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mhamdi, ghrissi

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STABILITY OF MONEY DEMAND FUNCTION IN TUNISIA

Ghrissi Mhamdi[12]

1. *Department of Economics, University of Sousse-TUNISIA, URTD Research Unit, Faculty of Economics and Management, University of Sousse, Tunisia*

2. **Corresponding author:** Ghrissi Mhamdi *Faculty of Economics sciences and Management, University of Sousse, Tunisia*

Abstract
The aim of this paper is to give an answer to the question that remains wide open; Is Central Bank of Tunisia, capable to transmit all the information on the evolution of prices to economic agents through targeting monetary aggregates. To answer this question, a way that focuses on the stability of the money demand function through the test of Cumulative Sum of residues (SUMCU) and Chow's Forecast test is followed. The results of this study indicate that there is no significant and important relationship between money and prices either in short term or long term. In addition, by estimating the money demand function and its long-term stability, the results show that this relationship is not stable in the case of the Tunisian economy.
Keywords: Monetary targeting, money demand function, Chow tests

Introduction

The instability of money demand can be explained by the instability of the flow velocity. More frequently, the instability of the application is shown on the factors included in the demand function. Anderson (1985) identified three sources of instability in the demand for money, (i) the change in velocity in response to changes in interest rates as well as movements in other variables the demand function of the currency other than real income, (ii) The demand function of the currency itself may change. For example, financial innovations and releasing the interest rate may change the demand for money, and (iii) short-term monetary stocks actually provided may not correspond to the desired equilibrium. In other words, if the speed of adjustment is small compared to unexpected shocks, this can lead to unexpected changes in the velocity of circulation of money.

1. The relationship between money and prices in the Tunisian economy

1.1. Variables and data

As Central Bank of Tunisia (CBT) targets the rate of increase in the money supply within the meaning of M3, then M3 is the variable used to measure changes in the money supply in the Tunisian economy. Concerning the measurement of inflation, changes in the price index (CPI) is the variable most suitable for our study. The adoption of the CPI instead of other measures of inflation is explained by two considerations. The first is the data. Indeed, the monthly data on the CPI are available for longer periods. The second consideration is the wide use of the CPI in the economic literature worldwide. While the CPI may involve some bais, it represents the most widely used measure as an indicator of inflation in empirical studies and analyzes of monetary policy. Regarding the sources of monthly data M2, M3 and CPI, they are issued by the IFC, and the CD-R 2008 IMF.

The analysis covers the period 1986-2007. The choice of 1986 as a starting point for the analysis refers to the fact that the period after the year 1986 is completely distinguished from other prior periods. In fact, Tunisia has adopted in 1986 a structural adjustment program (SAP) to restructure the national economy and integration into the global economy. Since then, a lot of freedom was given to the market as a coordinator of economic activities. The ratification of the GATT in 1990, the accession to the WTO in 1995 and the signing of the free trade agreement with the EU in 1995 reflect the new direction of the Tunisian economy.

1.2 The stationary series

1.2.1 Stationarity of the CPI series (Index of Consumer Prices)

Insert Figure 1: Curve of log (CPI)

On the stationarity of the series log (CPI), it can be studied by simple visual inspection of the graph of the series log (CPI) as well as its correlogram. No figure shows an overall upward trend of the series log (CPI). In addition, the correlogram showed in figure (Appendix 1, Table 1) shows that the autocorrelations are all significant and decrease very slowly. These observations suggest that the series log (CPI) is not stationary.

We propose to verify these intuitions by the application of unit root tests. We adopt the strategy of Dickey-Fuller and the results are shown in Table (Appendix 1, Table 2). The estimated ADF statistics (Augmented Dickey-Fuller) value is (-1.81). This value is greater than the critical value for the three statistical thresholds of 1%, 5% and 10%. So we accept the null hypothesis of a unit root: the series log (CPI) is not stationary. In addition, Figure No. 15 showing the appearance of Dlog series (IPC) suggests that the series is stationary in first difference (the trend seems to have been eliminated).

Insert Figure 2: Curve of log (CPI) in first differences

The estimated ADF statistics in the case of the series in first difference value is equal to (-11.48). This value is lower than the critical value read from the table (Appendix 1, Table 3) regardless of the statistical threshold. Accordingly, we reject the null hypothesis of a unit root: the Dlog series (CPI) is stationary.

1.2.2 Stationarity of the M3 series

On the stationarity of the series log (M3), it can be studied by simple visual inspection of the graph of log series (M3) as well as its correlogram (Appendix 1, Table 4). No figure shows an overall upward trend of the log series (M3). This observation suggests that the log series (M3) is not stationary.

Insert Figure 3: Curve of log (M3)

In addition, we adopt the strategy of Dickey-Fuller and the results are shown in Table (Appendix 1, Table 5). The estimated ADF statistics (Augmented Dickey-Fuller) value is equal to (1.11). This value is greater than the critical value for the three statistical thresholds of 1%, 5% and 10%. So we accept the null hypothesis of a unit root: the log series (M3) is not stationary.
In addition, Figure No. 17 showing the appearance of Dlog series (M3) suggests that the series is stationary in first difference (the tendency seems to have been eliminated).

