COINTEGRATION ANALYSIS OF MONEY DEMAND IN TURKEY

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Abstract

In this study we mainly dealt with money demand in broad sense for the period between 1987(I) when significant reforms related with money policy of Turkey were realised, and 1999(IV) when drastic measures were taken to cope with inflation. Moreover, interrelation between real money demand used in empirical studies for money demand equation, and income, money and treasury bond interest return and inflation were analysed. We applied cointegration test for cointegration analysis and a research was done to find out whether the series were CI(1,1) or not. ADF and PP tests were employed for testing stationary. Using both tests together enabled us to determine whether the series were I (I). Later, a suitable VAR (4) model for cointegration analysis was selected and Granger causality and misspecification ARCH (4) and AR (4) tests were applied. Cointegrating vectors were determined with restricted and unrestricted cointegration analysis, and a long-run money demand equation was tried to be derived.

Key Words: Money Demand, Cointegration, Vector Autoregressive Model, Granger Causality, Weak Exogeneity.

JEL Classification E41, E52

TÜRKİYE'DE PARA TALEBİNİN KOENTEGRASYON ANALİZİ

Özet

Bu çalışmada esas olarak; Türkiye'de para politikasıyla ilgili önemli reformların yapıldığı 1987 ile, enflasyonla mücadelede şiddetli önlemlerin alındığı 1999 yılı arasındaki dönemde, geniş anlamda para talebiyle ilgilendik. Daha da ötesinde, uygulamalı çalışmalarda para talebi eşitliklerinde kullanılan reel para talebi ile hazine bonosu faiz gelirleri ve enflasyon arasındaki ilişkileri analiz ettik. Koentegrasyon analizi için Koentegrasyon Testi (CI) uyguladık ve serilerin birlikte koentegre CI (1,1) olup olmadıklarını araştırdık. Durağanlık testleri için Augmented Dickey-Fuller (ADF) ve Phillips-Perron (PP) testleri kullanıldı. Bu, her iki test birlikte kullanıldığında serilerin entegre seriler I (1) olup olmadığını belirledi. Daha sonra, koentegrasyon analizi için uygun bir VAR (4) modeli seçilerek, Granger Nedensellik, Hatalı Sipesifiksyon ARCH (4) ve AR testleri uygulandı. Sınırlandırılmış ve sınırlandırılmamış koentegrasyon analizi ile koentegrasyon vektörleri belirlendi ve uzun dönem para telebi eşitliği tespit edilmeye çalışıldı.

Anahtar Kelimeler: Para Talebi, Koentegrasyon, Vectör Otoregresif Model, Granger Nedensellik, Zayıf Dışsallık.

INTRODUCTION

Turkey internalised an outward-oriented growing strategy leaving inward-oriented conservative policy by means of some preventive decisions and cautions in January 24.1980. From that date on, Turkey realised significant structural changes with a view of liberalizing the economy. These measures have eased the problem of lack of currency and resulted in a considerable increase in exports. However the inflation couldn't be controlled. Therefore, the Central Bank of The Republic of Turkey (CBRT), which directs money programs having vital function in fighting against inflation, has in fact started to act independently from political authority as of this date. In this respect, the year 1986 can be considered as the 'process year' for monetary policy. Money and credit policies control total reservoirs instead of a direct effect on portfolio structure of public sector and private once were plied up to this period. According to Yıldırım (1998), with this approach, the CBRT aims to control all the reserve money in TL (Turkish Lira) thereby controlling both the effectiveness of monetary policy and interest policy as well.

In this study Turkey money demand in broad sense (M_3)[*] between 1987(I) and 1999(IV) is analysed. This period is particularly chosen because in 1987 the CBRT started to apply open market operations and at the end of 1999(IV) Turkey had obtained serious support from International Monetary Fund, IMF, to fight inflation.[**]

