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The Term Structure of Interest Rate and Money Demand in Jordan (1982-2008)

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1. INTRODUCTION

Monetary authorities use empirical money demand estimations as a major tool in designing policies to influence real and monetary balances. Since the 1980's, economic variables such as income, interest rates, foreign exchange rates, and inflation presumed to be the most important factors that affect money balances in the literature. According to Friedman[1], money demand function assumes that there is a stationary long-run equilibrium relationship between real money balances, real income, and the opportunity cost of holding real balances[2].

Money demand is a key element in the monetary policy framework of most central banks. It constitutes a natural «nominal anchor» for the monetary policy of central banks that aim to maintain price stability; the European Central Bank in the euro area is an example. Generally, the existence of the well-specified and stable relationship relating money demand to the price level and some explanatory variables is usually perceived as a prerequisite for the use of monetary aggregates in the conduct of monetary policy[3]. A stable money demand function has long been sought after because it can be very useful for explaining, and even predicting, the behavior of other aspects of the macro-economy. In traditional formulations, money demand is a function of a scale variable, like nominal GDP, and the opportunity cost of holding money, if 1. The elasticity with respect to the opportunity cost is known, and 2. The relationship between money with GDP is stable, and then the observation of money data, which tend to be relatively high frequency, can help to predict nominal output, which is observed at a lower frequency. While both of those conditions are important, it is the second that is most often called into question[4].

Money demand has re-emerged in importance as equivalence between interest rate rules and money supply rules has been established in the recent monetary policy literature. McCallum[5] has been among the more prominent to emphasize recently the interlink age between money supply growth rates and the interest rate rules that was sometimes disregarded in the Taylor[6] rule literature. Alvarez, Lucas and Weber[7] show how the money supply growth rate can underlie a variety of monetary policy rules, including the

(1) Milton Friedman, «The Quantity Theory of Money: A Restatement,» in: *Studies in the Quantity Theory of Money*, edited by Milton Friedman (Chicago: University of Chicago Press, 1956).

(2) Cigdem Kogar, «Contegration Test for Money Demand: The Case of Turkey and Israel,» The Central Bank of the Republic of Turkey (1995).

(3) Alessandro Calza; Dieter Gerdesmeier and Joaquim Vieira Ferreira Levy, «Euro Area Money Demand: Measuring the Opportunity Costs Appropriately,» International Monetary Fund (IMF), Working Paper no. wp/01/179 (November 2001).

(4) Seth B. Carpenter and Joe Lange, «Money Demand and Equity Markets,» *Federal Reserve Board- Department of Monetary Affairs*, FEDS Working Paper no. 2003-03 (October 2002).

(5) Bennett T. McCallum, «Issues in the Design of Monetary Policy Rules,» in: John B. Taylor and Michal Woodford, eds., *Handbook of Macroeconomics* (Amsterdam: North Holland, 1999).

(6) John B. Taylor, «Discretion Versus Policy Rules in Practice,» *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (1993), pp. 195-214.

(7) Fernando Alvarez; Robert E. Lucas, Jr., and Warren E. Weber, «Interest Rates and Inflation,» *American Economic Review*, vol. 91, no. 2 (May 2001), pp. 219-225.

Talyor rule, by approximating a stochastic general equilibrium monetary economy. Schabert[8] establishes an equivalence between money supply and interest rate rules in a general equilibrium model in which money supply increases also can cause liquidity effect -type decreases that the nominal interest rate. Typically, equating the growth rate in the money supply to the growth in money demand in these economies is necessary for example to successfully target a zero inflation rate[9].

Traditionally, money-demand functions are estimated as relationships between real money balances, a scale variable (often represented by real income or real wealth), and the opportunity cost of holding real money (calculated as the yield on a risk-free short-term bond, or the difference between that yield and yields on the components of the monetary aggregate). Recent behavior of the monetary aggregates, however, cannot be explained by this simple relationship. A general reason given for the breakdown of the relationship is financial innovations. Although innovation in the financial sector of the economy has had a major impact on the demand function economic uncertainty, play an important role in an economic agent's decision on the level of money holding[10]. Countries with underdeveloped financial markets generally rely on the existence of a stable money demand function for the formulation and conducting efficient monetary policy. The literature on the determinants of inflation in developing countries traditionally postulates a money demand function and then specifies how expansionary monetary policy creates a disequilibrium in the money and goods markets that is eliminated over time through increases in the price level.

