An Empirical Money Demand Estimation for Mexico, 1986-2004*

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June 2, 2007

[WORKING PAPER]

Abstract

An econometric money demand equation is estimated for the Mexican economy using quarterly time series data following a cointegration methodology. In addition to the long run results, an Error Correction Model that shows a fast converge to equilibrium is developed. Results are contrasted with previous empirical studies for Mexico and Chile. Evidence of parametric instability is found, but contrasting with other studies, CUSUM tests shows evidence that, for the Mexican case, such instability was due the Peso devaluation, rather than improved credit technologies.

Keywords: Money Demand, Error Correction Model, Cointegration, Mexican Devaluation.

JEL Classification: E41, E43

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*I am particularly thankful to R. Emerson for his help and support.

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1 Introduction

By 1994, the Central Bank of Mexico (BANXICO) was unable to sustain a grossly over valuated currency, and finally accepted to abandon a quasi-fixed exchange rate regime to implement a floating exchange rate system. Driven by speculation and virtually overnight, the value of US currency went from 3.3 to 7 pesos for dollar, triggering one of the biggest financial and economic debacles of Mexico history.

In terms of political economy, this change also implied for the BANXICO a more active role in the Mexican economy (Carstens, 1999). Yet to completely determine the implications of the monetary policy, is utterly important to have handy an empirical estimation of money demand (Castellanos, 2000).

In this paper I conduct an empirical money demand estimation for Mexico using quarterly time series data from 1986:1 to 2004:4. This work was done following closely a theoretical formulation on Demand for Money on the Handbook of Monetary Economics by (Goldfeld, 1990). During the process of estimation, I reviewed also many other empirical money demand estimations (Aguilar and Vela, 1996; Matte and Vela, 1989; Larraín and Larraín, 1988). All data used in this work were obtained online from both the Mexican Bureau of Statistics (INEGI) and from BANXICO.

2 Theoretical Background

In essence, money is a financial asset that allows interchange of goods and services. People demand money for several reasons: in order to purchase goods and services now (transaction motive) or in the future (precautionary motive); Economic agents also demand money as a way mean of conserving value over time (reserve of value motive)

Modern theoretical approaches to money demand started around the fifties with explicit inventory models (Boulmol, 1952; Tobin 1952). In these models, economic agents holds only the optimum amount of money just as a firm optimize the level of inventories, considering the trade off between the opportunity cost of holding money (interest rate) and the benefit of holding it (money needed for transactions and as a reserve of value)

Stephen Goldfeld (Goldfeld, 1990), defines a money demand equation as:

$$\ln m_t = \alpha_0 + \alpha_1 \ln y_t + \alpha_2 \ln r_t + \alpha_3 \ln m_{t-1} + \alpha_4 \ln \frac{p_t}{p_{t-1}} + u_t \tag{1}$$

Where, u_t is an spherical stochastic term, and $\frac{\partial \ln m_t}{\partial \ln y_t} > 0, \frac{\partial \ln m_t}{\partial \ln r_t} < 0, \frac{\partial \ln m_t}{\partial \ln m_{t-1}} > 0, \frac{\partial \ln m_t}{\partial \ln \frac{p_t}{p_{t-1}}} < 0$ according to economic theory

3 Variables, Data Analysis and Potential Econometric problems

Acronyms in equation 1 stands for:

$\ln m_t$ and $\ln m_{t-1}$ natural logarithm of a representative monetary aggregate, M1 in this case.

$\ln y_t$ represents the scale variable, natural logarithm of GDP in Mexican real pesos, base year 1994.

$\ln r_t$ represents the opportunity cost of money, a Mexican Government debt paper called CETES which is widely used in Mexican business environment.

$\ln \frac{p_t}{p_{t-1}}$ is an inflation indicator, based upon the CPI (p_t)calculated by INEGI.

u_t stands for the stochastic disturbance term.