Insert Figure 4: Curve of log (M3) in first differences

In addition, the estimated ADF statistics in the case of the series in first difference value is equal to (-18.18). This value is lower than the critical value read from the table (Appendix 1, Table 6) regardless of the statistical threshold. Accordingly, we reject the null hypothesis of a unit root: the Dlog series (M3) is stationary.

1.3 The long-run relationship between money and prices in the Tunisian economy

This is to answer the following question is there a long-term relationship between money and prices in the Tunisian economy? The answer to this question depends on the cointegration relationship between these two variables. According to the Granger representation, if two variables X and Y are individually integrated of order one, but the regression residuals are stationary then there is a long-term relationship between these two variables.

In light of these assumptions, the two variables in question, namely log (M3) and log (CPI) are stationary in first differences. Therefore, the time series of log (CPI) and log (M3) are integrated of order one (log (M3) ~ I (1) and Log (CPI) ~ I (1). To determine if there is a cointegration relationship between money and prices we regress log (CPI) on Log (M3) and test the stationarity of the residuals. In other words, we apply the tests of the unit root on the residuals of the regression;

$$\log(CPI) = \beta_0 + \beta_1 \log(M3) + \varepsilon_t \qquad (1)$$

Results suggest that the residuals are not stationary. Figure No. 18 shows the following behavior of residues of this equation as a non-stationary process.

Insert Figure 5: Curve of the residuals from equation (1)

In addition, the Breusch-Godfrey test is used to verify the relationship of correlation (LM test) indicates that the residuals are auto correlated, as shown in table 7 (Appendix 1). The existence of the autocorrelation of a series means that the residuals of the equation are not stationary.

In light of these results, we can conclude that the variables Log (CPI) and Log (M3) are not co integrated. Therefore, there is no long term relationship between money supply within the meaning of M3 and prices in the Tunisian economy.

1.4 The short-run relationship between money and prices in the Tunisian economy

The non-existence of a long-run equilibrium relationship between money and prices in the Tunisian economy is not in contradiction with the fact that a short-term relationship may exist between the two variables. We can express the relationship between short-term uses stationary variables Δ log (M3) and Δ log (CPI).

The result of the regression of Δ log(CPI) on Δ log (M3), as shown in Table 14 below, indicates the existence of a positive relationship with a statistical correlation value Durbin-Watson less than 2. The LM test (Appendix1, Table 11) indicates that the residuals are positively correlated order (1).

Insert Table 1: Regression of Régression de $\Delta \log(CPI)$ on $\Delta \log(M3)$

The easiest way to explore the relationship between the two variables in such a case is to estimate the regression of Δ log (CPI) on Δ log (M3) with an AR (1) to eliminate the autocorrelation series and test whether there is a significant relationship between the variables. The results presented in Tables No. 12-13 (Appendix 1), indicate that there is no short-run relationship between money supply within the meaning of M3 and prices in the Tunisian economy.

1.5 The causal relationship between money and prices in an unrestricted VAR model

In this step, we follow a different path to explore the relationship between money and prices in the Tunisian economy. So if a causal relationship is found between the two variables when there is a report. The report of causality between money and prices in the Tunisian economy is checked through an unrestricted VAR of the form model:

$$\log(IPC)_t = \beta_0 + \sum_{i=1}^{k}\gamma_i (\log(IPC))_{t-i} + \sum_{i=1}^{m}\alpha_i (\log(M3))_{t-i} + \varepsilon_{1t}$$

$$(\log(M3)_t = \eta_0 + \sum_{i=1}^{k}\lambda_i (\log(IPC))_{t-i} + \sum_{i=1}^{m}\rho_i (\log(M3))_{t-i} + \varepsilon_{2t}$$

Avec, ε_{1t} et $\varepsilon_{2t} \approx$ iid $(0,\sigma^2)$

The estimation of this model covers the period 1990: 2011. According to the stability test, the model satisfies the stability condition where all the roots are in the inner circle of the unit (Appendix 1, figure 1). In addition, the model satisfies the test of normality of residuals from the Jarque-Bera statistic (Appendix 1, Table 9). In addition, according to the Wald test for Granger causality (Appendix 1, Table 10), there is no causal relationship between money supply within the meaning of M3 and the index of consumer prices in the Tunisian economy

2. Stability of the demand function for money

One of the fundamental assumptions of the regime of targeting monetary aggregates is stable relationship that should exist between the money offered and the price level. Under this assumption, the central bank can achieve the goal of price stability by varying the amount of money offered to affect actual price levels. The second assumption of the regime of targeting monetary aggregates is the demand function of the currency to be stable. Without a stable demand function, the central bank may not be able to predict the demand for the currency. Therefore the central bank will not be able to determine how much to offer to meet the additional demand. As a result, the central bank will not be able to accomplish the goal of price stability.

The instability of the money demand function can be illustrated by the instability of the velocity of circulation of money. Anderson, S. Palle (1985) identified three sources of instability in the demand for money, The first is the change in velocity in response to changes in interest rates as well as movements in other determinants of function money demand further that the real income. The second source is the demand function itself may change. For example, financial innovation and liberalization of interest rates can change preferences in the money demand function. With regard to the third source, stocks reserved for short-term periods may not correspond to the desired cash balances. Indeed, if the speed of adjustment is small, then barriers can lead to unexpected changes in the velocity of circulation of money.

