The Money Demand Function for Jordan: An Empirical Investigation

Dr. AL-Abdulrazag Bashier
College of Business Administration (CBA), Finance Department, Jeddah-KSA
Email: basheerf@yahoo.com

Dr. Abdullah Dahlan
College of Business Administration (CBA), Jeddah, KSA
Email: Abdullahdahlan@yahoo.com

Abstract

A Considerable volume of research has tried to estimate the demand for money function for different countries as well as in Jordan. This research is an attempt to examine the money demand function and its stability in Jordan over the period 1975-2009. Although previous studies have been conducted on the demand for money in Jordan, the results have been mixed due to different methodology and data time span. A common theme of almost all studies in Jordan until a short period is the application of the traditional estimation techniques. The reliability of the estimation results were questioned due to the shortcomings of traditional techniques. A modern estimation technique was introduced, like Cointegration technique. However, findings of Cointegration have been interpreted as a sign of constancy of parameter estimates. The present paper employs CUSUM and CUSUMSQ tests in conjunction with Johansen-Juselius (1990) Cointegration analysis of a multivariate system of equations to test for the existence of a long run relationship between the determinants. The study employs the Augmented Dickey-Fuller (ADF) unit root tests proposed by Dickey-Fuller (1981) to determine the order of integration of the series. Moreover, the study applies the impulse response functions (IRFs) and variance decomposition (VDC) to investigate the effect of the determinant factors on money demand. The statistical tests revealed that all time series data are integrated of order one I(1). The Johansen-Juselius Cointegration test shows that the determinant factors are cointegrated. The empirical findings stress the existence of a positive relationship between money aggregates and the level of income while the relationship is negative for interest rate and exchange rate depreciation. The results of stability tests reveal that M_2 money demand in Jordan is stable.

Keywords: Money Demand, Expected inflation rate, Expected exchange rate, GDP, Stability, Cointegration, IRFs

JEL Classification: C40 C32 E22

Introduction

The money demand plays a vital role in conducting an influential economic policy since it is considered a critical component of the transmission mechanism of monetary policy. From monetary view, a stable money demand function is an essential factor in determining the formulation and the conduct of an effective monetary policy which has a predictable effects on inflation and real output (Selletis, 2001; **Nachega**, 2001). Therefore, in developing countries, policymakers are concerned with the stability of money demand. The majority of studies found that the demand for money function is unstable and monetary aggregates lost their influence in the conduct of monetary policy, Rasina (2001).

Considerable empirical studies in the macroeconomic literature have investigated the determinant factors of the demand for money and its stability in Jordan over the last few decades. Most of the earlier studies relied upon the traditional the Ordinary Least Squares (OLS) estimation technique and estimated income elasticity and interest elasticity of the demand for money. Either those studies did not test for stability or, even if they did, they provided mixed results. The main shortcoming associated with those studies is that they suffer from |"spurious" regression problem due to non-stationary data employed. Therefore, neither the estimates nor the stability results could be relied upon. Moreover, the research on Jordan has data over a shorter period. Recent set of studies employed the most recent advances in time series analysis, to correct for the problem associated with the earlier studies. The main problem associated with the recent studies is that they interpreted their cointegration findings as a sign of stable demand for money in Jordan. However, many researchers pointed out that cointegration analysis does not imply stability (Bahmani, *et al*, 2005). Therefore, once the cointegration is established, formal stability tests of the parameters should be applied. **The** present paper aims at providing a theoretical and empirical basis for modeling the demand for money in Jordan.

The paper uses the cointegration analysis to estimate the money demand function and its stability in Jordan over the period 1975-2009. **To** this end, section 2 presents a review of literature on money demand on both developed and developing countries as well as on the demand for money in Jordan. Section 3 out lines the economic model specification of money demand and variable description. Section 4 presents data and methodology. Section 5 presents the empirical findings. The final section concludes the study and recommends some policy implications.

2. Review of Empirical Literature

In macroeconomic literature, an enormous research has been conducted to estimate the money demand function. The advancement in the time series econometrics has been a major contribution to the estimation of money demand function in the last few decades. Such advancement has motivated researchers to question the creditability and the significant findings of the previous empirical models. This section provides a brief survey of the empirical modeling and estimation techniques used in the applied money demand function. Mohsen, *et al,* (2005) examined the stability of the demand for monetary aggregates M_1 and M_2 in Greece using quarterly data for the period 1975I-2002IV. The estimation methodology employed the cointegration analysis approach and the CUSUM & CUSUMSQ tests for the stability of the money demand function. The Econometric model included a vector of interest rates and the real income as the determinant factors. The estimation results showed that both monetary aggregates are cointegrated with income and interest rate. The income elasticity is positive while the interest rate elasticity is negative. However, the stability tests revealed that only M_1 is a stable function but not M_2

Al-Zu'bi and Saw'i (2004) studied the determinants of the money demand function (broad and narrow money) and its stability for Jordan over the period 1971-2000. The authors used the OLS estimation method. The empirical results showed that the income elasticity of money demand is positive and the price and exchange elasticities are positive which contradicts the wisdom of the economic theory. Abbas Valadkhani and Mohammad Alauddin (2003) examined the major factors determining the demand for M2 function in eight developing countries using annual time series data for the period 1979-1999. He used the seemingly unrelated regression (SUR) estimation technique to estimate the money demand function. His model incorporates inflation rate, long-run and short-run interest rates, real income and the US long-term interest rate as determinant factors. The estimation results revealed a positive impact of income on money demand, where the all types of interest rate and the inflation rate have a negative impact.