We can divide this period into two parts: First until 1994(II) when the inflation rate was two digits on a yearly basis and second, after when it exceeded 132% in 1994 based on consumer prices index. While the rate of exports was growing, currency was excessively high and "the escape from Turkish Lira" started in the same period. There were also some extraordinary developments in this period: the growth rate of M_3 became exceedingly high, 42% at the beginning of the semester, 140% in 1994, 100% in the following years and 83% in 1999. The composition of various money values significantly changed during the period. M_1 has grown 50% in 1987,100% in 1994 and 84.7% in 1999; whereas M_2 has grown 37.2%, 143%, 82.5 % respectively. It is obvious that the ratings of M_3 and M_2 are parallel. We can conclude that M_1 has grown at a lower rate in the same period. In the years that follow the instability of 1994, we see that M_2 and M_3 increased in the same rate, and time deposits in M_2, domestic foreign exchange deposits in M_2Y and public deposits in M_3A grew more rapidly. ANLAŞILMIYOR: We see that almost the same increasing in all money phenomena shows that these materials, which increased in the transfer period than, narrow used and become normal.

[*] Look Annual Report of the Central Bank of the Republic of Turkey for the money definition of this Bank.

[**] Turkey presented an intention letter to IMF with the signs of a state minister and chairmen of the CBRT in December 9,1999 saying that Turkey need support of IMF. IMF approached positively and guaranteed to provide required credits on the condition that some measurements are to be taken. Turkey had significant financial support through IMF after this date. Moreover, IMF gave, additional support after the earthquake happened in August 17, 1999.

Keyder (1998) proposed another approach. According to Keyder, while the M_1 velocity rate was 6.7 during the period 1965-1979 it was doubled after 1980. The M_2 velocity for the same period was 5.4 and 6.33. This fact shows a decrease in real money demand. This change in real money demand (M_1) can, in one respect be explained with real income, the predicted inflation rate and changes in interest rates. Moreover, it is stated that real GNP, foreign currency yield and inflation prediction can explain the change in M_2 velocity. Yavan (1993) stated another interesting interpretation. In his study related with money demand of Turkey during the period 1980-1993, Yavan states that the inflation prediction of economic units had caught the inflation rates and so they could escape from inflation taxes by decreasing the amount of money they hold in TL in parallel to the inflation rate.

The GNP had decreased by –6.1% in 1994 after long period. In the second quarter of 1994, the government took some urgent stabilisation measures, but this could not help with the growing export deficits.) In 1999, the M_3 has increased by over 80%. The new government, after spring general elections in 1999, looked for agreement base with IMF and started some serious reforms.

SCOPE OF THE STUDY

The relationship of real money demand with income, money and non-money interest returns (treasury bonds and government bills) and inflation will be dealt in this study. To do this, we will specifically try to find out whether the series are integrated I (1) or not. That is whether the first-order differential is primarily stationary or not is significantly important. We will apply Augmented Dickey-Fuller test and Phillips - Perron test to determine whether the series are stationary or not. Later, we will apply cointegration analysis to find out the long-term relation between the series and determine the cointegrating vectors. Misspecification tests for VAR (4) model is to be used just before the cointegration analysis is done. Moreover, Granger causality relation between the variables will be studied. Additional tests as parameter constancy will not be applied because the series are not sufficient.

We have chosen the restricted and unrestricted cointegration analysis which also facilitates testing for weak exogeneity of the regressors. In addition, this approach will also allow for the analysis of long-run linear relationships in the form of equilibrium - correction. We will try to have required results by putting the inter-affecting analysis between variables on the level of delay. We have applied Johansen (1988) and Johansen and Juselius (1990) method in cointegration analysis.

STUDIES ON TURKEY

Keyder (1989, 1996) had studied money demand and the velocity of money in Turkey. Keyder (1996) derived the following equation for money demand between 1966-1986;

LnM_2= -1.365 +1.023 lny +1.01 lnP-0027P^e

t (-1.88) (6.87) (36.29) (-2.50) R^2=0.998

In this equation M_2 stands for nominal money demand, p for price, y for GNP (1968=100). P^e is GNP deflator ratio changes. It is seen in the equation that income elasticity is a little bigger than one. We applied ADF test for the variables in the equation, while Keyder (1998) by creating various alternatives for money (M_1 and M_2) looked for cointegrating relation. This study is, in a sense, a complation study for the previous ones. The second important study in this field belongs to Yavan (1993) in which he uses money demand models for the period 1980(1)-1991(11). In this study both Hendry methodology and Johansen cointegration analysis are used with statistic test of variables. He got the equation for long-term money demand as follows,

$$M=0.829p+0.897y+1.292r - 0.02g$$

In this equation M stands for M2 money size, y for GNP (1987=100), r for nominal interest rate, and g for gold price index. Kodar (1995) applied cointegration test by comparing and contrasting money demand in Turkey and Israel. One of the latest significant studies in this field is by Kıvılcım-Muslu (1999). In this study Turkish money demand is estimated by using data covered 1986(I)-1995(III) period. Cagan's hyperinflation model is applied. The results suggest that inflation and monetary treatment of Turkish economy can be explained by this model efficiently.