In this section, our goal is to consider the stability of money demand function in terms of its determinants. In addition to GDP, the nominal interest rate (R) affects the actual demand for the currency because of its effect on the opportunity cost of holding money.

In practice, measuring the stability of the money demand function, according to Hetzel (1984) and Mehra (1993), is tested by checking the stability of the following regression:

$$\log(\frac{M}{P})_t = \beta_1 + \beta_2 \log(Y)_t + \beta_3 \log(R)_t + \varepsilon_t \qquad (2)$$

Wagner, Jun R. (1981) indicated that once the interest rate appears in the money demand function, a stable demand for the currency no longer implies a stable money multiplier. The main drawback of this equation is that it does not take into account the effect of anticipated changes in the price level on the actual demand for the currency. We can then include the expected inflation in the demand function of money. Thus, the expected inflation and nominal interest rates affect the opportunity cost of holding money. For this, the values of past inflation rates are used as a measure of expected inflation.
Thus, we can check the stability of the form of demand function of money in the Tunisian economy;

$$\left(\frac{M}{P}\right)_t = \beta_1 + \beta_2(Y)_t + \beta_3(R)_t + (\pi^a)_t + \varepsilon_t \quad (3)$$

(π^a) Is the expected inflation rate (= π_{t-1})

With regard to the stationarity of the variables in this equation, series of tables (Tables No. 14-26) all variables are stationary in first differences with the exception of expected inflation is stationary in level.
In light of the foregoing analysis, we can measure the stability of the money demand function for the Tunisian economy in two stages. The first step is dedicated to the function of estimating the long-term application. The second step is dedicated to the study of the stability of this long-term relationship.

As the first step, the money demand function long term in the Tunisian economy can be estimated through the following form where all variables are integrated of order one;

$$log\left(\frac{M}{P}\right)_t = \beta_1 + \beta_2 log(PIB)_t + \beta_3 log(TMM)_t + (\Delta logIPC)_{t-1} + \varepsilon_t \ (4)$$

Table No. 27 summarizes the results of equation (4.4). We note, in this table, the R2 value shows that the explanatory variables used in the equation explained 64% the rate of change of the demand for money in the Tunisian economy.

In addition, since the variables in the equation (4) are individually integrated of order one, then the existence of a long-term relationship depends on whether the residuals are stationary or not. However, according to the ADF test (Table 28) of the residuals from equation (4) it shows that the residuals are stationary. Figure 2 (Appendix 1) represents the stationary behavior of residuals from equation (4.4). According to the normality test of Jarque-Bera (figure 3) the distribution of residuals is normal type. In addition, the Johansen cointegration test, as shown in Table 29, clearly indicated the existence of a cointegration relationship. In light of these results, we can conclude this equation highlights the demand for money long term in the case of the Tunisian economy.

The second step is to check if the existing long-term relationship is stable or not. Several stability tests can be used. Specifically, we will study the stability of the long-term relationship represented by equation (4) using two Chow tests and the test of recursive residuals.

According to the first test called Chow breakpoint test, the entire sample is divided into two or more samples. Equation (4) is estimated separately for each sub-sample, we test whether there are significant differences among the residuals of the estimated equations. Thus, a significant difference indicates a structural change in the relationship between the variables in question. To verify this assumption, are used in the Chow test (breakpoint test): namely, the Fisher statistic and log likelihood ratio statistic. The test is performed under the H0 hypothesis of no structural change in the sub-samples.

On the second Chow test (Chow's Forecast test), two models are estimated using first the entire set of data and the second uses a sub-period. In this context, a significant difference between the residuals of the two models is an indicator of structural change. The test is performed under the hypothesis H0 that there is no structural change between the two models.

Regarding the test residue Recursive, the equation is estimated repeatedly. If the model is validated, the recursive residuals are independent and normally distributed with mean zero and constant variance. In our case, we used the test of Cumulative Sum of residues (SUMCU) recursive. Where the model parameters will be unstable if the cumulative sum of recursive residuals is outside the confidence interval with 5% as the critical value.
Thus, using the criteria mentioned above, we checked the stability of the equation (4). The point 2005 is used to detect if there is a structural change. Chow tests, as shown in Tables No. 30-31, indicate the existence of a structural change. Therefore, the null hypothesis is rejected by the two values of the Fisher statistic and statistical likelihood. In addition, after testing Recursive residue, as reflected in the figure below, the parameters of the equation (4) are not stable over time.

Insert Figure 6: Recursive Residue Testing

3. Conclusion

In this paper, we tried to answer the following question: is that the Central Bank of Tunisia is able to achieve price stability under targeting monetary aggregates perform currently applied? The answer to this question depends on whether the function of money demand is stable or not in Tunisia. Indeed, with a stable money demand, the BCT can correctly predict the demand for money and hence the possibility of controlling the money supply to end accomplishes the goal of price stability. By cons, if the money demand function is not stable, the BCT should seriously take steps towards the adoption of inflation targeting regime.
We used without this analysis, monthly data covering the period 1990-2011 to estimate the money demand function long term in Tunisia. By testing its stability to detect the existence of structural changes, both Chow tests have indicated that long-term money demand function in Tunisia is not stable.
Thus, we concluded that the Central Bank of Tunisia can not accomplish the goal of price stability as monetary targeting regime currently applied. Thus, the BCT should take steps towards the adoption of inflation targeting regime.