A priori, we suspect this disturbance term to be non spherical. This suspect is based upon three reasons: 1) Model (1) may be ill specified if, for instance, Money Demand equation is not endogenously adjustable but dependent on a more "structural" equation in which GDP and interest rate are determined simultaneously. This approach is suggested in other studies (Larraín and Larraín, 1988). The context of a broader macroeconomic model that includes a money rule followed by the central bank, a Taylor Rule or Inflation Targeting as in the case of Mexico, has also being proposed (Attanasio and Jappelli, 1998)[1] ; 2) As suggested by nowadays classical studies (Goldfeld, 1976; Larraín and Larraín, 1988), this specification may be subject to the Lucas Critique, since is static and doesn't incorporate technical advances as ATM machines and improved credit technologies; and 3) as seen in class, the inclusion of a lagged dependent variable may cause the disturbance term to have serial correlation.

4 Econometric Estimation

4.1 Long Run Behavior of main variables and Normality Test

As we would expect, GDP shows an upward trend during all the sample space, the only exception being the 1994-1996 peso devaluation crisis. Accordingly, our main monetary aggregate, M1, shows a similar trend but presents a deep decline during the same crisis, as we would expect according to partial derivative signs in equation 1. The main interest rate indicator follows a turbulent trend since the time frame of this

[1] An attempt of "endogenize" the relevant interest rate is presented in Appendix 1.

estimations include a high inflation period (almost hyperinflation during 1986 to 1990, actually), followed by a stabilization period from 1990 to 1994, and the devaluation episode from 1994 to 1996; after that, Mexican economy has shown macroeconomic stability.

We also present the result for a normality test on the dependent variable. The Jarque-Bera (JB) statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as with 2 degrees of freedom. The reported p-value is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null— In this case, we fail to reject the null hypothesis of a normal distribution. Under certain conditions this result will allow us to argue that population disturbance u_t in equation 1 will also distribute normal, therefore that all the results regarding statistical inference that we saw in class hold, without having to invoke large sample properties. Graphic representation of the variables are shown in the Appendix.

4.2 Long Run Estimation

All the estimations in this paper were performed using Eviews version 5. Empirical estimation is shown in the Appendix. With exception of constant term, all parameters are statistically significant at a 6% confidence level.

In accordance with theory, money demand responds positively with the income and the lag of the dependent variable, and negatively with the opportunity cost and the inflation indicator. Next we compare our results with two of the most referred works on money demand in Latin America: the previous and most comprehensive study on Money Demand in Mexico done by BANXICO (Aguilar and Vela, 1996, pages 20 and 21) and the empirical estimation done by Felipe Larraín at Harvard University for Chile (Larraín and Larraín, 1988, page 254).

4.3 Stability Tests: Cusum and Cusum of Square Tests

The CUSUM test (Brown et al, 1975) is based on the cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5% critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines (Greene, 2003). For our model, results suggest some parameter instability specifically starting in 1993; the timing is not surprising: most economic historians now see the couple of years preceding 1995 as the genesis of the Mexican peso crisis, which exploded in December of 1994.

More on Instability of the Money Demand Parameters: As seen in class, we can use a Chow test to find the same result without using the CUSUM and the CUSUM squared tests. If we suspect a structural change, we can conceptually think the problem as composed of three different models:

1) $\mathrm{Y} = \mathrm{X}\beta + \mu$ the complete model that we have already estimated.

2) $\mathrm{Y}^I = \mathrm{X}\beta^I + \mu^I$ the partial model that includes only the observations corresponding to dates before 1995, in which we suspect the structural change took place.

3) $\mathrm{Y}^{II} = \mathrm{X}\beta^{II} + \mu^{II}$ the partial model that includes only the observations corresponding to dates after 1995.

Where β is the vector of parameters including a constant term. So the main hypothesis to test structural change is:

H_o: $\beta^I = \beta^{II}$

H_a: $\beta^I \neq \beta^{II}$

But first we need to test the implicit assumption here that $\sigma_I^2 = \sigma_{II}^2$ We do this with the statistic:

$$\frac{\frac{e^{I\prime}e^{I}}{n_1-k}}{\frac{e^{II\prime}e^{II}}{n_2-k}} \approx F(n_1-k, n_2-k)$$

In this case, the estimate results in:

F-test value: 7.89 ; $F_{critical}$ (31,36) = 1.84

In this case, $F_{calculated}$ (7.89) > F_{table} (1.84)

