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The Demand for Money in Jordan : Evidence from Cointegration Analysis

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الخلاصة

تهدف هذه الدراسة إلى تحليل دالة الطلب على النقود في الاردن باستخدام طريقة التحليل الاحصائي الجديدة التي قدمها كل من إنجل وجرانجر ، وطورها جوهانسن .

بشكل عام ، وجدنا أن كل المتغيرات المقترحة تعاني من مشكلة عدم الاستقرار (المتوسط والتباين يتغيران عبر الزمن) ، وهذا بدوره يلقي بعض الشك على الدراسات السابقة للطلب على النقود في الاردن ، والتي افترضت عدم وجود مثل هذه المشكلة ، كذلك وجدت هذه الدراسة ، أن هناك علاقة في المدى الطويل ما بين النقود ، والدخل ، وسعر الفائدة .

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Abstract

The goal of this paper is to investigate the money demand function in Jordan by employing the cointegration analysis proposed by Engle and Granger , and extended by Johansen. By using Johansen procedure the relative importance of each variable explaining the money demand function is identified .

Generally , it was found that all suggested variables are nonstationary . This consequently sheds some doubts on previous studies based on conventional methods of estimation . Also , the study found that there exists a long run relationship among money , income , and interest rate .

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Introduction

With the great development in econometrics and testing procedures , the findings of previous studies based on conventional methods of estimation should be treated with caution and skepticism , since most economic time series data , as it is known , are nonstationary . The application of traditional techniques to the macroeconomics data is likely to produce faulty results . Furthermore , differencing the data until stationarity is achieved may lead to the loss of long run information (Muscatteli and Hurn, 1991) .

Stationarity in economic time series is not only an econometric issue , but rather a serious problem that has important consequences for the significant interpretation of the model. As a result , evaluating the properties of the data before estimation helps in avoiding the so called spurious estimation . Cointegration analysis in time series econometrics was introduced in the late 1980's . It is believed that cointegration analysis yields more accurate results than those obtained by conventional methods (Pagan and Wickens , 1989). Johansen procedure identifies the long run relationships , the error correction mechanism (EC) of the money demand function allows for the short run dynamics by which the proposed variables adjust toward a long run equilibrium . This is important because for an aggregate to be useful as a monetary target , there should exist some sort of equilibrium between the aggregate and macroeconomics variables such as income and interest rate . Even though this prerequisite is adequately imposed on the long run behavior, but the usefulness of the long run relationship will not be as strong if short run movements in the aggregate have weak correlation with policy controlled variables .

The goal of this paper is to employ the recent econometric techniques , namely Johansen procedure , along with innovation accounting analysis to estimate the demand for money in Jordan [1] . Our study represents a modest attempt to help better understand the behavior of money demand function in Jordan . Two different models were tested . In the first model money in nominal terms was used . Since our analysis found no money illusion , in the second model , real money was used .

The Demand For Money :

Ageneral specification of the money demand function is as follows :

Md=f(P,Y,r) ....(1)

Where Md is the nominal demand for money .

P is the price level .

Y is nominal income .

r is interest rate .

Assuming that there is no money illusion then (1) can be written as :

md = f (y, r) ....(2)

Where md = Md / P

y = Y / P

That is the demand for real money balances is a function of an opportunity cost (interest rate) and a scale variable (real income) .

1 Data from 1964 to 1989 will be used .

Testing For Stationarity

In general , stationarity in economic time series is reached after taking the first defference . In some cases , however , higher orders of differencing are necessary . A relatively easy and preliminary practice to decide if the series is stationary , is to plot the series against time . Nevertheless , the augmented Dickey - Fuller (ADF) test along with visual inspection was applied . To check for the order of integration, the following regression equation was estimated for each variable :

$$DY_t = \beta t + \delta Y_{t-1} + \sum_{i=1}^{k} \delta_i Y_{t-i} + U_t$$

Where Y_t denotes each given series .

t is time trend defined by (t - (T+1) / 2) .

D is the difference operator .

The next step involves testing the hypothesis that $\beta = 0$ to check for the presence of a time trend , and $\delta > o$ for stationarity . Results of the univariate unit root test of each time series are reported in table (1) . On the bases of the critical values provided by Dickey ad Yoo (1987) , all variables reject the null hypothesis , that there exists a unit root . These results imply that the data on all series are nonstationary . The univariate (ADF) test is performed on each variable in its first difference , it appears that all variables are integrated of order one I (1) , i.e. , all series have invertable non - deterministic auto regressive moving average (ARMA) representation after first defference . Results are reported in table (2).