In the case of Madagascar, two previous studies[11] support the existence of a stable long-run relationship between monetary aggregates and inflation. However, since 2001, inflation (the consumer price index, CPI) has been highly volatile, while broad money expanded by about 17 percent on average. This raises the question as to whether the link between broad money growth and inflation has changed fundamentally over time[12]. Money demand models represent a natural benchmark against which to assess monetary developments. As a matter of fact, they can provide a framework which helps to distinguish between those changes in money which are explained by developments in macroeconomic variables and those changes which are specific to the situation at hand. Therefore, having a stable long-run money demand is very important, as the existence of a well-specified and stable relationship between money and prices which can be seen as prerequisite for

(8) Andreas Schabert, «On the Relevance of Open Market Operations,» *Hamburg Institute of International Economics*, Discussion Paper 257 (2003).

(9) Max Gillman and Dario Cziráky, «Money Demand in an EU Accession Country: A VECM Study of Croatia,» Central European University (5 April 2004).

(10) Josef Atta Mensah, «Money Demand and Economic Uncertainty,» Bank of Canada, Working Paper (2004), p. 25.

(11) Joel Toujas-Bernaté, «Inflation and Monetary Policy in Madagascar,» *International Monetary Fund*, Staff Country Report no. 96/59 (1996), and Emilio Sacerdoti and Yuan Xiao, «Inflation Dynamics in Madagascar, 1971-2000,» *International Monetary Fund*, Working Paper no. 01/168 (2001).

(12) Koffie Ben Nassar, «Money Demand and Inflation in Madagascar,» *International Monetary Fund*, Working Paper 05-236 (2005).

the use of monetary aggregates in the conduct of monetary policy. The stability of this relationship is usually assessed in a money demand framework, where money demand is linked to other macroeconomic variables like income and interest rates[13]. The term structure of interest rates represents the relationship between the maturities and the yields of bonds. While short-term interest rates are crucially influenced by monetary policy, long-term interest rates mainly reflect market players' expectations of future macroeconomic developments.

However, interest rates of different maturities do not move independently from each other or linked to the absence of arbitrage. Accordingly, it means that the term structure must not allow any trading strategy that permits risk-free investment profits from investment in bonds of differing maturities. Modern term structure models link this key concept from the finance literature to the explanatory approaches from macroeconomics.

This article presents the basic idea of such combined modeling, using the German term structure as an illustration. It identifies how the term structure reacts to inflationary and business cycle movements and calculates the level of the risk premiums contained in bond yields[14]. Interest rates and their dynamics are a crucial part of modern financial theory. Financial and investment decisions in corporate finance are greatly dependent on interest rates. In financial engineering and portfolio management, they are used in pricing securities such as fixed-income securities, derivative securities sensitive to interest rates, and other capital assets. Other important implications are hedging long-term interest risk and developing interest rate derivative securities. Study of interest rate modeling will help better understanding of the term structure or yield curve behavior.

The term structure of interest rates represents the relationship between fixed interest securities that differ only in their time and maturity. It is simply the relationship between yields and terms. When interest rates of bonds are plotted against their terms, this is called the yield curve. In the world of finance, knowledge of the term structure is very helpful in pricing fixed coupon bonds. Knowing the discount factor curve, pricing securities at any date is simple when cash flows are available. Also, implied forward rate curve can be derived. Mathematically, the yield curve can be used to predict interest rates at future dates. It helps to understand the future direction of interest rate movement[15].

2. LITERATURE REVIEW

Thamchamrassri[16] investigated the implementation of B-spline curve fitting to the term structure of interest rates for Thai government bonds. Four fitting models, namely

(13) Christian Dreger; Hans-Eggert Reimers and Barbara Roffia, «Long-Run Money Demand in the New EU Members States with Exchange Rate Effects,» *European Central Bank* (ECB), Working Paper no. 628 (May 2006).

(14) Deutsche Bundes Bank, «Monthly Report,» Determinants of the Term Structure of Interest Rates-Approaches to Combining Arbitrage-Free Models and Monetary Macroeconomics (April 2006).

(15) Kant Thamchamrassri, «Estimating the Term Structure of Interest Rates for Thai Government Bonds: A B-Spline Approach,» Thammasat University (Bangkok-Thailand) (May 2006).