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Figures and tables

Figure 1: Curve of log (CPI)

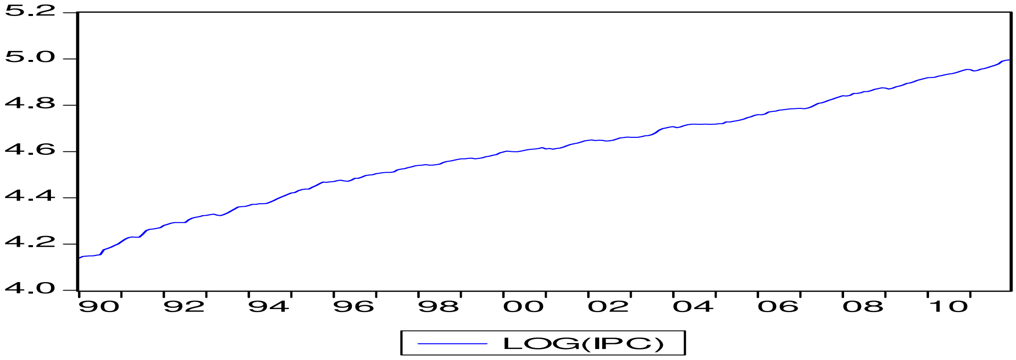


Figure 2: Curve of log (CPI) in first differences

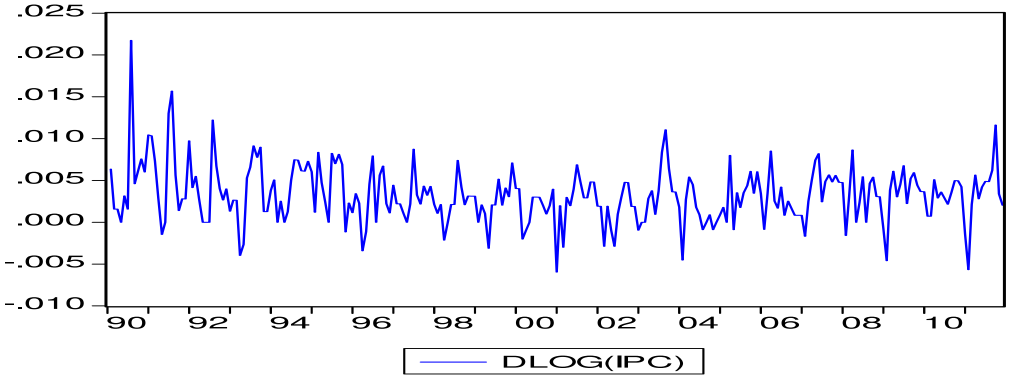


Figure 3: Curve of log (M3)

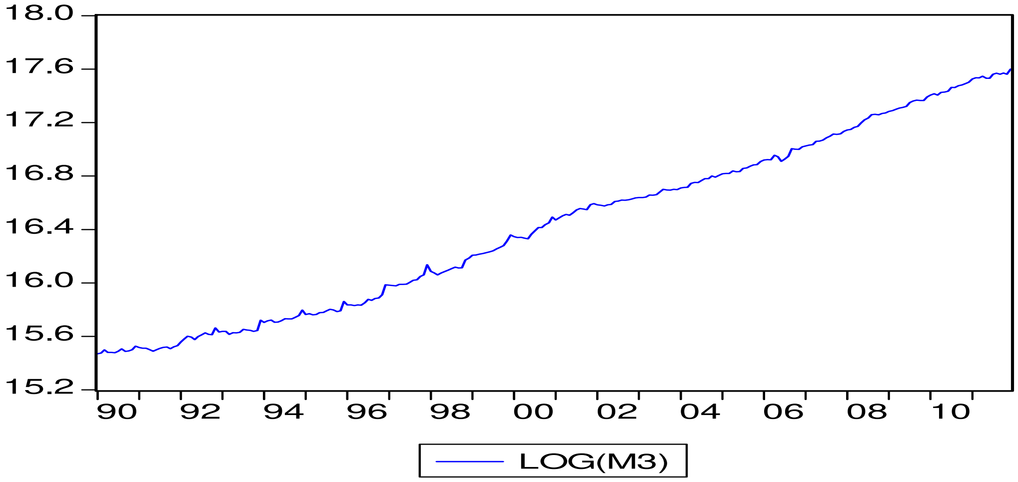


Figure 4: Curve of log (M3) in first differences

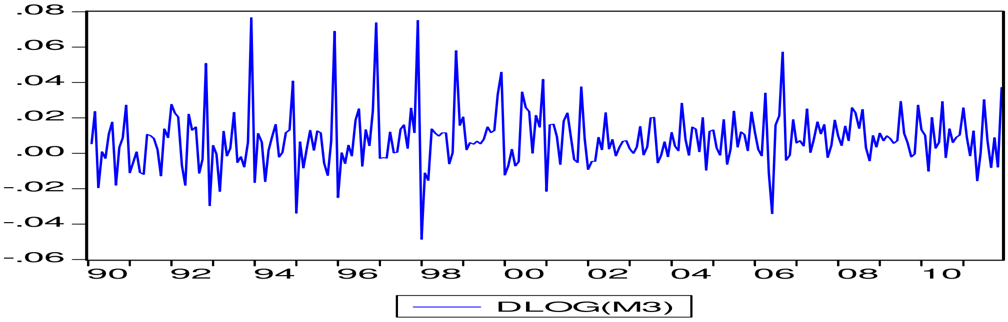


Figure 5: Curve of the residuals from equation (4.1)

