob A., and Mark P. Taylor (1993). Money Demand and Inflation in Yugoslavia, 1980-1989. Journal of Macroeconomics, 15, 455-481.
Girton, Lance,and Rober, Don (1981). Theory and Implications of Currency Substitution. Journal of Money, Credit,and Banking, 13, 12-30.
Goldfeld, Stephen M. (1973). The Demand for Money Revisited. Brooking Papers on Economic Activity, 3, 577-638.
Goldfeld, Stephen M. (1976). The Case of the Missing Money. Brooking Papers on Economic Activity, 3, 683-730.
Hafer, R. W., and Dennis W. Jansen (1991). The Demand for Money in the United States: Evidence from Co-integration Tests. Journal of Money, Credit and Banking, 23, 155-168.
Hafer, R. W., and A. M. Kutan (1994). Economic Reforms and Long-Run Money Demand in China: Implications for Monetary Policy. Southern Economic Journal, 60, 936-945.
Hansen, Hendrik, and Soren Johansen (1993). Recursive Estimation in Co-integrated Models. Institute of Mathematical Statistics preprint, 1, (University of Copenhagen, Copenhagen).
Hoffman, Dennis L., and Robert H. Rasche (1991). Long-Run Income and Interest Elasticities of Money Demand in the United States. The Review of Economics and Statistics, 73, 665-674.
Hoffman, Dennis L., Robert H. Rasche, and Margie A. Tieslau (1995). The Stability of Long-Run Money Demand in Five Industrial Countries. Journal of Monetary Economics, 35, 317-339.
Johansen, Soren (1992). Testing Weak Exogeneity and the order of Co-integration in UK Money Demand Data. Journal of Policy Modeling, 14, 313-334.
Johansen, Soren, and Katarina Juselius (1990). Maximum Likelihood Estimation and Inference on Co-integration With Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics, 52, 69-210.
Karfakis, Costas I., and Ashok Parikh ((1993). A Co-integration Approach to Monetary Targeting in Australia. Australian Economic Papers, 32, 53-70.
Kwiatkowski, Denis, Peter C.B. Phillips, Peter Schmidt and Yongcheol Shin (1992). Testing the Null

Hypothesis of Stationarity Against the Alternative of a Unit Root. Journal of Econometrics, 54, 159-178.

McNown, Robert, and Myles S. Wallace (1992). Co-integration Tests of a Long-Run Relationship between Money Demand and the Effective Exchange Rate. Journal of International Money and Finance, 11, 107-114.

Melnick, Rafi (1990). The Demand for Money in Argentina 1978-1987: Before and After Austral Program. Journal of Business and Economic Statistics, 8, 427-434.

Miller, Stephen M. (1991). Monetary Dynamics: An Application of Co-integration and Error-Correction Modeling. Journal of Money, Credit and Banking, 23, 139-154.

Muhd-Zulkhibri and Muhd-Zulkhibri Abdul Majid (2005). Modeling the Stability of Money Demand in Small Open Economy: The Case of Malaysia. The Icfai Journal of Applied Economics, 4 (2), 7-23.

Muscatelli, Vito A., and Luca Papi (1990). Co-integration, Financial Innovation and Modeling the Demand for Money in Italy. The Manchester School, 58, 242-259.

Reinsel, Gregory C. and Sung K. Ahn (1992).Vector Autoregressive Models with Unit Roots and Reduced Rank Structure: Estimation, Likelihood Ratio Test, and Forecasting. Journal of Time Series Analysis, 13, 353-375.

Roley, V. Vance, “Money Demand Predictability (1985). Journal of Money, Credit and Banking, 17 (2), 611-653.