Harb (2003) estimated a long-run money demand function for the GCC's six countries using panel data for the period 1979-2000. The econometric model has alternatively used both M1 and M2 monetary aggregates as the dependent variable. The GDP has been used as a scale. The opportunity cost of holding money was measured by the interest rate and the expected exchange rate. The methodology of the study used the FMOLS and Modified FMOLS models to estimate the money demand function. He also used the unit root test and the cointegration test. The statistical test results indicated that the included variables are integrated of order one, I(1), and cointegrated. The estimation results showed that the elasticities of the money demand with respect to the scale variables are in line with the economic theory. The income elasticity was positive, the interest elasticity was negative, and the expected exchange elasticity was negative. Alkiswani (2001) estimated the demand for narrow money (M_1) Syria for the period 1974-1994. The money demand function included the real income representing the transaction demand motive, and inflation rate as a proxy for opportunity cost (since the financial market is not developed yet) as the independent variables. The methodology employed the ECM approach and the cointegration approach using the quarterly data. The estimation results showed a positive impact of income and a negative one for inflation rate. Where the elasticity of the dynamic model is greater that dynamic short run and the OLS (the static long run). The interest rate and exchange rate showed no significant impact on the money demand function.

Cluadia's (2001) paper provided an empirical investigation to determine the factors affecting the long-run money demand function and assed the stability of the relationships between the various factors and different types of monetary aggregates for Jordan over the period 1971-2005. The money demand function depends negatively on the opportunity costs of holding money, which can be captured by foreign or domestic interest or inflation, and positively on the volumes of transactions. Malawi (2001) investigated the money demand function in Jordan over the period 1969-1997. Using the OLS for the first difference of the variables (Real GNP, Inflation rate), and the Instrumental variable approach. The results showed the positive impact of income and negative impact of inflation rate as a measure of the opportunity cost of holding money (physical assets).Marashdeh (1996) estimated the demand for money (domestic and foreign) in Jordan in an open economy framework, using quarterly data over the period 1973:4-1984:4. The study is performed using several estimation methods (OLS).

His findings revealed that expected exchange rate and foreign interest rate have no influence on money demand. On the other hand, the expected inflation rate and real GDP have the expected effect while domestic interest rate showed no effect. The implication of his findings suggested that currency substitution and capital mobility are no the major factors determining the money demand in Jordan. Awad's (1994) study aimed at estimating the correct functional form of the demand for money in Jordan over the period 1969-1990. He used the Box-Coxe technique for the purpose of the paper. His results revealed that the linear functional for is better fit the demand function in Jordan. The demand for money is inelastic with respect to income and discount rate in the short run, but become elastic in the long-run. Hadad (1985) estimated the money demand in Jordan over the period 1956-1977 using both narrow and broad money definitions (M1&M2) by OLS method. Findings: (1) Income has a significant positive impact on money demand. (2) Expected rate of inflation has a negative but insignificant impact on money demand (he argued that the demand for money by people is not sensitive to changes in price level).

3. The Economic Model

The economic literature contains various theories of money demand concentrating on the relationship between the quantity of money demanded and a set of explanatory variables, which are thought to have a significant effect on money demand. The simple version of theoretical demand function relates the quantity of money demanded to a scale variable and the rate of interest rate (Opportunity cost). Thus, following the economic theory of the money demand, the theoretical money demand relationship can be expressed as:

$$(M_t) = f(S_t,\ O_t) \qquad (1)$$

The M_t is the real money balance demanded, S_t is the scale variables related to activity in the real sector of the economy, and O_t is the opportunity cost of holding money. The selection of the scale variable and the opportunity cost of holding money depend on the theoretical background of money demand function and vary among empirical studies. The first issue in estimating the money demand function is the selection of the monetary aggregate as the dependent variable. The economic literature provides two major approaches in estimating the money demand: 1) the transaction approach and 2) the assets approach (Harb, 2003). According to the transaction approach, households choose between holding liquid money or interest bearing assets as a store of value. Thus, the decision on allocating their portfolio depends on the return of each choice. The assets approach, on the other hand, based on the consumer demand theory, assumes that the consumer drives utility by holding real and financial assets including money. The choice of monetary aggregate as the dependent variable depends on the approach used in estimating the money demand function. The transaction approach emphasizes the liquid asset of money suggesting using the narrow money (M_1) as the monetary aggregate. While the asset approach (portfolio) emphasizes the role of financial assets employs the broader money aggregate (M_2) as the monetary aggregates. Nevertheless, Goldfeld and Sichel (1990) provided that the selection of the monetary aggregate is arbitrary. Accordingly, the present study uses M_2 as the monetary aggregates.