ECONOMIC THEORY

Similar equations for empirical studies related with money demand were used. Here, money demand in its broad sense is the function of inflation, income, money and non-money assets return. On the other hand real money demand function can be explained by M/P =f (y, p, R). Here M/P stands for real money quantity, y for real income and p for price level and R for interest rates vector. In the empirical studies such as Ericsson (1998) and Ericsson-Sharma (1998) the equation of money demand is stated as follows;

$$(m^d-p)=\gamma_0+ \gamma_1 i+ \gamma_2 R^{out}+ \gamma_3 R^{own}+ \gamma_4 \Delta p,$$

On the other hand Lütkephol (1998) states equation of money demand as follows;

$$(m-p)_t= \beta_1 y_t+\beta_2 \Delta p_t+\beta_3 (R-r)_t+v$$

In this equations (m-p) stands for real money demand, R^{own} and r for money return, R^{out} and R for yield of non-money alternative saving tools, y for real income, Δp for inflation value and v for shock concept. Doornik-Hendry-Nielsen (1998) used similar money demand equation study related with determination of cointegration models of UK M_1. In addition to that, even if the money demand model (p.216 and 306) prediction method interpreted in Clements-Hendry (1998) is different in reality it is same as the above equation. In these papers M_3 stands for nominal money quantity in its broad sense, y for real income calculated according to 1987 base prices, R^M and R^B for six month in and out deposits interest rates, p for quarterly inflation rate. We can state money demand equation for Turkey as follows,

$$(m-p)_t= \beta_0 + \beta_1 y_t + \beta_2 r_t^b + \beta_3 r_t^m + \beta_4 dp_t$$

In this equation quarterly data for 1987(I)-1999(IV) period are used. $(m-p)_t$ stands for logarithmic real money demand, y_t for logarithmic real income, r_t^b for bond income, r_t^m for nominal money income, dp_t for value of quarterly inflation rate. Because we did not want to have difference in the data set, all data excluding bond interest rate were taken from CBRT. Since the sale of threasury bonds are not continuous, it is sold in one of three month. That is why, the bond interest rate were taken for the month that the sale occurred. The seasonal adjustment were not done in the variables used in VAR Models. Seasonal dummy variables (d_1, d_2, d_3) were added to the model. The dummy variables used in the model were "1" for 1991 and and "0" for the others. In addition to that d_4 was used as another dummy variable for stability precaution period. The following figure 1 shows the values of all the variables.