(16) Ibid.

non-restricted discount fitting, restricted discount fitting, spot fitting and forward fitting, are estimated by regression equations. The generalized cross validation and mean integrated squared error are two indices applied to the selection of optimal conditions. The estimation results are then compared with the Thai Bond Market Association (Thai BMA) zero-coupon yield curve. This study found that the generalized cross validation and mean integrated squared error criteria provide similar term structure estimates. Schabert and Stoltenberg[17] examined how money demand induced real balances that affect and contribute to the determination of the price level, as suggested by Patinkin[18]. The authors concluded that a constant money growth policy and equilibrium sequences where most likely to be locally stable and unique for all model variants. Bjornland[19] investigated the demand for broad money in Venezuela, over a period of financial crisis and substantial exchange rate fluctuations from 1985Q1 to 1999Q1. The study used the cointegration method.

The study showed that there is a long-run relationship between real money, real income, inflation, the exchange rate and an interest rate differential, that remains stable over major policy changes and large shocks. The long run properties emphasize that both inflation and exchange rate depreciations have negative effects on real money demand, whereas a higher interest rate differential had positive effects. The long run relationship is finally embedded in a dynamic equilibrium correction model with constant parameters. Mensah[20] examined the impact of economic uncertainty on the money demand in Canada from 1997 to 2003. The study used a general-equilibrium theory; he argues that in a world inhabited by risk-averse agents, who are constantly making portfolio decisions against a backdrop of macroeconomic uncertainty, the money demand is a function of real income and interest rates, and an index of economic uncertainty. The study then used the Johansen procedure of cointegration to estimate the long-run stationary relationships between a Canadian monetary aggregate (M1, M1++, and M2++) and the explanatory variables. Allowing for an index of economic uncertainty to enter the short-run dynamics of the estimated model, the author obtains empirical results that show that, in general, increased economic uncertainty leads, in the short run, to a rise in the desired M1 and M1++ balances that agents would like to hold. The impact of economic uncertainty on M2++ is, however, observed to be negative. Nagayasu[21] evaluated the validity of the term structure of interest rates in a low interest rate environment using high-frequency Japanese data from 1990 to 2003. Allowing for the time-varying term premium, the study

(17) Andreas Schabert and Christian Stoltenberg, «Money Demand and Macroeconomic Stability Revisited,» European Central Bank (2005), Working Paper Series, no. 458.

(18) Don Patinkin: «The Indeterminacy of Absolute Prices in Classical Economic Theory,» *Econometrica*, vol. 17, no. 1 (January 1949), pp. 1-27, and *Money, Interest and Prices: An Integration of Monetary and Value Theory*, 2nd ed. (New York: Harper and Row, 1965).

(19) Hilde C. Bjornland, «A Stable Demand for Money despite Financial Crisis: The Case of Venezuela,» *Department of Economics* (University of Oslo) (2005).

(20) Mensah, «Money Demand and Economic Uncertainty,» Bank of Canada, Working Paper (2004).

(21) Jun Nagayasu, «The Term Structure of Interest Rates and Monetary Policy during a Zero Interest Rate Period,» International Monetary Fund and Institute of Policy and Planning Sciences (University of Tsukuba) (2004).

obtained evidence that when interest rates are low and the short end of the term structure is studied, there is no evidence to support the term-structure relationship. This poor performance is attributed to little information in the interest rate spread that can be used to predict future economic activity and/or to the absence of the persistent term premium. In contrast, some evidence for the term-structure relationship is found when the long end of the term-structure data is considered during a relatively high interest rate period.

Maghyereh[22] examined whether there was a stable function of money demand in Jordan over the period 1976-2000 despite the substantial financial market liberalization in 1988. This study used cointegration and error correction methodology and found that money demand in Jordan was stable during investigation period. Results also showed that inflation rate was the most important variable that explained money demand in the Jordanian economy.