In this case again we reject H_o. We can not assume variances in the two subsamples are equal. Now, testing the main hypothesis under this finding[2], we use the Wald Statistic (Greene, 2003):

$$(\hat{\beta}^{I} - \hat{\beta}^{II})'(\hat{V}^{I} - \hat{V}^{II})^{-1}(\hat{\beta}^{I} - \hat{\beta}^{II}) \overset{asy}{\approx} \chi_k^2$$

After computation this formula yields $\chi_k^2 = 42.19$, and a chi-squared with 5 degrees of freedom at a significance level of 5% has a value around 11, so in this case:

$\chi^2_{calculated}$ (42.2) > χ^2_{table} (11.07)

And once again we reject Ho. Sample data supports the evidence of a structural change in the parameters before and after the Mexican devaluation of 1995. It's worth noting that this result on instability of money demand parameters has being found in several empirical studies (Matte y Rojas, 1989; Corbo, 1982)

4.4 Cointegration Analysis (Parul and Choon-Geol, 1994)

In order to verify if there exist a long run relationship among the variables in model (1) we proceeded to analyze the order of integration for each one of the variables. Results are shown in the Appendix.

[2] I used Gauss to get this result since the asymptotic result the equation is not incorporated in Eviews.

This implies that out of all the variables in our model, only CPI is stationary. Furthermore, the rest of the variables are integrated of order one. Under non stationary series we face the possibility of having an spurious estimation: In order to guarantee a long run relationship, we need to verify that there exist a lineal combination of the I(1) variables that is per se stationary. If such relationship exists, is called co-integrated equations and we can still state that the model (1) holds as a long run relationship. In order to verify if this linear combination exists, we can either perform a Johansen cointegration test, or to do a traditional Augmented Dickey-Fuller unit root test to the residuals of model one (Enders, 1995). The Former test is presented as in Appendix Number Two, the latter test results suggests an ADF value of -8.4 versus a critical value of -1.95 (Phillips and Ouliaris, 1990). This allows us to reject the null hypothesis of unit root on the residuals; with stationary residuals, we can conclude model (1) is a valid long run relationship, with variables co-integrating in the long run.

4.5 Potential non spherical disturbance term

Breusch-Godfrey Serial Correlation Test concludes that serial correlation problem does not exist in model (1) The complete auxiliary regression is presented in the Appendix, in which we can verify the almost null statistical significance on all the parameters in the auxiliary regression.

Other approach to detect a first order autorregresive process using the Durbin-Watson statistic. The reported value of 1.95 fails to reject the hypothesis of H_o: ρ=0 in the process $\varepsilon_t = \rho\varepsilon_{t-1} + \zeta_t$ Therefore, there is no evidence of serial correlation of order one. Full description of the test is given in Appendix.

To detect the presence of heteroskedasticity in the disturbance term, we proceeded to perform a White test with both cross and no cross terms.

4.6 Short Run Model Estimation: Error Correction Model (ECM)

We just showed that model (1) presents at least one cointegrated linear combination; in other words, there's a long term or equilibrium relationship. In the short run, however, there may be disequilibrium. In these cases (Sargan, 1984), we can treat error term in (1) as the equilibrium error to tie the short run with the long run behavior. A model or mechanism showing this short run dynamics is often referred as the Error Correction Model, includes only stationary variables and the residual of the original model (1) as explanatory variable. The results are as shown in Appendix. Results suggests, first, that parameter associated with the lagged error term in the Error Correction Model has a high statistical significance. This high significance implies that there's a disequilibrium at the short run, with an eventual Long Run Equilibrium. Second, the speed of adjusted, given by the absolute value of the error coefficient which in this case is around $\frac{3}{4}$, implies that full adjustment towards long term equilibrium is achieved in less than two years. Third, a visual inspection of the error of the ECM doesn't suggest the existence of econometric problems such serial correlation and Heteroskedasticity.

4.7 Stability Test

Results for the ECM both in the CUSUM and the CUSUM of squared test are consistent with the structural change starting around 1993 detected in the Long Run

Model, are presented in the Appendix.