The scale variable in the money demand function represents the transactions related to economic activity. The selection of the scale variable depends on the role of money as a transaction approach or asset approach. The transactions approach emphasized the role of money as a means of transactions, thus the level of Gross national product (GNP), gross domestic product (GDP) and net national product (NNP) are the most commonly used as scale variables. The permanent income, which is constructed from the present and expected future incomes, can be used as a scale variable. The level of income, however, is less inclusive than a more comprehensive measure of transactions, for example, gross national product (GNP). However, recent research has focused on the scale variable involving more comprehensive measures of transactions and categorization of transactions into various components stemming from the idea that all transitions do not have the same degree of 'money intensive' (Golfed and Sichel, 1990; Resima, 2001). Goldfed and Sichel (1990) found no evidence that categorization of GNP yields an improvement in the behavior of money demand. This move reflects the idea that not all transactions are money intensive.

The coefficient of the real income (income elasticity of money demand) has a particular meaning. If it equals to one, then the quantity theory applies, and if it equals 0.5, then the Baumal-Tobin inventory theoretical approach is applicable, and finally if it is greater than unity, then the money can be considered as a luxury. According to Ball (2001), income elasticity of less than unity has a number of implications in terms of monetary policy. Thus, the Friedman rule is not optimal and in this case the supply of money should grow more than output to achieve the goal of the price stability (Abbas, *et al,* 2003).Expected Inflation rate has been used as a proxy for the rate of return on real assets, representing the opportunity cost of holding money (Resina, 2001).

The theoretical foundation of the inclusion of the expected inflation rate in the money demand function goes back to the pioneered work of Freedman (1956, 1969). The idea for the inclusion of expected rate of inflation is based on the fall of the purchasing power of the real value of money. The strong inflationary expectations would give people the incentive to switch out of money to real assets (Resina, 2001). In the case of developing countries, where they suffer from underdeveloped monetary and financial systems and non-market determined interest rate physical assets represent one of the major hedge against inflation and an alternative asset in the portfolio of the non-bank-public, the expected rate of inflation is the proper variable used as the opportunity cost of holding money. In other words, in developing countries where interest rate ceiling and capital controls prevail, assets substitution is likely to be between money and physical assets rather than between money and financial assets (Nachega, 2001)

The expected inflation rate is expected to have a significant and positive impact but not always statistically significant. The results suggest that depositors run a way from domestic currency whenever they expect losses associated with their domestic currency. However, in many cases there has been an increase in dollarization despite the fact that the country following a successful macroeconomic stabilization programs. This is because it is costly to return to domestic currency after domestic inflation decreased. Clements *et al* (1992) argued that it is very difficult for domestic residents to forget the episode of high inflation and these memories will stay for long periods. Moreover, they will assign more weight in comparison to episodes of low inflation rates. It is assumed that the past value (one year) of actual inflation (π_{t-1}) is a good proxy for expected inflation (π^e) (Hadad, 1985):

The choice between interest rate and inflation rate is a practical matter. It is possible that the two variables can be included simultaneously in money demand function especially in developing countries (Harb, 2003). Where as some researcher used inflation rate alone like (Eker et al, 1995; Yashiv, 1994). Harb (2003) used only nominal interest rate because the GCC's six countries have no experience periods of excessive inflation. In an open economy model, additional opportunity costs have been include in the money demand function, the expected exchange rate of national currency. Expected Exchange rate is usually included in the money demand equation in an open-economy to capture the degree of currency substitution in the economy. It has undetermined effect on money demand, which depends on how the public anticipate the future currency depreciation. If the public anticipate future depreciation, therefore, the effect of currency depreciation on money demand is negative, where the agent prefers to substitute their local currency by a foreign and stable currency. On the other hand, the anticipation of currency depreciation has a positive impact on money demand (Muhd, 2004). An increase in expected exchange rate would lead to the substitution of domestic currency for foreign currency under the implication that expected return from holding foreign currency will increase (Resina, 2001). Exchange rate plays a noticeable role in the degree of dollarization. This role is influenced by the expected volatility of the inflation rate. Dollarization occurred when the expected rate of inflation is high in relation to that of exchange rate depreciation. The exchange rate is defined as the number of local currency per one unit of SDR. The use of SDR stems from its definition as the average of the exchange rate versus a set of other currencies. Therefore, the appreciation of the local currency is the same as a decrease in the exchange rate.

The present analysis is based on an open economy money demand function follows.

$$M_t = \beta_0 + \beta_1 y_t + \beta_2 R_t + \beta_3 Dep + \varepsilon_t$$

M_t^* is the natural logarithm of the real money aggregate.

Y_t is the natural logarithm of the real scale variable.

R_t is the local nominal interest rate.

Dep is exchange rate depreciation.

Real values are deflated by the price index (P_t) and expressed in logarithmic form except for interest rate is expressed in percent/annum.