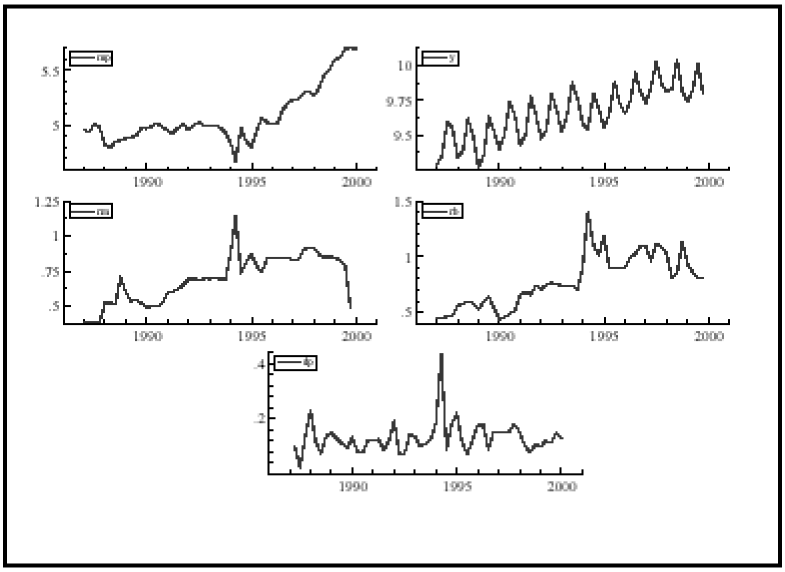

Figure 1: Drawing of Values of Variables

COINTEGRATION UNIT ROOT GRANGER CAUSALITY AND MISSPECIFICATION TESTS

Engle-Granger (1987) methodology proposes a test to show whether these two variables - y_t and x_t - are cointegrated of order one, C (1,1). Here, the two variables which are both I (1) will be tested to see whether they are cointegrated of order CI (1,1). The variables are pretested for their own orders. Cointegration variables must be cointegrated in the same step. In this process, we apply unit root tests as stated before. If the variables are cointegrated in different steps, cointegration cannot be applied. If y_t and x_t become I (1), long-run estimate is applied.

Stationary Test

If the first differential of the non-stationary series become stationary series; that is to say, if they become I (1) series, cointegration analysis can be done between the series. We applied Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests for stationary. When both results are handled together, we can easily see that all the series are I (1). Table 1 shows the results of ADF and PP tests in accordance with McKinnon critical values for k=4 delay values of the series whose level and first differential values were taken. While all series are I (1) according to ADF except for r_t^m series, the other series are on 1% significance level according to PP test when y_t series and dp_t are stationary.

In this table the sign (**) stands for the fact that the first difference of the series 1% can never include unit root on the significant level, the sign (*) is that it doesn't include unit root at the 5% significance level.

Table 1. ADF and PP Unit Root Test of Series.

Veriables	ADF test* (k=4) Level	First Difference	PP test(k=4) Level	First Difference
$(m\text{-}p)_t$	-0.03	-3.09*	-0.45	-8.04**
y_t	-0.99	-2.96*	-3.59**	-9.62**
r^b_t	-1.45	-3.44*	-1.97	-7.49**
r^m_t	-1.73	-2.85	-2.22	-7.94**
dp_t	-2.49	-5.33**	-7.13**	-16.84**

Granger Causality and Misspecification Tests

VAR model is estimated for k=4 delay. Granger Causality test (1969) was done to test the causality relation between the variables establishing VAR (4) model. Table 2 includes only the serial values having causality relation. As seen in the table, income and deposit interest return and inflation have strong causal relation on the real money demand with 1% sufficiency level. This value for bond interest rates is at the sufficiency level of 5%. Moreover, it can be seen that the income has strong relation with the inflation, money and non-money interest return has causality relation with income. This value is 5% sufficiency level for bond interest rates.

Table 2 Granger Causality Test

Null Hypothesis	Obs.	F-Statistic	Probability
y does not Granger Cause $(m\text{-}p)_t$	48	7.81915	1.0E-04
r^b_t does not Granger Cause $(m\text{-}p)_t$	48	3.20416	0.02284
r^m does not Granger Cause $(m\text{-}p)_t$	48	4.55117	0.00411
dp_t does not Granger Cause $(m\text{-}p)_t$	48	9.70082	1.5E-05
r^b_t does not Granger Cause y_t	48	2.77170	0.04044
r^m does not Granger Cause y_t	48	3.14004	0.02485
y_t does not Granger Cause dp_t	48	3.60162	0.01362

There is not any misspecification other than the variation from normality of the yt and rmt (m-p)t, dpt series at the 5% and 1% significant level in VAR (4) single equation specification tests in which there are seasonal dummies and stability dummy variables.

Table 3 Misspesification Tests

	AR1-4	Normality	ARCH 4
$(m\text{-}p)_t$	2.99343 [0.0450]*	10.039 [0.0066]**	0.0430 [0.9961]
y_t	0.91495 [0.4754]	4.014 [0.1344] *	0.1994 [0.9348]
r^b_t	2.1983 [0.1299]	17.555 [0.0002]**	0.1528 [0.9588]
r^m_t	0.78931 [0.5464]	3.100 [0.2122]	0.0255 [0.9987]
dp_t	1 1.2845 [0.3111]	21.098 [0.0000**]	0.0517 [0.9944]