5 Conclusions

1. The long run equation presented by Goldfeld in the Handbook of Monetary Economics shows a nice fit for our case of study, that is, for Mexico during the period 1986-2004. Theoretical signs are according to the theory and the magnitudes of key elasticities are in line with other empirical studies.

2. Other empirical estimations differs from the present incorporating other money aggregates as M2 or M3 (Aguilar and Vela, 1996; Larraín and Larraín, 1988) as dependent variable. An alternative estimation using M2 as the aggregate money demand is presented in Annex Number Five. Statistical problems are found in this model, which leads us to reject M2 as the dependant variable, favoring M1 instead.

3. Evidence that support the thesis of a structural change is found by at leas two different criterions: CUSUM and CUSUM of squared test and the Chow Test. This evidence of instability is common in most of the other empirical studies reviewed, notoriously in Goldfeld's famous Case of the Missing Money (Goldfeld, 1976). Even though in the literature this instability is linked basically to technical change and credit technologies improvement (such as credit cards and ATM's), in the case of Mexico and given that the CUSUM of squares test identifies specifically a time in which the suspected structural change may have occurred, we can argue the instability was caused for the Peso Devaluation rather than some technical change. Chow test supports these findings.

4. Unlike old studies, we favored and follow a co-integration approach. The statistically highly significance of the parameter associated with the lagged error term in the Error Correction Model would simply mean there's a disequilibrium at the short run, with an eventual Long Run Equilibrium, which we tested using the Johansen test for cointegration. Furthermore, the speed of the adjusted, measured by absolute value of the error coefficient, is high, which implies Mexican agents adjust fast to changes in their economic environment.

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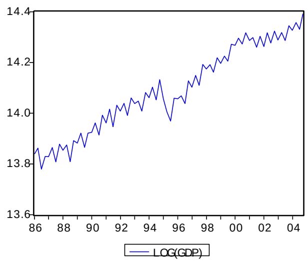
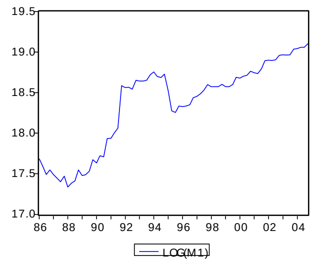
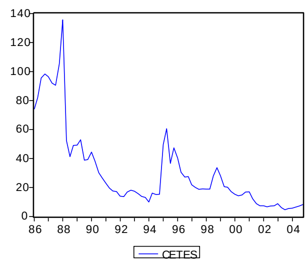
Appendix

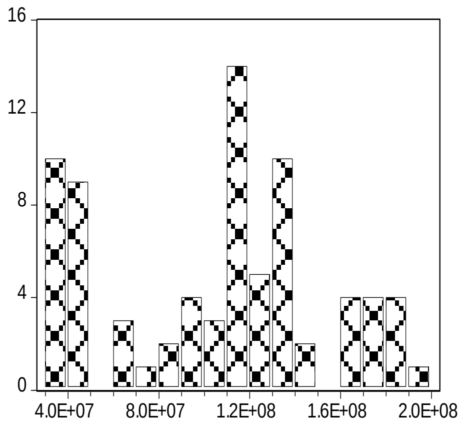
Basic Graphic Representation of main Variables







Jarque-Bera Test for the residuals of main model



Series: M1	
Sample 1986:1 2004:4	
Observations 76	
Mean	1.06E+08
Median	1.16E+08
Maximum	1.98E+08
Minimum	33826888
Std. Dev.	47301692
Skewness	-0.052824
Kurtosis	1.972746
Jarque-Bera	3.376972
Probability	0.184799