4. Data and Methodology

data covers the period 1971-2009. Nominal Gross Domestic Product, Inflation rate, money supply aggregates, private consumption, and interest rate are obtained from the Central Bank of Jordan (CBJ) publications. The real GDP was calculated by deflating the nominal GDP by GDP deflator (base=2000) obtained from International financial statistics (IFS) yearbook. Moreover, all variables are expressed in logarithmic form. The present paper applies an economic strategy, which takes into account both the dynamic behaviors of the series and the presences of the feedbacks in their mutual relations. The procedure includes stationarity and cointegration analysis, impulse response functions (IRF) and variance decomposition (VDC).The reasons behind choosing the econometric procedure are the following.

As well known, the estimation approach based on static equations using the series in their levels may suffer from certain problems. The first problem is the stationarity of the data which intern results in a spurious regression and the estimation results are meaningless. The issue of weather or not the economic time series are stationary is very important for both estimation and hypothesis testing. The money demand variables are better characterized as a difference stationary (**DT**) process rather than trend stationary (**TS**) process. Therefore, differencing rather than detrending is more suitable to achieve stationarity (Nelson and Plosser, 1982). Moreover, if the variables are non-stationary and cointegrated, but the regression doe not include the dynamic behavior, the OLS estimation may suffer from the simultaneity bias and residuals could be correlated. Second, regression may impose restrictions on the causality direction among the variables. Hence, the dynamic feedbacks are in the analysis. On the contrary, the present study takes into account the dynamic interrelations among the variables in a multivariate framework to examine the short run influences as well as the adjustment process over the long time horizon (10 years).

5. Estimating the money Demand

5.1 Testing for Unit Roots

The first step of the strategy of our empirical analysis involves determining the order of integration of the series used in the analysis by applying the stationarity (or unit root test). The objective of test for unit roots enables researchers to distinguish between the difference processes (DS) and trend stationary processes (DS). The augmented Dickey-fuller (ADF) test (Dickey and Fuller; 1979, 1981) is performed to test for unit root (with constant only, with constant and a time trend, and without constant and time trend) for the sample period 1971-2006. The maximum lag length is chosen based on the minimum AIC criterion. The Perron unit root (PP) test (Perron, 1989) is also performed due to the possibility of the existence of structural breaks which result in the ADF test wrongly indicating non-stationarity in what is actually a stationary series. The PP test tries to determine the order of integration of a time series by considering the possibility of structural changes occurring in its behavior (Ribeiro, 2004).

The prerequisite for cointegration test is to examine the properties of the time series variables, in order to have a reliable regression tests, we first need to make sure that our model could not be subjected to "Spurious Regression". The problem of spurious regression arises because time series data usually exhibit non-stationary tendencies and as a result, they could have non-constant mean, variance and autocorrelation as time passes. This could lead to non-consistent regression results with misleading coefficients of determination (R^2) and other statistical test. Therefore, we need to establish the stationarity properties of the variables used in the model using Augmented Dickey-Fuller "ADF" (1979, 1981) to determine the degree of integration of the variables; how many times should a variable be differenced to attain stationarity. The order of integration (***d***) identified the differencing times to make the series stationary, the series contains (***d***) unit roots, and hence, the integration of the series is of order (***d***). If ***d=0***, the series is said to be integrated of degree zero and stationary at level. The augmented Dickey-Fuller test (ADF) tests the significance of the coefficient of AR(p) based on the estimate of the following regression without the deterministic trend where (p) is the number of augmentation terms included in ADF test $(\Delta Y_{t-1}, \quad , \Delta Y_{t-p})$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta X_{t-1} + \varepsilon_t$$

AR (p) with deterministic trend

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta X_{t-1} + \beta t + \varepsilon_t$$

P= is the number of lags which should be large enough to ensure the error terms are white noise process and small enough to save degrees of freedom. The number of lags can be determined and will be chosen based on the AIC and SBC selection. The error term is normally distributed and the null and alternative hypothesis can be stated as follows:

$$H_0 = \alpha_1 = 0$$
$$H_1 = \alpha_1 \neq 0$$

If the t-ratio of the estimated coefficient is greater than the critical t-value, the null hypothesis of unit root (nonstationary variable) is rejected indicating the variable is stationary at level and integrated of degree zero denoted by I(0). On the other hand, if the series are found to be nonstationary at level, a transformation of the variable by differencing is need until we achieve stationarity that is non-autocorrelated residuals.

5.2 Cointegration test

The heart of the use of cointegration analysis is the error term deviation in the money demand function must be temporary for the economic theory to make sense. If e_t has stochastic trend, the error term will be a cumulative so that the deviation from money market equilibrium will not be determined. Therefore, the error term must be stationary. As the variables tend to be non-stationary I(1), there will be no tendency to return to long-run level. However, the theory asserts that that there exists a linear combination of there nonstationary variables that is stationary. Equilibrium theories involving non-stationary variables require the existence of a combination of the variables is stationary. Since the variables are considered to be I(1), the cointegration method is appropriate to estimate the long-run demand for money. The cointegration technique helps to clarify the long-run relationship between integrated variables" Resima (2001). That is when cointegration holds and there any disequilibrium in the money market due to a shock, there is a short-run dynamic adjustment process such as error-correction mechanism that pushes the system back toward the long-run equilibrium (Jason, 2005).