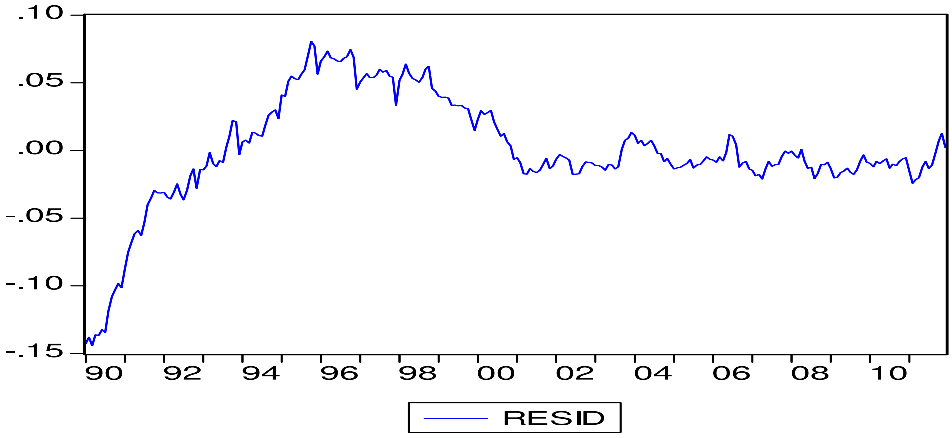


Figure 6: Recursive Residue Testing

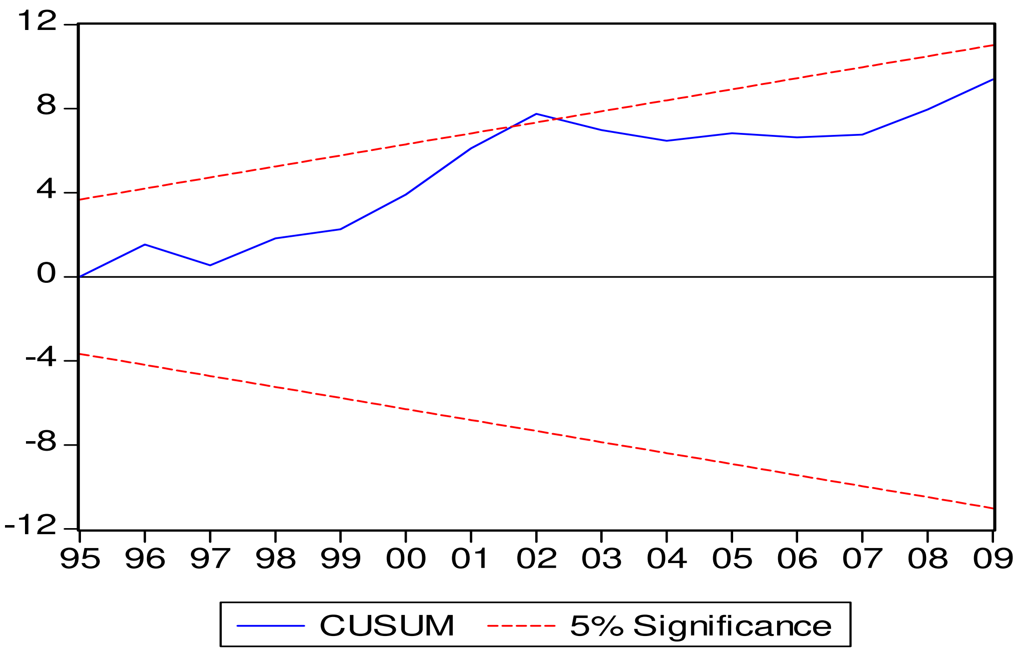


Table 1: Regression of $\Delta\log(CPI)$ on $\Delta\log(M3)$

Dependent Variable: DLOG(IPC)
Method: Least Squares
Date: 04/08/12 Time: 12:30
Sample (adjusted): 1990M02 2011M12
Included observations: 263 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003123	0.000234	13.34357	0.0000
DLOG(M3)	0.016178	0.012816	1.262293	0.2080

R-squared	0.006068	Mean dependent var	0.003254
Adjusted R-squared	0.002260	S.D. dependent var	0.003407
S.E. of regression	0.003403	Akaike info criterion	-8.520876
Sum squared resid	0.003022	Schwarz criterion	-8.493711
Log likelihood	1122.495	F-statistic	1.593382
Durbin-Watson stat	1.324741	Prob(F-statistic)	0.207970

Appendix 1 :