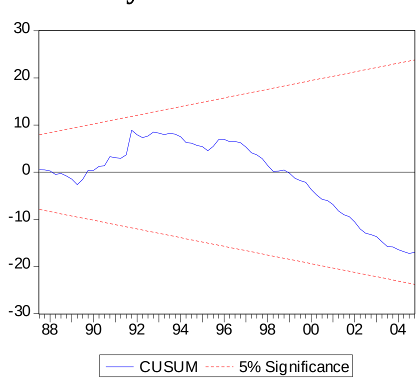
Output for Main Model

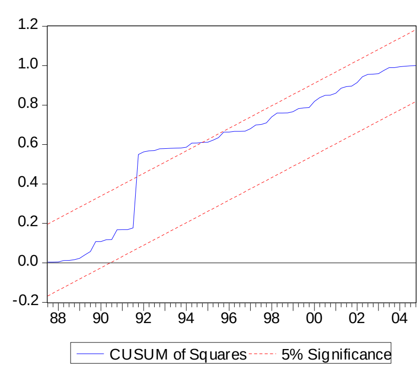
Dependent Variable: LOG(M1)				
Method: Least Squares				
Date: 04/11/05 Time: 16:07				
Sample(adjusted): 1986:2 2004:4				
Included observations: 75 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.633916	1.379609	0.459489	0.6473
LOG(GDP)	0.230506	0.118149	1.950974	0.0551
LOG(CETES)	-0.003801	0.001305	-2.913371	0.0048
LOG(CPI/(CPI(-1)))	-0.424697	0.228520	-1.858467	0.0673
LOG(M1(-1))	0.802079	0.039167	20.47836	0.0000
R-squared	0.981977	Mean dependent var		18.36332
Adjusted R-squared	0.980948	S.D. dependent var		0.536450
S.E. of regression	0.074047	Akaike info criterion		-2.303905
Sum squared resid	0.383802	Schwarz criterion		-2.149406
Log likelihood	91.39643	F-statistic		953.5034
Durbin-Watson stat	1.951057	Prob(F-statistic)		0.000000

Summary of Empirical Elasticitie's Comparison

Type of Elasticity on Money Demand	Current Estimation	Aguilar and Vela for Mexico, 1996	Larraín and Larraín for Chile, 1988
Interest Elasticity $\eta_{M1,i}$	-0.3%	-0.1%	-2.1%
Income Elasticity $\eta_{M1,GDP}$	23%	15%	13%
Lagged M1 Elasticity $\eta_{M1,M1(-1)}$	80%	89%	75%

Stability Tests:





Cointegration Analysis

VARIABLE	Unit Root Test	MODEL Estimated Included*:			ADF	Critical Value** 5%	Result	Integration Order
		CONSTANT	Trend	Lags				
Log M1	Level	No	No	0	1.796999	-1.9446	Don't Reject H_o	
	1st Difer.	No	No	0	-7.862032	-1.9447	Reject H_o	I(1)
Log GDP	Level	No	No	0	1.278212	-1.9447	Don't Reject H_o	
	1st Difer.	No	No	0	-19.96238	-1.9447	Reject H_o	I(1)
Log CETES	Level	No	No	0	-1.908106	-1.9447	Don't Reject H_o	
	1st Difer.	No	No	0	-9.433448	-1.9447	Reject H_o	I(1)
Log CPI	Level	No	No	0	9.402313	-1.9447	Reject H_o	I(0)

* Therefore, the model tested is: $\Delta Y_t=\gamma Y_{t-1}+\varepsilon_t$,
With: H_o: $\gamma_t=0$
If $\gamma_t=0$ ➔ Unit Root: Non stationary series.
Criterion: If ADF < Valor Crítico, Reject H_o

** Obtained from **(Phillips and Ouliaris, 1990)**

Serial Correlation on Error Term

Breusch-Godfrey Serial Correlation Test, 2 lags (p).			
F-Statistic	0.032965	Probability	0.967588
$N*R^2$	0.072646	Probability	0.964329

In auxiliary regression:
$e_t= p_i\mathbf{X} + B_i\sum e_{t-p} + \zeta_t$
H_o: $p_i= B_i=0\ \forall i$ ➔ Serial Correlation does not exist.
Criterion: If $(n - p)R^2>\chi^2_p$ Reject H_o.
Critical value for χ^2 at 5% significance level $\cong$ 6
Result: **Fail to Reject H_o**.