The study applies the cointegration method developed by Johansen (1988, 1991), and Johansen and Juselius (1990) to the data. The Johansen procedure is favored over the two-step Engle-Granger procedure since it can test for multiple cointegrating vectors, and it obtains the maximum likelihood estimates of the cointegrating vectors and adjustment parameters directly. Moreover, it allows for tests on restricted versions of the cointegrating vectors and speed of adjustment parameters.Cointegration results for the model with real broad definition of money supply $\mathbf{M_2}$ are reported in table 2. The maximal eigenvalues and trace eigenvalues statistics ($\lambda_{\max}$ *and* λ_{trace}) reject the null hypothesis of no cointegration in favor of at least one cointegrating relationship.

The second step of the strategy, after determining the order of integration of each series, is the determination of the number of the linearly independent cointegration vectors by using the maximum likelihood multivariate cointegration test. The long run relationship between the variable series is investigated by the Johansen-Juselius (1990) multivariate cointegration approach. The short–run, on the hand, is analyzed by employing Granger-causality within the vector error correction model (VECM). The system of cointegration vectors can be described as a set of vector autoregression (VAR) of non-stationary time series as follows (Boon, 2000):

$$\Delta X_t = \Pi X_{t-1} \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \mu + \Theta t + \varepsilon_t$$

Where

$$\Pi = -\left(I - \sum_{i=1}^{k} \Pi_i\right), \Gamma i = -\left(I - \sum_{j=1}^{i} \Pi_j\right), i = 1,\ldots\ldots, k-1$$

X_t is a vector of ***P*** variables.

μ are the intercepts

t are the deterministic trends

ε is a vector of Gaussian random variables

The matrix coefficient Π is the long run impact matrix containing information on the stationarity of the variables and the long run relationship amongst them. The rank of the matrix determines the number of cointegration vectors. If the coefficient matrix is full rank, r=p, then all variable are stationary without trend or long-run relationship amongst them. However, if the rank of the matrix is zero, r=0, then there is no cointegration and the variables are non-stationary. The last possible case is where the rank lies between zero and p ($0<r<p$). In this case, there are r linear combinations of variables in X_t that are stationary, and that the variables are cointegrated in the long run with r vectors. The Johansen-Juselius (JJ) approach (1990) to cointegration is a VAR-based test. The mean work of JJ is the development of two tests the -trace and the maximum eigenvalues test- to determine the number of cointegrating vectors. Then the next step is the test for cointegration among the included variables in order to find out, if any, the existence of significant long run relationships using the Johansen procedure. Then the impulse response analysis is used to single out the effects produced by shocks in one variable on all others, and study the dynamic behavior of the series on a ten years horizon.

5.3 Selection of lag length

The criterion for selecting the optimal lag length consists of chosen the Number of lags that are needed to eliminate the VAR in the residual. There are different tests that would indicate the optimal number of lags. The study utilizes the AIC and SC criterion **The** included variables are entered as endogenous variables in that order. A constant is included. Determine the lag order of the VAR is not known priori so tests of the lag order are needed to ensure sufficient power of the Johansen procedure.

Therefore, to attain a model with appropriate lag length, the cointegration is repeated by sequentially reducing one lag at a time (beginning with a third order VAR) until the lag length reaches one. Multivariate tests are performed for each run and the results suggest that it is statistically acceptable to simplify the model to first order VAR.

5.4 Tests on Parameters Stability

A classic problem in econometrics is the determination the stability of the model, that is whether the coefficients (two or more) are the same in two (or more than two) separate subsamples. In time series data, subsamples would normally span over different periods, and these tests are often called tests for structural change. All stability tests try to test for significant differences in the estimated coefficients equation, which in turn indicate a structural change in the relationship.

6. Empirical Findings

6-1 Augmented Dickey – Fuller (ADF) test

The Augmented Dickey-Fuller Test (ADF) is used to determine the degree of integration of the series. For comparison purposes, we repeat the test for unit root using the Philip-Perron test.

Table 1: Unit root test results

	Intercept only				Intercept & trend			
	Level		First difference		Level		First Difference	
Variable	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
Lrm2	-1.635 (0)	-1.6353(0)	-3.5518(0)	-3.5364(2)	2.1445(1)	-1.7592(1)	-3.597(0)	-3.6715(1)
Lrgnp	-0.4234(1)	-0.8471(1)	-4.4835(0)	-4.5001(1)	-1.9696(1)	-1.939(1)	-4.403(0)	-4.4204(1)
R	-2.3415(1)	-1.855(1)	-4.125(0)	-4.125(0)	-2.3405(1)	-1.889(1)	-4.055(0)	-4.055(1)
Deprate	-1.777	1.89	-3.578	-3.567	-2.134 (1)	-1.936 (1)	-3.562 (0)	-4.137 (1)

The lag number are shown in the brackets

C.V are -3.653, -2.9499 and -2.6133 at 1% , 5% and 10% level of significance respectively

Table 1 shows the results of both the augmented Dickey-Fuller (ADF) test and PP test for the level and the difference series on constant only and constant and trend. The number of lags included in the estimation to eliminate the possibility of autocorrelation of residuals. The lag number is determined according to the minimum value of (AIC). The results indicate that the null hypothesis of non-stationarity (of unit root) at level cannot be rejected for all variables at 5 percent level of significant, which casts doubts on the validity of the (OLS) results. To determine the degree of integration, all variables were tested in their first difference. The ADF and PP tests reject the null hypothesis of a unit root at 5 percent level of significant. The results are shown in table (1). It appears that all variables are integrated of order one. To test for the existence of long relationship among the proposed variable, the Johnson multivariate unit root test is used. The lag structure is reported in table (2). According to AIC criterion, two lags are included in the cointegration test.