Table 1

Date: 04/04/12 Time: 21:19
Sample: 1990M01 2011M12
Included observations: 264

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*******|	.|*******|	1	0.974	0.974	253.18	0.000
.|*******|	.|. |	2	0.948	-0.001	494.13	0.000
.|*******|	.|. |	3	0.923	0.002	723.50	0.000
.|*******|	.|. |	4	0.899	0.002	941.90	0.000
.|*******|	.|. |	5	0.876	-0.004	1149.7	0.000
.|*******|	.|. |	6	0.852	-0.009	1347.3	0.000
.|****** |	.|. |	7	0.828	-0.015	1534.8	0.000
.|****** |	.|. |	8	0.806	0.011	1713.0	0.000
.|****** |	.|. |	9	0.784	-0.003	1882.2	0.000
.|****** |	.|. |	10	0.762	-0.002	2042.8	0.000
.|****** |	.|. |	11	0.741	-0.001	2195.4	0.000
.|****** |	.|. |	12	0.720	-0.010	2340.0	0.000
.|***** |	.|. |	13	0.700	-0.004	2477.1	0.000
.|***** |	.|. |	14	0.680	0.003	2607.0	0.000
.|***** |	.|. |	15	0.661	0.003	2730.2	0.000

Table 2

Null Hypothesis: LOG(IPC) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.8180781858105	0.371241334613481
Test critical values:	1% level	-3.4551925453873	
	5% level	-2.87236994363302	
	10% level	-2.57261474383512	

*MacKinnon (1996) one-sided p-values.

Table 3

Null Hypothesis: D(LOG(IPC)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.4882693627	3.0135920171607e-20
Test critical values:	1% level	-3.4551925453873	
	5% level	-2.87236994363302	
	10% level	-2.57261474383512	

*MacKinnon (1996) one-sided p-values.

Table 4

Date: 04/04/12 Time: 21:55
Sample: 1990M01 2011M12
Included observations: 264

Autocorrelation	Partial Correlation		AC	PAC
.|********	.|********	1	0.978	0.978
.|*******|	.|. |	2	0.956	0.004
.|*******|	.|. |	3	0.934	-0.010
.|*******|	.|. |	4	0.913	0.001
.|*******|	.|. |	5	0.892	-0.019
.|*******|	.|. |	6	0.870	-0.011
.|*******|	.|. |	7	0.850	0.011
.|****** |	.|. |	8	0.830	-0.004
.|****** |	.|. |	9	0.809	-0.014
.|****** |	.|. |	10	0.790	0.004
.|****** |	.|. |	11	0.770	-0.004
.|****** |	.|. |	12	0.751	-0.005
.|****** |	.|. |	13	0.732	-0.001
.|****** |	.|. |	14	0.714	-0.008
.|***** |	.|. |	15	0.695	-0.006

Table 5

Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.11893598951826	0.997619238188112
Test critical values:	1% level	-3.45509634357268	
	5% level	-2.87232768410668	
	10% level	-2.57259213523765	

Table 6

Null Hypothesis: D(LOG(M3)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=15)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-18.1823983450927	1.50069427481082e-29
Test critical values:	1% level	-3.4551925453873	
	5% level	-2.87236994363302	
	10% level	-2.57261474383512	

*MacKinnon (1996) one-sided p-values.

Table 7

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1794.980	Probability	0.000000
Obs*R-squared	246.1712	Probability	0.000000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/12 Time: 23:02
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003024	0.016633	0.181786	0.8559
LOG(M3)	-0.000184	0.001012	-0.181447	0.8562
RESID(-1)	0.978132	0.062112	15.74799	0.0000
RESID(-2)	-0.012929	0.062123	-0.208121	0.8353

R-squared	0.932467	Mean dependent var	1.14E-15
Adjusted R-squared	0.931688	S.D. dependent var	0.041087
S.E. of regression	0.010739	Akaike info criterion	-6.214858
Sum squared resid	0.029984	Schwarz criterion	-6.160677
Log likelihood	824.3612	F-statistic	1196.654
Durbin-Watson stat	1.320332	Prob(F-statistic)	0.000000

Table 9

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Date: 04/09/12 Time: 15:03
Sample: 1990M01 2011M12
Included observations: 261

Component	Skewness	Chi-sq	df	Prob.
1	0.913452	36.29615	1	0.0000
2	1.135564	56.09347	1	0.0000
Joint		92.38962	2	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	7.602423	230.3574	1	0.0000
2	6.688025	147.9166	1	0.0000
Joint		378.2740	2	0.0000

Component	Jarque-Bera	df	Prob.
1	266.6536	2	0.0000
2	204.0101	2	0.0000
Joint	470.6636	4	0.0000

Table 10

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 04/09/12 Time: 14:22
Sample: 1990M01 2011M12
Included observations: 261

Dependent variable: DLOG(IPC)

Excluded	Chi-sq	df	Prob.
DLOG(M3)	0.710095236852905	2	0.701140055227484
All	0.710095236852905	2	0.701140055227484

Dependent variable: DLOG(M3)

Excluded	Chi-sq	df	Prob.
DLOG(IPC)	4.28131474760659	2	0.117577525226277
All	4.28131474760659	2	0.117577525226277

Table 11

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	17.13141	Probability	0.000000
Obs*R-squared	30.72712	Probability	0.000000