ERROR CORRECTION MODEL AND COINTEGRATION ANALYSIS

The method developed by Johansen (1990) and Johansen - Juselius (1990) is used in cointegration analysis. Non-stationary money demand variables are I (1), as can be seen in ADF and PP tests. The series are used in multiple equation system and then transferred into I (0). The VAR model in which a linear model k delay has non-stationary X_t variables in n number, and which is transferred into stability with D_t deterministic variable can be interpreted as follows,

$$\Delta X_t = \prod X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \Phi D_t + \varepsilon_t$$

The deterministic variable can include constant, linear expression, seasonal dummies, additional dummies and other non-stochastic regressors. nxn dimensional εt shock variable are iidNp(0,Ω). A submodel of VAR, α and β H(r) nxr, sized matrix and Π = αβ in condition reduced rank, can be stated as,

$$\Delta X_t = \alpha \beta' X_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \Phi D_t + \varepsilon_t$$

This model is also known as reduced form error-correction model. In this last equation the rank of Π matrix is equal to the independent cointegrated vector number. If the rank is (Π)=0, the Π matrix in the last equation will be 0. The equation will be first step differential VAR model. If the rank (Π)=n, the vector process is stationary. The last expression in the equation $\alpha\beta X_{t-1}$ is equal to error-correction factor. In conclusion, if rank (Π) is 1 the number of cointegrated vector is equal to 1. In brief, if 1 <rank< n, there are a lot of cointegrating vectors.

Different number of cointegrating vector can be handled by examining characteristic root proficiency of Π matrix. The rank of matrix is other then zero and equal to number of eigenvalues. Λ eigenvalues can be solved as,

$$\left| \lambda S_{11} - S_{10} S^{-1}{}_{00} S_{01} \right| = 0$$

using maximum likelihood estimator method for simultaneous equation system. By this way the r largest eigenvalues of Π matrix can be stated as follows. 1>λ1>λ2>....λr>...λn <0, Johansen(1995), Hendry(1995). If the xt variables are not cointegarted, the rank of Π matrix will be equal to zero and all the eigenvalues will be zero.

Because ln(1) is zero, ln (1- λ_i) value will be directly equal to zero. If the rank of the matrix is changing between 1 and 0< λ_i<1 all the characteristic roots will be zero when ln (1-λ_i) is negative. To test the number of eigenvelues roots, the following method is used

$$\lambda_{trace}(r) = -T \sum_{i=r+t}^{n} \ln(1 - \lambda_i)$$
$$\lambda_{trace}(r, r+1) = -T \ln(1 - \lambda_{r+i})$$

In this equation λ_i stands for estimated eigenvelues, T is for usable observation number. When the value of r is known examination is done between these two equation values, Hendry (1995), Enders (1995). The vector of money demand can be expressed as (1,(m-p)$_t$, y_t, $r^b{}_t$, $r^m{}_t$, dp_t). Being different in drifts in ECM model show that the series have different average.

COINTEGRATION ANALYSIS

The rank determination method is tested against H (0), H (n). When H (0) is rejected, H (1) is tested against H (n) hypothesis. In the end it is accepted that there is r rank in H(r) hypothesis. Later, the Doornik et all (1998) hypotheses including deterministic trend and quadratic form cointegrating vector for model selection are developed as follows,

Hypothesis	x	$\beta' x$
$H_{ql}(r)$: $\pi=\alpha\beta$. $\Phi q_t=\phi c+\phi_l t$	quadratic	linear
$H_l(r)$: $\pi=\alpha\beta$. $\Phi q_t=\phi_c+\phi\rho_l t$	linear	linear
$H_{lc}(r)$: $\pi=\alpha\beta$. $\Phi q_t=\phi_c$	linear	constant
$H_c(r)$: $\pi=\alpha\beta$. $\Phi q_t=\alpha\rho_c$	constant	constant
$H_z(r)$: $\pi=\alpha\beta$. $\Phi q_t=0$	zero	zero

After the determination of the rank of the model according to Johansen method, the subsidising models are tested against each other. The most suitable model using PcGive9.30 software is tested according to following test, and the selection is done. According to this method,

H_{lc} (0)⊂........ ⊂H_{lc}(r) ⊂.......⊂H_{lc}(n)

U U II

H_c(0) ⊂…......⊂H_c(r) ⊂ ...... ⊂H_c(n)

H_c(0), H_{lc}(0), H_c(1), H_{lc}(1)............H_c(n-1), H_{lc}(n-1).