Defreitas[23] investigated the stability of the money demand in the Euro area in the context of an open economy. A sample consisting of quarterly data covering the 1982:2-1999:3 periods is considered. The main finding is that the US long-term rate of interest plays a significant role in the European money demand relationship. This result holds for different combinations of variables forming the vector auto-regressive system. This evidence suggested that currency substitution vis-à-vis the US dollar may be an important factor influencing the European Central Bank (ECB) monetary policy. Gerlach and Svensson[24] examined inflation indicators for the Euro area by studying the relationship between inflation, output, money and interest rates, using data spanning 1980-2001. The study used the cointegration method. The central finding is that both the output gap and the real money gap (the difference between the real money stock and the long-run equilibrium real money stock) contain considerable information regarding future inflation. In contrast, the Euro system's money-growth indicator (the difference between nominal money growth and a reference value), the prominent «first pillar» in its monetary strategy, contains little information about future inflation, and no information beyond that contained in the output and real money gaps. Beguna[25] tried to find out whether there was a stable money demand equation in Latvia for the period 1993-2001. They estimated and interpreted the income and interest rate elasticity's of the money demand. The study used cointegration analysis and error-correction mechanism (ECM). The researchers found that: although Latvian financial situation had not been stable all the time, considering rapid development of the money market and influence of two crises, there was a stable M_1 money demand function, which indicated the appropriateness of accomplished monetary policy.

(22) Aktham Maghyereh, «Financial Liberalization and Stability Demand for Money in Emerging Economies Evidence from Jordan,» *Applied Econometrics and International Development*, vol. 3, no. 2 (2003).

(23) Miguel Lebre DeFreitas, «Currency Substitution and Money Demand in EuroLand,» *Atlantic Economic Journal*, vol. 34, no. 3 (September 2006).

(24) Stefan Gerlach and Lars Svensson, «Money and Inflation in the Euro Area: A Case for Monetary Indicators?,» *Journal of Monetary Economics*, vol. 50, no. 8 (2003).

(25) Beguna [et al.], «Money Demand in Latvia,» *Euro Faculty*, Working Paper in Economics, no. 15 (2002).

Celasun and Goswami[26] examined money demand and inflation dynamics in the Islamic Republic of Iran, using quarterly data for the period 1990/91-2001/02 and test whether the disinflation during 2000/01-2001/02 represents a structural break in the data. A long - run money market equilibrium condition is identified and the short-run behavior of the inflation, measured in terms of non-administered component of the consumer price index (CPI) is modeled conditional on the disequilibria in the money market. Estimation results indicate that the stabilization of the exchange rate on account of strong oil revenues during 2000/01-2001/02 buoyed the demand for domestic money and contributed to the decline in inflation. Tests of model stability do not point to a structural shift in the inflation equation during the period of analysis. Fujiki and Shioji[27] used annual Japanese prefecture data on income, population, demand deposits, and saving deposits from 1992 to 1997 to investigate the issue of whether there exists a stable money demand function under the low interest rate policy. The evidence appears to support the contention that there does exists a stable money demand function with long-run income elasticity greater than one for M2 and less than one for M1. Furthermore, the study found that Japan's money demand is sensitive to interest rate changes. However, there is no evidence of the presence of a liquidity trap.

Jamal[28] investigated the money demand behavior in the U.S for the period 1977-1999. The entire term structure of interest rates was taken into account. The study used the Chi-square test of the log likelihood function. The results showed that the log form of the money demand function could not be rejected at the 10% level of significance. The study found that the interest elasticity of money demand was constant when the level of the entire term structure of interest rates was taken into account. The study also found that the quantity of real money balances varied directly with the slope of the term structure of interest rates.

Cuthbertson and Bredin[29] analyzed the demand for money since the ' break up ' of the Czech-Slovak Republics at the beginning of 1993 to 1997 and for the aggregates M0, M1, and M2 using monthly data. Due to the widespread use of foreign currency in formally centrally planned economies, the study also investigated the issue of currency substitution. The model is estimated using non linear least squares (NLLS) or nonlinear instrumental variables (NLIV). Previous empirical evidence on money demand in Eastern Europe, and specifically Czech Republic, had been mixed. Both graphical and empirical results suggest that any currency substitution was a one-off event due to increased uncertainty at the end of 1992 at the time of the monetary dissolution. Certainly currency substitution in the

(26) Oya Celasun and Mangal Goswami, «An Analysis of Money Demand and Inflation in the Islamic Republic of Iran,» *International Monetary Fund* (IMF), Working Paper 02/205 (December 2002).

(27) Hiroshi Fujiki and Etsuro Shioji, «Bank Health Concerns, Low Interest Rates and Money Demand: Evidence from the Public Opinion Survey on Household Financial Assets and Liabilities,» *Monetary and Economic Studies* (MES), vol. 24, no. 2 (2006).