Table 2: lag structure

VAR Lag Order Selection Criteria Included observations: 33	
AIC	**SC**
2.587044	2.768439
-3.823023	-2.916048*
-3.892214*	-2.259660

Table (3) shows that the null hypothesis of no cointegration is rejected at the conventional level, it also shows that we can't reject the hypothesis of 2 cointegrating vectors we conclude that there exists a relationship among the proposed variables in the long run. The trace statistics and the Max Eigen statistics reveal that there is at least one linear combination in the long run, and hence, there is a long run equilibrium relationship between variables in the long run.

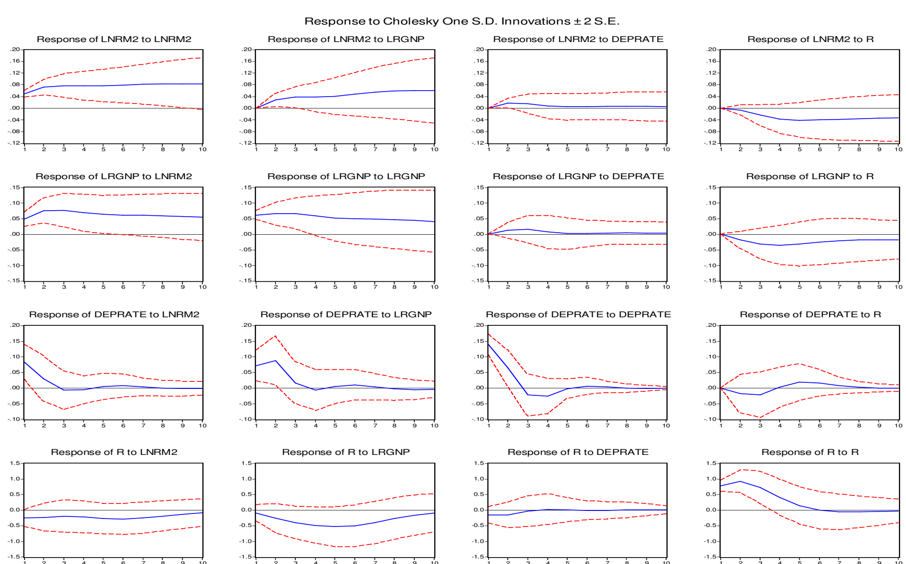
The cointegration equation reveals that the real gross national product has a positive effect on the money demand of the broad money definition. On the other hand, the interest rate has a negative impact on the money demand for M_2. The exchange rate depreciation has a negative effect on the money demand.

Table 3: the Johansson cointegration test results

Sample(adjusted): 1975 2009				
Hypothesized		Trace	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None **	0.624322	66.81066	47.21	54.46
At most 1 *	0.465516	32.54485	29.68	35.65
At most 2	0.258072	10.61898	15.41	20.04
At most 3	0.004885	0.171388	3.76	6.65
*(**) denotes rejection of the hypothesis at the 5%(1%) level				
Trace test indicates 1 cointegrating equation(s) at the 1% level and 2 at the 5% level				
Hypothesized		Max-Eigen	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None **	0.624322	34.26581	27.07	32.24
At most 1 *	0.465516	21.92587	20.97	25.52
At most 2	0.258072	10.44759	14.07	18.63
At most 3	0.004885	0.171388	3.76	6.65
*(**) denotes rejection of the hypothesis at the 5%(1%) level				
Max-eigenvalue test indicates 1 cointegrating equation (s) at the 1% level and 2 at the 5% level				
1 Cointegrating Equation(s):		Log likelihood	101.0225	
Normalized cointegrating coefficients (std.err. in parentheses)				
LNRM2	LRGNP	R	DEPRATE	
1.000000	-1.054933	0.233380	0.035253	
	(0.15210)	(0.05097)	(0.56479)	

6.2 Impulse response Function (IRF)

Then, we implement impulse response functions IRF analysis to single out the effects produced by shocks in one variable on all other variables, and study the dynamic behaviors of the series on a ten years horizon. The deviation from the equilibrium are stationary and any shock to the system generates a time path that eventually returns to a new equilibrium provided no further shocks occur. The impulse response analysis investigates the interaction between the variables and assesses the adjustment to long run equilibrium. The IRF functions examine the positive and negative responses of private investment to changes in different variables in the model (Mehdi, 1998). To determine the significance of the response to a particular shock, the methodology constructs a one standard deviation confidence interval bands. The response is significant if the confidence interval do not pass through the zero line.