We apply hypothesis test in the form of unrestricted alternatives. Results of unrestricted cointegration analysis are given in Table 4 and Table 5. Here the number of cointegraing rank according λ_{max} and λ_{trace} eigenvelues statistics for k=4 delay is taken for the both tests. The rank number according to λ_{max} and λ_{trace} statistics, and 95% critical values is taken as 2 in the following Table 5.

Table 4 Unrestricted Cointegration Analysis

Eigenvelues	0.649	0.609	0.300	0.249	0.062
Hypotheses	r=0	r≤1	r≤2	r≤3	r≤4
λ_{max}	49.28**	44.2**	16.8	13.47	3.035
%95 critical value	34.4	28.1	22	15.7	9.2
λ_{trace}	126.8**	77.51**	33.3	16.51	3.035
%95 critical value	76.1	53.1	34.9	20	9.2

The choice of unrestricted model is done according to Johansen model and whether it is chosen right or not can be shown as follows. The chosen model is in the form of H_c(r). This model can be tested against previous model H_{lc}(r).

Hypothesis r=0 r≤1 r≤2 r≤3 r≤4
H_c(r) H_c(r) 126.8** 77.51** 33.3 16.51 3.035
H_{lc}(r) 108** 56.85** 31.43* 12.29 1.74

In this comparison λ_{trace} 126.8**, 108**, 77.51**, 56.84* can be seen; that is $H_{1c}(r)$ is rejected and $H_c(r)$ hypothesis r accepted. In this both models the Scwartz Hannan-Quinn and Akaike Information criteria are taken as -25.459, -28.651, -30.576 The following results are reacted in model selection by using Evievs 3.1 software in addition PcGive 9.30 software in information criteria. Here only Akaike information AIC and Scwartz information SC criteria are given. When looked at information criteria it can be seen

Table 5. AIC and SC Information Criteria for VAR (4)

VAR assumes no deterministic trend	AIC	BC
No intercept or trend in CE	-15.14	-9.63
Intercept in CE	-15.47	-9.88
VAR assumes no deterministic trend		
Intercept in CE	-15.41	-9.70
Intercept and trend in CE	-15.46	-9.67
VAR assumes quadratic in CE		
Intercept and trend in CE	-15.50	-9.60

that this suits the conditions proposed by Doornik et all (1998). The best model taken above and the best model according to information criteria in AIC and SC are -15.47, and -9.88. This result is compatible with the model produced above. When VAR models are sequenced, it can be seen that the values of $H_c(r)$ and $H_{lc}(r)$ in λ_{trace} of Doornik et all (1998) are used in selection of the best models. On the other hand, here, the best model is taken according to different models in Table-5, and different handled information criteria. The alternative VAR models and the accepted variables in these models are shown in the following table,

Unrestricted and Restricted Cointegration Analysis

In unrestricted cointegration analysis two vectors can be seen. The normalised values according to the determined number can suit the theory. In money demand theory money is handled for transaction and portfolio. Interest earns and inflation rate are the alternative cost of handling money. It is seen that money income elasticity is bigger than one in received cointegrating vector. According to quantitiy theory it is accepted that the income coefficient must be one and, according to Baumol -Tobin thesis it must be 0.5. Money and non-money interest earn, in empirical studies like Ericsson (1998) and its coefficient numbers can be close to each other, both in opposite signs.