(28) A. M. M. Jamal, «The Term Structure of Interest Rates and the Demand for Money,» *Applied Economics Letters*, vol. 9, no. 9 (2002), pp. 571-573.

(29) Keith Cuthbertson and Don Bredin, «Money Demand in the Czech Republic since Transition,» *Journal of Policy Reform*, vol. 4, no. 4 (2001).

Czech Republic is not as strong as has been found in other former centrally planned economies. However, the results do indicate that Czech National Bank may have to take account of foreign interest rates when interpreting movements in the monetary aggregates.

Bossogo[30] analyzed broad money demand (M2) in Guyana from January 1990 to September 1999; a period marked by deep transformations aimed at shifting Guyana from a centralized to a market economy. The paper developed a stable error-correction model based on a long run cointegrating vector of money demand. The paper found that established real money demand is determined in the long run by real income, interest rates, and the exchange rate. The results also show the existence of strong exchange rate-induced inflation anticipations that are typical to Guyana.

Alnsoor[31] investigated the impact of the structural changes in the money market in Jordan upon the demand function for money by using test of stability developed by Chow (1960) over the period 1969:1 through 1990:4. The study used ordinary least squares (OLS) analysis to estimate the coefficients of demand equation. The study found that interest rates are important arguments in the money demand function, income variable defined as Gross National Product (GNP) performed extremely well on theoretical and statistical grounds, and nominal stock adjustment model is more suitable from Jordanian case than log linear model for the M_1 and M_2 definitions of money. The shortfall of this study is that it considers money demand function appeared to be more closely related to short-term interest rather than long-term interest rate but the study didn't take into consideration the impact of level and slope of interest rate that plays a significant role in determining the impact of interest rate on money demand.

Alma'ani[32] shed the light on the improvement of the financial and banking system in Jordan, and explained the importance of the role played by the financial authorities represented by the Central Bank of Jordan (CBJ) in encouraging development in the country. The study covered the period (1973-1987) and the procedure was done in two phases: the first was (1973-1987) and the second was (1979-1987).

The methodology of the study was based on standard economic models in which the measurement was carried out using the (OLS) method. The study found that money demand in Jordan was in reversed proportion with inflation and interest rate on saving deposits. Another finding of the study was that money demand in Jordan was positively proportional with the income.

3. DATA, METHODOLOGY AND STATISTICAL ANALISIS

A. The Data

The study was implemented by using secondary data. The bulk of data needed is

(30) Philippe Egoumé-Bossogo, «Money Demand in Guyana,» International Monetary Fund (IMF), Working Paper no. 00/119 (June 2000).

(31) A. Alnsoor, «The Demand for Money and the Effectiveness of Monetary Policy: the Jordanian Case,» (Unpublished Master Thesis, Yarmouk University, Irbid, Jordan, 1992).

(32) W. Alma'ani, «Money demand Function and Monetary Policy in Jordan,» National Planning Center (Egypt) (in Arabic) (1989).

found in the publications of the (CBJ) (the monthly statistical bulletins, the annual reports, and some special issues). Real income is measured by (IPI) and the price level is measured by (CPI). In addition, the shortest interest rates were 3 month treasury bills and the longest interest rates were 7 years development bonds and money stock is measured by M_2.

B. The Model

This study analyzes the effect of the term structure of interest rate on the money demand function, using monthly data during 1978 - 2004.The study also analyzes other variables that used to estimate the level and slope of interest rate (M_2, price level and income).

The money demand model estimated has a non - linear form which was originally developed by Friedman[33]. The form has been proven to be the best fit method for the model, because the log enhances the accuracy of the data in the equation.

$$\log(M_t/P_t) = \beta_0 + \beta_1 \log(M_{t-1}/P_{t-1}) + \beta_2 \log Y_t + \beta_3 \log R_{mt} + \beta_4 S_t$$

Where:

M_t: is the money stock measured by M_2.

P_t: is the price level measured by CPI.

Y_t: is the real income measured by IPI.

R_{mt}: is the level of the term structure of nominal interest rate

S_t: is the slope of the term structure of interest rate.

In order to estimate the effect of the selected variables on money demand in Jordan, this study employs the Correlogram to test the convergence or divergence for the variables, then the Augmented Dickey Fuller (ADF) test is used to test if the variables are stationary or not.

C. Box-Cox transformation

The log form of the equation restricts the elasticity of M_t with respect to R_{mt} to be constant. Therefore, a more general form is needed to test the hypothesis regarding the interest elasticity of money demand[34].