The IRF reveals a significant positive relationship between real GNP. The exchange rate depreciation has a positive, but dies out after four periods. The interest rate has a significant negative relationship with the money demand, reflecting the opportunity cost of holding money.

6.3 Variance Decomposition (VDC): VDC Indicates the importance of certain variable but fail to give information about the direction of the response of the variable to certain shocks.

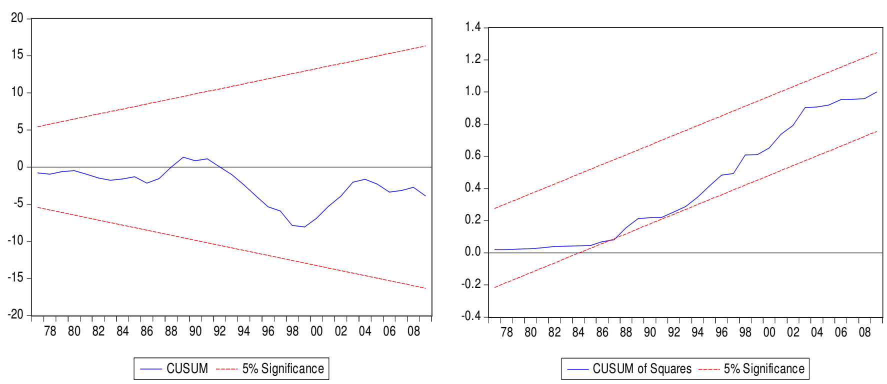
Table 4: Variance Decomposition of LRM2

Variance Decomposition of LNRM2:					
Period	**S.E.**	**LNRM2**	**LRGNP**	**DEPRATE**	**R**
1	0.049518	100.0000	0.000000	0.000000	0.000000
2	0.093580	87.22768	8.840597	3.434547	0.497175
3	0.129686	80.34290	12.87198	3.106008	3.679105
4	0.159340	75.95279	14.02657	2.273080	7.747557
5	0.186024	72.75820	15.03800	1.733197	10.47060
6	0.211538	70.29810	16.64199	1.409376	11.65054
7	0.236222	68.31951	18.55030	1.204998	11.92519
8	0.259634	66.77947	20.34644	1.059775	11.81432
9	0.281385	65.63161	21.84770	0.948979	11.57171
10	0.301367	64.78980	23.04605	0.863203	11.30095
Cholesky Ordering: LNRM2 LRGNP DEPRATE R					

Table 4 shows that LRGNP explains 23.04% of the variation in the money demand after ten years. While the exchange rate depreciation explains 0.86% of the variation which implies the week effect of currency substitution. Finally, interest rate explains 11.3% of the variations.

6.4 Tests on Parameters Stability

Graham (1993) suggested that the model (equation) is sensitive to the sample size. Based on this proposition, it is important that we investigate the stability of the long-run relationship between variable series for the entire period. In other words, we have to test for the parameter stability. To achieve the task, the study implemented the methodology based on the cumulative sum (CUSUM) and the cumulative sum squares (CUSUMSQ) tests proposed by Brown *et al.* (1975). The advantage of such a test over the Chow test is that the former test requires the specification of the break points, while the latter test uses the cumulative sum of recursive residuals based on the first n observations and is updated recursively and plotted against break point (Ouattara, 2004). On the other hand, CUSUMSQ test uses the squared recursive residuals in the same manner as CUSUM test. The decision about the parameter stability relies on the position of the plot relative to the 5% critical bound. If the plot of the CUSUM or CUSUMSQ lies with the 5% critical bound, then the null hypothesis that the coefficients are stable then the null hypothesis of parameter stability can't be rejected, but if the plot crosses either one of the parallel lines.



After estimating equation by OLS, the next step is to apply the CUSUM and CUSUMSQ tests to the residuals of the equation. Fig.2 shows the stability results for M2 money demand function. From figure 2, it is clear that both CUSUM and CUSUMSQ plots stay within the 5 percent critical bound, which provide evidence that the parameters are stable over the study period that is there is no structural change.

7. Conclusion: This research examines both the determinants and the stability of money demand function in Jordan during the period 1975-2009. The methodology of the present research employs a modern econometric technique known as the Johansen-Juselius (1990) Cointegration analysis of a multivariate system of equations to test for the existence of a long run relationship between the determinants. The CUSUM and CUSUMSQ tests are employed to investigate the stability of the money demand function. To determine the order of integration of the variable series, the study employs the Augmented Dickey-Fuller (ADF) unit root test proposed by Dickey-Fuller (1981). Moreover, the study applies the impulse response functions (IRFs) and variance decomposition (VDC) to investigate the effect of the determinants on money demand. The statistical tests revealed that all time series data are integrated of order one I(1). The Johansen-Juselius Cointegration test shows that the determinants are cointegrated. The empirical findings stress the existence of a positive relationship between money aggregates and the level of income. The results of stability tests reveal that M_2 money demand in Jordan is stable.

References

Abbas Valadkhani and Mohammad Alauddin, (2003), "Demand for M2 in Developing Countries: An Empirical Panel Investigation", Queensland University of Technology, School of economics and Finance, Dicussion Paper No. 149.