While money demand in the first vector for restricted cointegartion analysis is one, the

Table 6. Unrestricted Cointegration Analysis (rank=2)

β	$(m-p)_t$	y_t	r^m_t	r^b_t	dp_t	Constant
	1.0000	-1.7691	1.2636	-0.13684	1.1457	10.997
	-0.34296	1.0000	-0.052782	-0.67603	1.9743	-7.2479

α			Standard errors of α		
m-p	0.31231	0.075884	m-p	0.14803	0.17028
y	-0.23306	-0.24595	y	0.10301	0.11849
rm	-0.80664	-0.18548	rm	0.19212	0.22100
rb	-0.79040	0.55479	rb	0.28939	0.33289
dp	-0.28099	-0.21322	dp	0.15670	0.18027

money demand is accepted in the second vector as 0, and income as -1. Here, it can be seen whether there is weak exogeneity between variable or not while $X^2(1) = 2.493$ [0.1143] in these restrictions. The restrictions can not be rejected, and this fact shows that there is weak exogeneity. The restrictions related with feedback's are all rejected. The second cointegrating vector shows the relation between income, interest returns and inflation. It is seen that the income has direct relation with inflation and money deposit. On the other hand, it has reverse relation with bond interest.

Table. 7 Restricted Cointagration Analysis (rank= 2)

β'

1.0000	-1.6337	1.4081	-0.39404	1.9595	9.7985
0.00000	-1.0000	-1.4019	2.0972	-5.9480	8.9006

	α			Standard errors of α	
m-p	0.27429	0.00000	m-p	0.12775	0.00000
y	-0.10791	0.10629	y	0.10216	0.040593
rm	-0.79726	-0.070965	rm	0.19178	0.075448
rb	-1.1248	-0.45485	rb	0.26322	0.074099
dp	-0.27396	0.00000	dp	0.13646	0.00000

Equilibrium-Correction mechanism (EqCM) is as follows. The following equation shows the long-term money demand equation, here the first cointgarting vector taken from unrestricted (ur) and restricted (r) models.

$C(1,1)_{ur}: (m\text{-}p)_t = 1.769\, y_t - 1.2636\, r^m{}_t + 0.13684\, r^b{}_t - 1.1457\, dp_t - 10.997$

$C(1,1)_r: (m\text{-}p)_t = 1.6337\, y_t - 1.4081\, r^m{}_t + 0.3940\, r^b{}_t - 1.9595\, dp_t - 9.798$

In money demand equations, income elasticity of money demand is bigger than one. However it is obvious that money demand has a reverse relation with time deposit return, but direct relation with bond return variable. One of the elasticity is bigger than one, but the other is much less than one. When this result is compared with the money demand equations by Keyder (1996) and Yavan (1993) and when it is considered that some of the variables used are different, some changes can be observed. While the income elasticity of money demand in Turkey according to Keyder is one, according to Yavan is a result; it is less than one. The fact that the constant in equation is negative shows another peculiarity of vectors. In research related with Spain Vega (1988) and in another related with Greece Ericcson-Sharma (1998) claim that deposit return variable of money demand is positive, but it is negative in non-money deposit return variable. Variables of returns of deposits and non-deposits are all reversing signed. Weliwita-Ekanayake (1998) claim that interest rates of money and non-money assets isolated from functions of money demand especially in developing countries. The reason for this is that interest rates are going on constantly because regulatory authorities determine the interest rates arbitrarily.

IMPULSE RESPONSE FUNCTION

It is criticised that residuals of impulse response analysis will be in correlation, and for this reason the shocks will be isolated. Lütkephol (1998). However it is obvious that money demand has a reverse relation with time impulse response of the series is stated. It can be also being stated as vector moving average (VMA) as it is called vector autoregression equation system. Showing of VAM provides to see shocks of Sims methodology in VAR system. The equation can be stated as Φij(i) elements and Φi matrix Enders (1995).

$$x_t = \mu + \sum_{i=0}^{\infty} \Phi_i u_{t-i}$$

Showing moving average is a good tool to show interrelation in models. The elements of Φi matrix in the equation present the effects of stocks on the series in the period. The total effect of unit impulse power in shock variables can be handled by the calculation of coefficient of impulse response function. When n approach ∞ long run multiplier comes in to being. Since the series are stationary for all the i and j the case,

$$\sum_{i=0}^{\infty} \Phi^2{}_{jk}(i)$$

When it is stationary all the series are directed to zero, Mills (1998). The accessible Φ11(i) Φ12(i) coefficient set is also called response function. When Φij(i) values are signed to i, it shows the treatments of the series used against various shocks. The impulse response functions of the variables related with money demand in Turkey are given together. The grapes have more quality to see the shocks in the series than in tables. In the following Figure 2, we can see the response of shocks of various series, because n=10.