Transforming the variables according to Box-Cox, the money demand equation would be:

$$(M_t / P_t)^{(\lambda)} = \alpha_0 + \beta_1 + (M_{t-1} / P_{t-1})^{(\lambda)} + \beta_2 Y_t^{(\lambda)} + \beta_3 R_{mt}^{(\lambda)} + \beta_4 S_t$$

Where:

$$(M_t / P_t)^{(\lambda)} = ((M_t / P_t)^{(\lambda)} - 1) / \lambda \qquad \text{IF } \lambda \neq 0$$

$$(M_t / P_t)^{(\lambda)} = \log(M_t / P_t) \qquad \text{IF } \lambda = 1$$

(33) Milton Friedman, «Time Respective in the Demand for Money,» *Scandinavian Journal of Economics*, vol. 79 (1977), pp. 397-416.

(34) Ibid.

$y_t^{(\lambda)}$: is the real income after transforming the variables according to Box- Cox.

$R_{mt}^{(\lambda)}$: is the level of the real interest rate after transforming the variables according to Box-Cox.

S_t : is the slope of the term structure of interest rate.

β_4 : represents the effect of the slope.

λ : is the transformation parameter.

The study used the Box - Cox transformation to test the hypothesis of the study which determines the relationship between money demand function, level and slope of the term structure of interest rate.

D. Summary Statistics

Table (1) presents the monthly summary of statistics which supports in identifying the characteristics of the variables in order to properly use the figures in the Correlogram, ADF test and Box - Cox transformation phases.

Table (1)
Summary Statistics

Statistics	M_2	TSIR	Price level	Income
Mean	4015.9	3.37	67.81	87.80
Median	3335.2	3.54	73.90	89.59
Maximum	10571.4	6.76	107	144.30
Minimum	473	-0.61	25.51	32.28
Std.Dev.	2666.5	1.61	25.99	22.72
Skewness	0.59	-0.47	-0.08	-0.21
Observation	324	324	324	324

From the first column the average mean for M_2 variable is (4015.9) with a sample Std.Dev (2666.5), and the median is (3335.2). The M_2 variable is positively skewed which means the elongated tail at the right; more data in the right tail than would be expected in a normal distribution.

From the second column the average mean for TSIR variable is (3.37) with a sample Std.Dev (1.61) and the median is (3.54). The TSIR variable is negatively skewed which means the elongated tail at the left; more data in the left tail than would be expected normal distribution.

From the third column the average mean for the price level variable is (67.81) with a sample Std.Dev (25.99) and the median is (73.90). The price level variable is negatively skewed which means the elongated tail at the left; more data in the left tail than would be expected in a normal distribution.

From the fourth column the average mean for the income variable is (87.80) with a sample Std.Dev (22.72) and the median is (89.59). The income variable is negatively skewed which means the elongated tail at the left; more data in the left tail than would be expected in a normal distribution.

E. Correlogram

This view displays the autocorrelation (AC) and partial autocorrelation functions (PACF) selected up to 36 lags considering it the most appropriate method for the assumptions.

Table (2): presents the AC and (PACF) and Q-statistic test for all monthly variables.

From the table above, the ACF shows a monotonic decay of the autocorrelation, while the PACF exhibits the single spike at lag 1, then the data will estimate using an Auto Regressive AR(1) model[35].

For M_2 variable the values of AC for 1- 12, 18, 24, 36 lags indicates strong convergence, although all the values of ACF is positive then the convergence will be direct. In the PACF there is a sizable spike of 0.988 at lag one and all other partial autocorrelation are very small. The Q-statistic of these residuals indicates that they are not significantly different from zero. This is a strong evidence that the AR (1) model fits the data well.

For TSIR variable the values of AC for 1-12, 18, 24 lags indicates strong convergence but at 36 lag the value is negative then the autocorrelation will follow a dampened oscillatory path around zero. In the PACF there is a sizable spike of 0.974 at lag one and all other partial autocorrelation are very small. The Q-statistic of these residuals indicates that they are not significantly different from zero. This is a strong evidence that the AR (1) model fits the data well.

For price level variable the values of AC for 1- 12, 18, 24, 36 lags indicates strong convergence, in addition to, all the values of ACF is positive then the convergence is direct. In the PACF there is a sizable spike of 0.992 at lag one and all other partial autocorrelation are very small. The Q-stat of these residuals indicates that they are not significantly different from zero. This is a strong evidence that the AR (1) model fits the data well.