Alkiswani M., (2001), "The Demand for Money in Syria: An Error correction Model and Cointegration Approach", Journal of Damascus University, Vol. 17, No.1.

Al-Zu'bi B., Khalid Saw'I, (2004), "Demand for Money in Jordan", Dirasat, Administrative Science, Vol.31, No. 1.

Awad Talib, (1994), "Functional forms of the money Demand in Jordan", Dirasat, (the Humanities), Vol. 21 A, No. 5.

Boon, T. H., (2000) "Savings, Investment, and Capital Flows: An Empirical Study of the ASEAN Economies", working paper, 3.2000, University of Putra Malaysia.

Brown, R. L., Gurbin, J. & Evans, J. M. (1975), "Techniques for Testing the Constancy of Regression Relations over Time.", Journal of the Royal Statistical Society, 37, Series B, pp. 149-163.

Cluadia M. Buch, (2001), "Money demand in Hungary and Poland", Applied Economics, 33, 989-999.

Crockett A., Owen, J. E., 1980, "Demand for Money in the Middle Eastern Countries", IMF Staff Papers, Vol. 27, No. 3, pp.543-77.

Dickey, D.& Fuller, W., (1979) "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", Journal of the American statistical Association, Vol. (74), pp. 427-431.

Dickey D., W. A. Fuller (1981), "Likelihood ratio statistics for autoregressive time series with unit root", Econometrica, vol.49, No.4, Evanston, Illinois, The Econometric Society.

Doowitz, I., and Ibrahim, E., (1987), "An Error Correction Approach to Money Demand: The case of Sudan", Journal of Development Economics, Vol. 26, No. 2, pp.257-75.

Eken, S., Cashin, P., Erbas Nuri, S., Martelkino, J. and Mazarai, A., (1995), "Economic Dislocation and Recovery in Lebanon", IMF Occasional Paper, No. 120.

Goldfeld, S M. & Daniel E. Sichel, (1990), "The Demand for Money.". In the Handbook of Monetary Economics, 1, B. M. Friedman & H. Hahn (eds). Amsterdam:North-Holland.

Hadad, Adeeb, (1985) "Model of Demand for Money in Jordan" Central Bank of Jordan, Unpublished paper.

Harb, Nasri, (2003), "Money Demand Function: Heterogeneous Panel Application", Unpublished Paper, UAE University.

Hoffman, D. L., Chakib T., (1994), "Money Demand in Morocco: Estimating Long-Run Elasticities for Developing Countries", Oxford Bulletin of Economics and Statistics, Vol. 56, No.3, pp.305-24.

Honohan P, (1997). "Inflation and the Demand for Money in Developing Countries". World Development, Vol. (22), No. (2). pp 215-23.

Jean-Claude Nachega, (2001), "A Cointegration Analysis of Broad Money Demand in Cameroon", International Monetary Fun, (WP/01/26).

Johansen, S. and Juselius, K. (1990) "Maximum Likelihood estimation and inference on cointegration with application to the demand for money", Oxford Bulletin of Economics and Statistics, Vol. 52, 169-210.

Jason, F. Vaccavo, (2005), "Cross-country Evidence on the Demand for Money", Unpublished Thesis, Calgary, Alberta, Canada.

Malawi A. I., (2001), "The Demand for Money in Developing Countries: The Case of Jordan", Dirasat, Administrative Science, Vol. (29, No.

Mankiw, N. G., L. H. Summers, (1986), "Money Demand and the Effects of Fiscal Policies", Journal of Money, Credit, and Banking, 18, 415-429.

Mohsen B. and Charikleia, E., (2005), "How Stable is the Demand for Money in Greece", International Economic Journal, Vol. 19, No.3, 461-472.

Muhd-Zulkhibri, A. Majed (2004), "Reassessing the Stability of Broad Money demand in Malaysia", Unpublished Paper, Central Bank of of Malaysia.

Ouattara, Bazoumana, (2004), "Modeling the Long Run Determinants of Private Investment in Senegal" CREDIT, University of Nottingham.

Perron, P. (1989), "The great crash, the oil price shock, and the unit root hypothesis", Econometrica, vol.57, No.6, Evanston, Illinois, The Econometric Society.

Resina, Katafono, (2001), "A Re-Examination of the Demand for Money in Fiji", Working Paper (2001/03), Reserve Bank of Fiji.

Reza Anglingkusumo, (2005), "The Stability of the Demand for Real Narrow Money in Indonesia", Tinbergen Institute Discussion Paper, Ti 2005-051/4, Amsterdam.

Ribeiro M. B., Joanilio, R. T. (2004). "An Econometric Analysis of Private-Sector Investment in Brazil". CEPAL Review, 74.

Serletis, Apostolos, (2001), The demand for money: theoretical and Empirical Approaches, i[st] ed, Kluwer Academic Publishers, London.

Yashiv, E. (1994), "Money Demand in High Inflation Economy: The Case of Israel". The Review of Economics and Statistics, Vol. 76, PP. 186-191.