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/12 Time: 12:35
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.75E-05	0.000221	-0.350352	0.7264
DLOG(M3)	0.009319	0.012195	0.764131	0.4455
RESID(-1)	0.358453	0.062529	5.732548	0.0000
RESID(-2)	-0.049789	0.062035	-0.802598	0.4229

R-squared	0.116833	Mean dependent var	5.21E-19
Adjusted R-squared	0.106603	S.D. dependent var	0.003396
S.E. of regression	0.003210	Akaike info criterion	-8.629908
Sum squared resid	0.002669	Schwarz criterion	-8.575579
Log likelihood	1138.833	F-statistic	11.42094
Durbin-Watson stat	2.004785	Prob(F-statistic)	0.000000

Table 12

Dependent Variable: DLOG(IPC)
Method: Least Squares
Date: 04/08/12 Time: 12:56
Sample (adjusted): 1990M03 2011M12
Included observations: 262 after adjustments
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003070	0.000313	9.815801	0.0000
DLOG(M3)	0.020080	0.011131	1.804028	0.0724
AR(1)	0.336940	0.058804	5.729906	0.0000

R-squared	0.118961	Mean dependent var	0.003243
Adjusted R-squared	0.112157	S.D. dependent var	0.003408
S.E. of regression	0.003211	Akaike info criterion	-8.633109
Sum squared resid	0.002670	Schwarz criterion	-8.592250
Log likelihood	1133.937	F-statistic	17.48548
Durbin-Watson stat	1.953563	Prob(F-statistic)	0.000000
Inverted AR Roots	.34		

Table 13

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.779304	Probability	0.459806
Obs*R-squared	1.579352	Probability	0.453992

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/08/12 Time: 13:17
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.69E-06	0.000313	0.014975	0.9881
DLOG(M3)	0.000905	0.011165	0.081077	0.9354
AR(1)	-0.486818	0.459154	-1.060250	0.2900
RESID(-1)	0.505863	0.460787	1.097824	0.2733
RESID(-2)	0.129195	0.167186	0.772764	0.4404

R-squared	0.006028	Mean dependent var	-1.20E-17
Adjusted R-squared	-0.009442	S.D. dependent var	0.003199
S.E. of regression	0.003214	Akaike info criterion	-8.623888
Sum squared resid	0.002654	Schwarz criterion	-8.555789
Log likelihood	1134.729	F-statistic	0.389652
Durbin-Watson stat	1.998783	Prob(F-statistic)	0.815975

Table 14

Null Hypothesis: LOG(DEMANDE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.479740	0.9986
Test critical values:	1% level	-3.788030	
	5% level	-3.012363	
	10% level	-2.646119	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LOG(DEMANDE)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.922078	0.0009
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LOG(PIB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.039491	0.9513
Test critical values:	1% level	-3.831511	
	5% level	-3.029970	
	10% level	-2.655194	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LOG(PIB)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.708419	0.0018
Test critical values:	1% level	-3.857386	
	5% level	-3.040391	
	10% level	-2.660551	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LOG(TMM) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.898932	0.7680
Test critical values:	1% level	-3.788030	
	5% level	-3.012363	
	10% level	-2.646119	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LOG(TMM)) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.259961	0.0004
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Table 26

Null Hypothesis: INFANTICIPE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.036311	0.0062
Test critical values:	1% level	-3.808546	
	5% level	-3.020686	
	10% level	-2.650413	

*MacKinnon (1996) one-sided p-values.

Table 27

Dependent Variable: DLOG(DEMANDE)
Method: Least Squares
Date: 04/14/12 Time: 05:13
Sample (adjusted): 1991 2009
Included observations: 19 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00338...	0.040842	0.082821	0.0000
DLOG(PIB)	1.393829	0.794142	1.755139	0.0000
DLOG(TMM)	0.037318	0.150656	0.247705	0.3256
DLOG(INFANTICIPE)	-0.000251	0.010646	-0.023609	0.1534

R-squared	0.64593...	Mean dependent var	0.058614
Adjusted R-squared	0.61312...	S.D. dependent var	0.053120
S.E. of regression	0.052502	Akaike info criterion	-2.871257
Sum squared resid	0.041347	Schwarz criterion	-2.672428
Log likelihood	31.27694	F-statistic	1.142016
Durbin-Watson stat	2.16428...	Prob(F-statistic)	0.364108

Table28

Null Hypothesis: RESID has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.720826	0.0132
Test critical values:	1% level	-3.857386	
	5% level	-3.040391	
	10% level	-2.660551	

*MacKinnon (1996) one-sided p-values.