Table (2)
AC, PACF and Q-Stat.

Lags	M_2			TSIR			Price level			Income		
	AC	PACF	Q-Stat	AC	PACF	Q-Stat	AC	PACF	Q-Stat	AC	PACF	Q-Stat
1	0.988	0.988	319	0.974	0.974	310	0.992	0.992	321.83	0.926	0.926	280.61
2	0.975	-0.001	631.14	0.943	-0.099	601.61	0.984	-0.005	639.50	0.900	0.293	546.11
3	0.964	0.006	936.67	0.909	-0.073	873.36	0.976	-0.001	953.05	0.873	0.095	796.88
4	0.952	-0.007	1235.6	0.876	0.018	1126.7	0.968	-0.009	1262.4	0.838	-0.038	1028.8
5	0.940	0.001	1528.1	0.843	-0.027	1361.9	0.960	-0.016	1567.6	0.816	0.047	1249.1

to be Continued

(35) Walter Enders, *Applied Econometric Time Series* (New York: John Wiley and Sons, 1995).

Continued

6	0.929	0.015	1814.6	0.806	-0.094	1577.7	0.952	-0.009	1868.5	0.799	0.083	1461.2
7	0.918	0.011	2095.3	0.772	0.042	1776.1	0.943	-0.008	2165	0.772	-0.038	1659.7
8	0.907	0.013	2370.5	0.737	-0.028	1957.5	0.935	-0.010	2457.2	0.762	0.088	1853.8
9	0.897	-0.002	2640.4	0.700	-0.061	2122	0.926	-0.029	2744.9	0.753	0.073	2043.9
10	0.887	0.001	2905	0.669	0.081	2272.3	0.918	0.039	3028.4	0.736	-0.015	2225.9
11	0.876	-0.020	3164.2	0.638	0.007	2409.8	0.910	0.018	3308.1	0.743	0.161	2412.4
12	0.865	-0.028	3417.6	0.610	-0.008	2535.9	0.902	-0.009	3583.8	0.747	0.103	2601.4
18	0.800	0.005	4823.9	0.468	-0.098	3115	0.852	0.002	5150.8	0.627	0.058	3509.4
24	0.741	0.008	6051.7	0.271	-0.004	3385.9	0.803	-0.009	6571.6	0.608	0.001	4281
36	0.626	0.002	8040.2	-0.046	0.034	3449.8	0.703	0.003	8998.1	0.441	-0.088	5420.1

For income variable the values of AC for 1- 12, 18, 24, 36 lags indicates strong convergence, in addition to, all the values of ACF is positive then the convergence is direct. In the PACF there is a sizable spike of 0.926 at lag one and all other partial autocorrelation (except for lag 2) are very small. The Q-stat of these residuals indicates that they are not significantly different from zero. This is a strong evidence that the AR (1) model fits the data well.

F. Augmented Dickey Fuller (ADF) Test

Based on the results of the Correlogram method and AR (1) model used above; the M_2 variable, TSIR, price level and income will be best examined by using ADF test to identify their stationary.

For M_2 variable, the result shows that the estimated static is (5.268023); therefore, using ADF test, it can be concluded that the null hypothesis of no unit root cannot be rejected at 5 percent level of significance. That is, the M_2 variable is stationary.

For TSIR variable, the result shows that the estimated static is (-2.173863); therefore, using ADF test, it can be concluded that the null hypothesis of no unit root cannot be accepted at 5 percent level of significance. That is, the TSIR variable is non-stationary.

For price level variable the result shows that the estimated static is (-7.869176) therefore, using ADF test it can be concluded that the null hypothesis of no unit root is cannot be rejected at 5 percent level of significance. That is, the price level variable is stationary.

For income variable the result shows that the estimated static is (-1.674074); therefore, using ADF test, it can be concluded that the null hypothesis of no unit root cannot be accepted at 5 percent level of significance. That is, the income variable is non-stationary.

4. Empirical Results

A. Box - Cox transformation

According to the model of this study, S_t represents the slope of the term structure of interest rate. Since S_t is not always positive, its logarithmic value cannot be used in the model; also, the log form of the model restricts the elasticity of M_t with respect to R_{mt} which represents the level of the term structure of interest rate to be constant. Therefore, a more general form is needed to test the hypothesis of the study by transforming the variables according to Box - Cox.