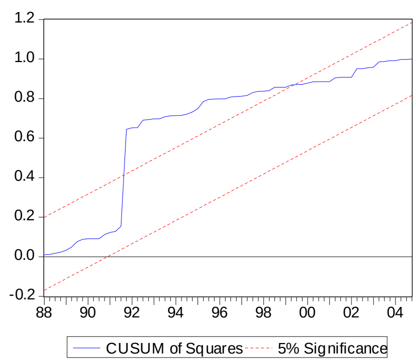
White Heteroskedasticity Test

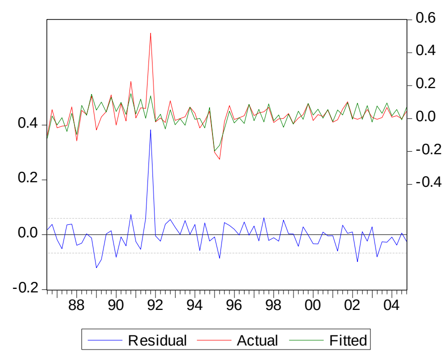
White Heteroskedasticity Test, No Cross Terms.			
F Statistic	1.117182	Probability	0.363445
$N*R^2$	8.944918	Probability	0.346964

H_o: $\sigma^2=\sigma^2 I$ ➔ Residuals are Homoskedastic
Criterion: If $(n)R^2>\chi^2_{d.f.\ auxiliary\ reg}$, Reject H_o. $\chi^2_{df\ aux\ reg}$ critic at 5% $\cong$ 90
Result: **Fail to Reject H_o**.

Error Correction Model

Dependent Variable: D(LOG(M1))				
Method: Least Squares				
Date: 04/16/05 Time: 20:17				
Sample(adjusted): 1986:3 2004:4				
Included observations: 74 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001770	0.007904	-0.223997	0.8234
D(LOG(GDP))	1.037408	0.156775	6.617191	0.0000
D(LOG(CETES))	-0.083153	0.038944	-2.135170	0.0364
D(LOG(CPI/(CPI(-1))))	-0.187385	0.284992	-0.657509	0.5131
D(LOG(M1(-1)))	0.626591	0.137362	4.561590	0.0000
RESIDUALS1(-1)	-0.755186	0.169698	-4.450174	0.0000
R-squared	0.543348	Mean dependent var		0.020386
Adjusted R-squared	0.509771	S.D. dependent var		0.089910
S.E. of regression	0.062951	Akaike info criterion		-2.615300
Sum squared resid	0.269476	Schwarz criterion		-2.428484
Log likelihood	102.7661	F-statistic		16.18200
Durbin-Watson stat	1.891783	Prob(F-statistic)		0.000000





White Heteroskedasticity Test, No Cross Terms.			
F Statistic	1.060204	Probability	0.405818
$N*R^2$	10.65936	Probability	0.384665

H_o: $\sigma^2=\sigma^2 I$ ➔ Residuals are Homoskedastic

Criterion: If $(n)R^2>\chi^2_{\text{d.f. auxiliary reg}}$, Reject H_o. $\chi^2_{\text{df aux reg}}$ critic at 5% ≅ 90

Result: **Fail to Reject H_o**.

Breusch-Godfrey Serial Correlation Test, 2 lags (p).			
F-Statistic	0.724192	Probability	0.488527
N*R2	1.589073	Probability	0.451791

In auxiliary regression:

et= piX + Bi∑et-p + ζt

Ho: pi= Bi=0 $\vee$ i ➔ Serial Correlation does not exist.

Criterion: If (n - p)R2>χ2p Reject Ho.

Critical value for χ2 at 5% significance level $\cong$ 6

Result: Fail to Reject Ho.

Further Analysis

1] Determination of "the" interest rate[1]

Say that the interest rate follows

$$r^* = \bar{r} + \alpha_1 \left[\Pi_t - \Pi^m \right] + r_t^e + \upsilon_t \qquad \text{Long Run Equation.}$$

$$r_t = \rho * r^* + (1-\rho) * r_{t-1} + \varepsilon_t \qquad \text{Short Run adjustment of Interest Rate.}$$

Where r* is the long run interest rate, π represents inflation, π^m expected inflation, r bar a mean of the rate in the economy, rho represent adjustment weights, and both v_t and ε_t represents normally distributed disturbances.