Table (1) Unit Root Test For Variables In Level ADF - Test.

Variable	Statistic	5% Critical Value
M1	-0.91228	-2.9907
GNP	-0.468842	-2.9907
P	-1.7417	-2.9907
r	0.28964	-2.9907

Table (2) Unit Root Test For Variables In First Difference ADF - Test.

Variable	Statistic	5% Critical Value
M1	-5.0540	-3.7921[2]
GNP	-3.1110	-3.1004
P	-3.8456	-3.1485
r	-3.2940	-2.9969

Cointegration

The outcome of the multivariate unit root test (Johansen test) is reported in table (3).

[2] With a trend .

Table (3) Johansen Test Based on Maximal Eigenvalue .

Null Hypothesis	Statistic	5% Critical Value
none	54.42	47.21
at most one	27.18	29.68
at most two	09.89	15.41
at most three	02.08	03.76

Evidently the null hypothesis of no cointegration is rejected at the conventional level . The test results indicate that there is one cointegrating vector (stationary relation) based on the maximum likelihood ratio and the trace statistic respectively , which propounds that the proposed variable have one common long run trend , i.e. , over time the variables in the model drift together . The interpretation of the cointegrating vectors is not straight forward[4] . The δ 's are interpreted as the speed of adjustment , and their signs are not important because we are dealing with difference equations (see Enders , 1994) . As for the β 's they are interpreted as the long run elasticity .

The cointegrating vector can be written as :

$$M1=-1.43\ GNP + 0.853\ P - 0.485\ r + 6.313 \qquad (3)$$

$$(0.4246) \quad (0.72804) \quad (0.87196)$$

The Johansen procedure enables us to impose some restrictions on the cointegrating vectors , as long as these restrictions are homogeneous[5]. By assumption the demand for

[4] most of the studies did not make use of the multi - cointegrating vectors other than stating the fact that a long run relationship exists .

[5] See Enders , 1994 .

money is positively related to all proposed variables , except the interest rate . The signs of all variables are as expected but on GNP . However , the coefficient on interest rate is small . To test for its inclusion , we restricted it to be zero. The null hypothesis was rejected . Also we tested the hypothesis that prices and money have the same coefficients but with opposite signs , i.e. , the coefficient on prices equals one. In this case we failed to reject the null hypothesis , implying that there is no money illusion .

Since our estimate shows that money demand does not display money illusion , we use real money as a variable without biased results . The outcome of the Johansen test is reported in table (4) .

Table (4) Johansen Test Based on Maximal Eigenvalue .

Null Hypothesis	Statistic	5% Critical Value
none		
at most one	30.35718	29.68
at most two	6.650538	15.41
at most three	0.304014	03.76

Clearly, the null hypothesis of no cointegration is rejected by both maximum likelihood ratio and trace statistic at the conventional level. The cointegrating vector is as follows :

$$M1 = 6.95\ RGNP^{6} + 25.43\ r + 43.44 \qquad (4)$$

(3.22166) (15.4671)

6 Real GNP

We restricted the coefficient on interest rate to be zero . The null hypothesis was rejected .

Error Correction Mechanism .

Before determining the dynamic specifiction of our model , the lag length should be set . A simple procedure is followed . Since the error terms should be uncorrelated , k[7] should be long enough to guarantee that . But , in this case , the cointegration vectors are to be used to further investigate the VAR model , i.e. , interpret the short run dynamics and the speed of adjustment , hence , we can not allow for a large k that would exhaust the degrees of freedom , otherwise , the economic interpretation would be fruitless . Bearing in mind that forcing a small k will hinder our estimat , we compare estimates of our model for small and large k. Long run model estimates should not be dependent on k, while the short run estimates should . Then if the estimated cointegrating vectors are similar for these lag lengths , we select the shorter one . In this study it was found that two is the appropriate lag length[8] .

Cointegration by itself is not a sufficient condition for the usefulness of a particular policy target . In this section we consider the dynamics by which the cointegrated variables adjust in the short run toward a long run equilibrium . According to Grangers Representation , the existence of a cointegration relation implies the existence of error correction term , otherwise any deviation from the long run

[7] k is the lag length .

[8] The error term clearly approximates white noise .

equiblibrium will be exclusive in nature , i.e. , there does not exist a mechanism by which the variables can go back to the steady state .