Friedman[36] suggested a process for including the whole term structure of interest rate in the money demand function; Friedman's hypothesis that the interest elasticity of money demand varies inversely with the level of the term structure of interest rate, which means when the term structure of interest rate increases by the same amount for long and short maturities then the weight for each interest rate goes for the short-term interest rate. Friedman also assumes that an increase in the slope of the term structure of interest rate, which keeps the mean interest rate at the initial cash balances unaffected, will decrease cash balances, and the converse is true, this is most probably because that short-term rates have more weights than long-term rates, the increase in long rates would have to be larger than the decrease in short rates to keep the mean constant. Friedman further explains the slope effect by suggesting that the weight of the long rates at the margin is much larger than the average weight; as an increase in cash balances have the longest term securities.

β_4 represents the effect of the slope of the term structure of interest rate with the arithmetic mean of the interest rates, where R_{mt} held constant. Given that short-term rates have more weight than long-term rates, then an increase in the slope of the term structure of interest rate result in the arithmetic mean of the interest rates being larger than the weighted mean. Accordingly, the negative impact of the slope on the money demand decreases when R_{mt} is constant, but it is not estimated to become positive since the average level of the interest rate is held constant, and this suggests β_4 should be negative.

The empirical results of the Box - Cox transformation are reported in Table (3) below:

Table 3
Determinants of Real Money Balances

Variable	Coefficient	P-value
C	23.45472	(0.023)
Lag	0.8735454	(0.006)
Income	0.0712365	(0.569)
Level (R_{mt})	61.5466	(0.356)
Slope (S)	0.329587	(0.091)

The above figure shows that the null hypothesis of no unit root cannot be rejected at 10 percent level of significance. Also, the sign of the parameter is positive, which is in

(36) Milton Friedman: «The Quantity Theory of Money: A Restatement,» in: *Studies in the Quantity Theory of Money*, edited by Milton Friedman (Chicago: University of Chicago Press, 1956), and «Time Respective in the Demand for Money».

the opposition of Freidman's hypothesis that the interest elasticity of money demand moves inversely with the level of interest rate, then the probability of the relationship between interest elasticity of money demand and the level of interest rate is positive 64 percent but the probability of negative relationship is 36 percent.

As shown in Table (3), the coefficient of the slope (S) is (0.329587) with a positive sign which means that an increase in the slope of the entire term structure of interest rate by 1 percent would make money demand to increase by (0.329587) percentage point, which means that the money demand have a positive relationship to the slope of the term structure if interest rate keeping the mean interest rate unchanged. This result is in opposition with the hypothesis number two of this study, also contrary with Freidman's hypothesis, which stated that an increase in the interest rate for each holding period does not necessary imply a decline in cash balances, if the increase in long rates is less than that in short rates.

5. CONCLUSION

This study attempts to examine the relationship between the interest elasticity of the money demand function and the level of the term structure of interest rate. It also examines the relation between the money demand function and slope of the term structure of interest rate in Jordan, using time series data on an monthly basis during 1982 - 2006.

The variables ($M_{2,}$ TSIR, real income and price level) were examined, using correlogram to displays (AC) and (PACF) and (Q- Stat). The results show that all variables have strong convergence, and if all ACs are positive, the convergence is direct, in the PACF there is a sizable spike at lag one and all other PACF are very small. The Q-Stat indicates that they are not significantly different from zero. This is a strong evidence that the AR (1) model fits the data well.

Using ADF test, the variables ($M_{2,}$ TSIR, real income and price level) were examined to test their stationary. The results show that M_2 and the price level variables were stationary at the time that TSIR and real income variable were not. Also, S_t is not always positive and its logarithmic value cannot be used in the model and the log form of the model restricts the elasticity of M_t with respect to R_{mt} to be constant. Therefore, the study transforms the variables according to Box - Cox transformation.

The Box - Cox transformation shows that the probability of positive relationship between interest elasticity of money demand and the level of interest rate is 64 percent, but the probability of negative relationship is 36 percent, thus the study strongly rejects Freidman hypothesis. While the quantity of money demand moves directly with the slope of the term structure of interest rates, particularly an increase in the slope of the entire term structure of interest rate by 1 percent would make money demand to increase by (0.329587) percentage point.