Table 29

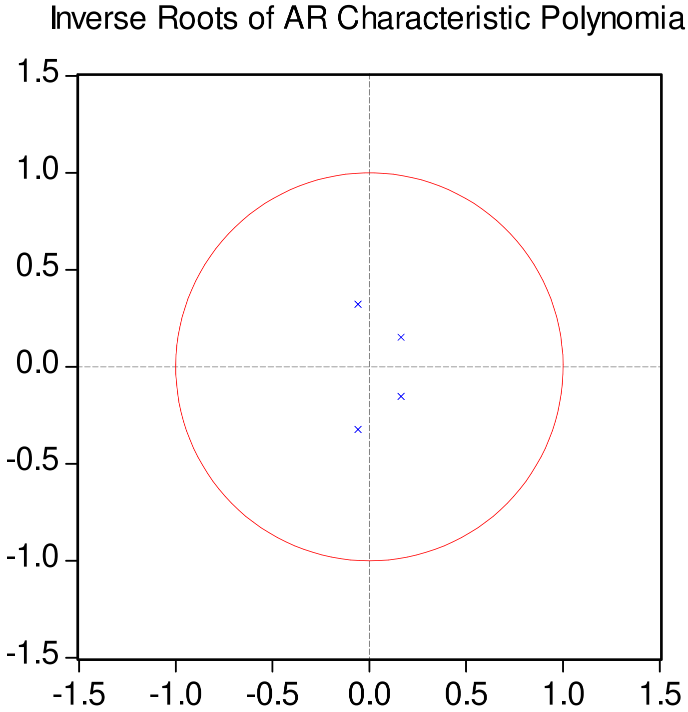
Date: 04/14/12 Time: 06:36
Sample (adjusted): 1993 2009
Included observations: 17 after adjustments
Trend assumption: Linear deterministic trend
Series: DLOG(DEMANDE) DLOG(PIB) DLOG(TMM) DLOG(INFANTICIPE)
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

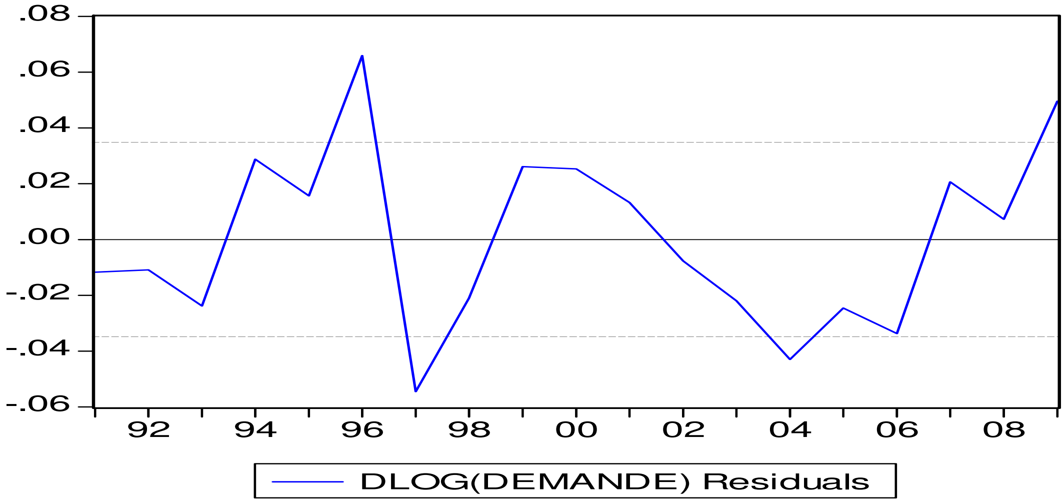
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.766463	51.20331	47.85613	0.0234
At most 1	0.591491	26.47829	29.79707	0.1150
At most 2	0.391073	11.25921	15.49471	0.1960
At most 3	0.153165	2.826230	3.841466	0.0927

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

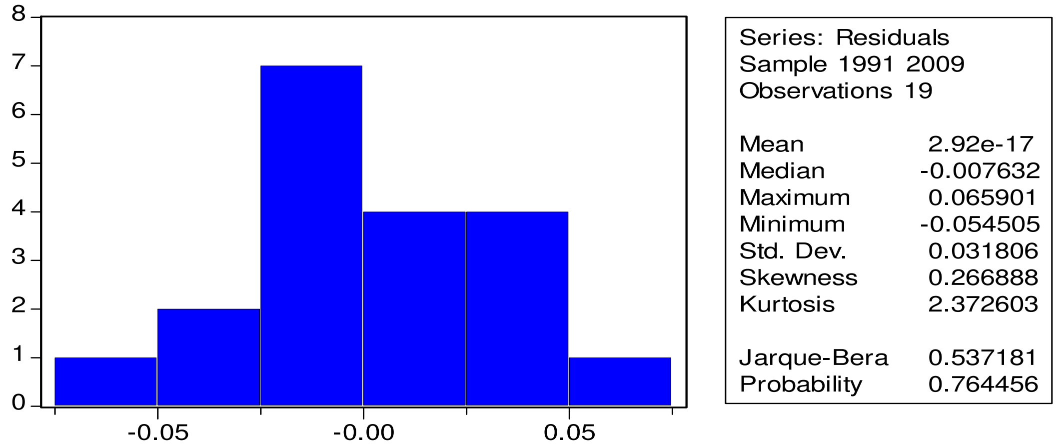
Graph 1



Graph2



Graph 3


8
7
6
5
4
3
2
1
0
-0.05
-0.00
0.05
Series: Residuals
Sample 1991 2009
Observations 19
Mean 2.92e-17
Median -0.007632
Maximum 0.065901
Minimum -0.054505
Std. Dev. 0.031806
Skewness 0.266888
Kurtosis 2.372603
Jarque-Bera 0.537181
Probability 0.764456