Moving average impact matrix;

mp :	0.61188	- 0.81159	0.93479	- 0.30859	- 0.46219
y :	0.40492	0.22261	0.075432	0.041954	- 0.069139
rm :	- 0.23904	0.75447	- 0.13060	0.060060	- 0.68549
rb :	2.0629	2.0343	- 3.0319	1.5299	5.0059
dp :	0.60120	0.46302	- 0.91751	0.45061	1.6505

CONCLUSION

In this study, we tried to produce equation for long-term money demand of Turkey. Although there are not many researches on this subject, it is obvious that the previous research, even less in number, contributed in interpretation and improvement of the model. Here, in empirical studies, equation of money demand, income, money and non-money returns and their relation with inflation are dealt in detail. The fact that money demand has reverse relation with money income but direct relation with non-money income distinguishes our study from the others. The arbitrary interference to interest rates by money authorities in developing countries may give way to this result. That income elasticity of money is bigger than one means that money demand increased more than GNP with transaction instinct. There is not much difference in respect of money demand equation between unrestricted and restricted models. Almost all the restrictions done on α and β in restricted model are significantly rejected.

To determine weak exogeneity between the variables only the restrictions in the second cointegrating vector is rejected. Treatment of the series against the shocks can be seen in response functions.

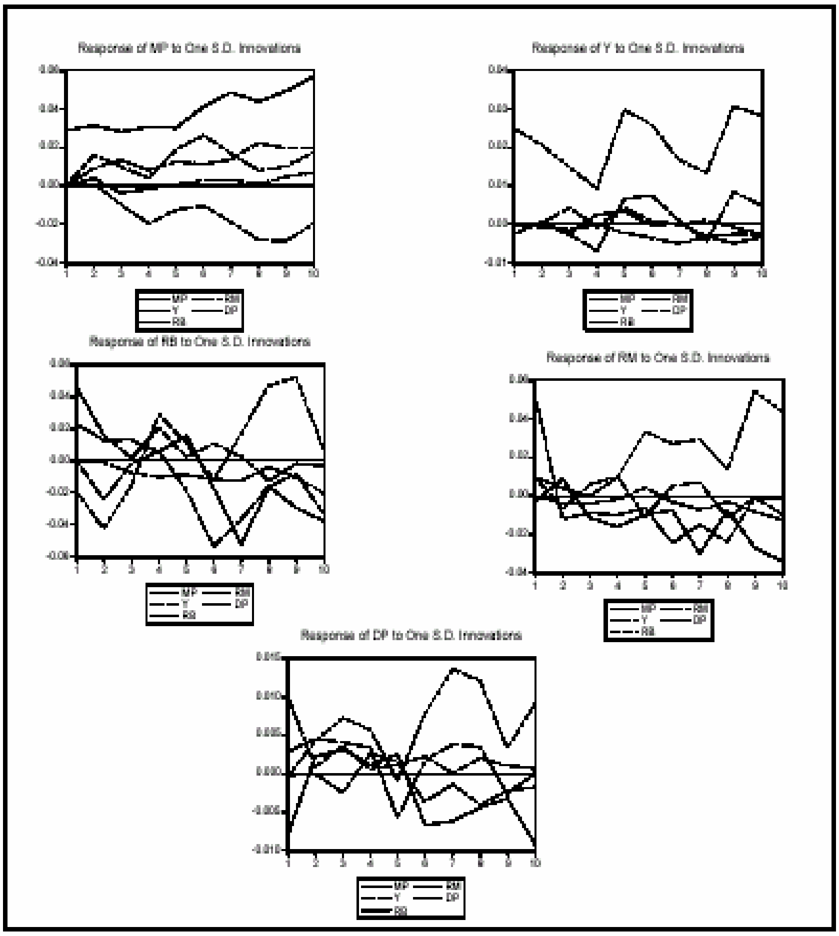

Figure 2: The Response of Shocks of Various Series

Data

All the data except bond interest rates are taken from the Central Bank of Republic of Turkey. The variables used are as follows:

(m-p) = logarithmic quarterly money volume in TL.

y = logarithmic GNP (1987=100).

r^b= six month bond interest rate exported by the treasury.

r^m= six month time deposit interest rate.

dp = difference of quarterly consumer price index

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