In this study one cointegrating relation was found , that is to say that there exists one error correction term . The model that is to be tested is in the following form :

$$DY_t = \sum_{i=1}^{n} A_i DX_{t-1-i} + \alpha U_{t-1} + \xi_t$$

Where X_t is (nxn) vector of I (1) variables .

$U_t = (B_0 + B_1 X_{it} + \dots + B_n X_{nt})$ is the equilibrium error terms .

ξ_t is an (nx1) vector of white noise errors[9] .

α is a vector of speed of adjustment coefficients .

A_i is a matrix of parameters .

In order to determine how much of the error variance is due to the forecasting error of the demand for money itself and how much is attributable to other variables , we now proceed to discuss the variance decomposition.Table (6) shows the results of different forecasting horizons .The test yields different results based on the ordering [10] . In this study , however , the variables were arranged in two different orders . The first ordering of the variables is M1 → GNP→ P → r. In the second test the sequence was reversed . Overall , the results indicate that after 16 periods money demand explains about 80% of its own forecasting error . The results also show that the demand for money is

[9] Note that the error terms may be correlated .

[10] We used choleski Decomposition .

tied in a long relation to other variables that collectively explain a pproximately 20% of the demand for money forecasting error . The interesting finding is that when the ordering was reversed (see table 7) , all variables better explained the short run variation in money demand .

Table (6) Decompostion of Variance for M1.

k	M1	GNP	P	r
1	100	0.0	0.0	0.0
4	94.0	1.5	1.0	3.0
8	86.3	1.4	5.0	7.3
12	85.0	1.3	5.3	7.8
16	85.7	1.2	5.2	7.8

Table (7) Decompostion of Variance for M1 Reversed Order .

k	r	P	GNP	M1
1	8.9	2.6	9.0	79.5
4	17.0	6.4	17.5	59.3
8	25.5	12.0	15.3	47.2
12	26.7	12.7	14.8	45.7
16	26.9	12.8	14.7	45.6

A beter way to understand the short run dynamics of the model is to examine the Impulse Response Function (IRF) . We invert the VAR model to obtain its moving average representation . This process is important to examine the interaction among variables and the error terms , i.e. , using the error representation to generate shocks and then test the shocks' impact on the entire time path of the variables .

A One standard deviation (positive) shock in the growth rate of the demand for money does not show a fluctuating pattern to itself over 16 years horizon . Beyond the 16th year , the shock's impact starts to die out . This response indicates that the serial correlation is phasing out after 10 years .

A one standard deviation shock in the rate of growth in GNP has a predominantly positive influence on the demand for money , the positive strong response holds at the third , fourth , fifth , and sixth year , but at the seventh year it starts to decline and continues to oscillate . After the twelfth year it begins to die out .

A one standard deviation to r has a positive impact beginning the first year and continues until the second year where it turns negative and generates a weak negative response .

The initial response of money demand to one standard deviation shock to prices is negative , in the third year the response is positive, i.e. , people adjust their expectations . Altogether the response is mostly positive . To conclude this section , the demand for money response to shocks to other variables in the system is consistent with our expectations . the only exception is its response to a shock in the interest rate.

Summary and Conclustion .

This paper has cast some doubt concerning the validity of previous studies that applied the conventional methods of estimation to non stationary time series data . In this study we examined the demand for money in Jordan . The ADF unit root test was carried out on each time series . Also , the Johansen multivariate unit root test was performed . We found that there eists a cointegrating vector among the proposed variables that is consistent with the economic literature . It has a clear economic inference (except for the sign on GNP " The demand for money in Jordan in the long run is a function of all intended variables .

When restrictions were imposed , the demand for money was found to change proportionally to changes in the price level . Furthermore , the results reveal that the interest rate has little impact on the short run for money , at the same time they show that in the long run , interest rate plays an important role in the fluctuations in the demand for money .

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Data

For the purpose of this study , yearly data from 1964 to 1989 are used . Data on gross national product (GNP) , the short term interest rate (r)[11] , consumer prices (P) , and the money supply (M1) , were obtained from the International financial statistics (IFS) tapes . All variables are in log form . All series are yearly and seasonally unadjusted [12] .

[11] Discount rate (end of period) .

[12] Pagan et al (1989) , and Muscatelli and Hurn (1991) , recommend the use of unadjusted data , particularly , the ones that are seasonal in nature, such as the demand for money for the following reasons ;

1- the seasonal pattern of the data is useful for forecasting purposes .

2- seasonally adjusting the data will distort the dynamics of the estimation method .

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