The topic of selecting "the" interest rate is somehow discretionary on behalf of the researcher; a proper approach will determine the main interest rate of the Mexican economy based upon the kind of monetary policy followed by BANXICO, that includes the an inflation target of gap (π - π^m) or DIFP, a representative international rate (The federal reserve representative rate, of FED), and a measure of real exchange rate (TCR94). The result for the case of the Mexican economy are:

Dependent Variable: CETES
Method: Least Squares
Date: 04/17/05 Time: 18:17
Sample(adjusted): 1986:2 2004:4
Included observations: 75 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.364042	0.116127	-3.134854	0.0026
DIFP	-0.280498	0.094984	-2.953114	0.0044
FED	1.830691	2.201542	0.831549	0.4089
TCR94	12.11996	1.706856	7.100752	0.0000

R-squared	0.713121	Mean dependent var	0.259388
Adjusted R-squared	0.699239	S.D. dependent var	0.119450
S.E. of regression	0.065508	Akaike info criterion	-2.554589
Sum squared resid	0.266063	Schwarz criterion	-2.421883
Log likelihood	88.30145	F-statistic	51.37287
Durbin-Watson stat	0.560878	Prob(F-statistic)	0.000000

[1] Based upon **(Corbo, 1982)**

2) Contegration Matrix: Johansen's Test1

	M1	GDP	R	CPI
M1	N.A.	Co-integrates**	Co-integrates*	Co-integrates*
GDP		N.A.	Co-integrates*	Co-integrates*
R			N.A.	Co-integrates**
CPI				N.A.

[1] For all pairwise Hypothesized relationships, options employed in E-Views for the test are: Allowing a linear trend in the cointegrating equation and in the Vector Autorregresive Specification. This is one of the five cases considered by Johansen (1990) in his seminal work on **Cointegration and Money Demand**, the case not completely restrictive, but not the most permissive either. One example of the Eviews output for this test, for the pair (R, CPI) is given as example next:

<u>Reference</u>: **Johansen, Soren and Katarina Juselius** (1990) "*Maximum Likelihood Estimation and Inferences on Cointegration—with applications to the demand for money,*" Oxford Bulletin of Economics and Statistics, 52, 169–210.

* At 5% significance level

** Al 1% significance level

Date: 04/11/05 Time: 21:42				
Sample: 1986:1 2004:4				
Included observations: 75				
Test assumption: Linear deterministic trend in the data				
Series: CPI CETES				
	Likelihood	5 Percent	1 Percent	Hypothesized
Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
0.478392	53.33823	25.32	30.45	None **
0.058552	4.525252	12.25	16.26	At most 1
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 1 cointegrating equation(s) at 5% significance level				
Unnormalized Cointegrating Coefficients:				
CPI	CETES	@TREND (86:2)		
-0.011515	0.006160	0.026718		
0.006934	0.003015	-0.011535		
Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)				
CPI	CETES	@TREND (86:2)	C	
1.000000	-0.534921	-2.320260	55.95734	
	(0.09019)	(0.12544)		
Log likelihood	-382.5367			

3) Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.032965	Probability		0.967588
Obs*R-squared	0.072646	Probability		0.964329
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Date: 04/11/05 Time: 22:51				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.020461	1.432912	-0.014279	0.9886
LOG(GDP)	0.002894	0.129070	0.022423	0.9822
LOG(CETES)	0.000313	0.027283	0.011465	0.9909
LOG(CPI/(CPI(-1)))	-0.007990	0.236968	-0.033719	0.9732
LOG(M1(-1))	-0.001136	0.044420	-0.025563	0.9797
RESID(-1)	0.022975	0.135636	0.169386	0.8660
RESID(-2)	-0.022308	0.125443	-0.177836	0.8594
R-squared	0.000969	Mean dependent var		4.87E-15
Adjusted R-squared	-0.087181	S.D. dependent var		0.072017
S.E. of regression	0.075091	Akaike info criterion		-2.251541
Sum squared resid	0.383431	Schwarz criterion		-2.035242
Log likelihood	91.43277	F-statistic		0.010988
Durbin-Watson stat	1.992354	Prob(F-statistic)		0.999994

4) Durbin Watson Serial Correlation Test

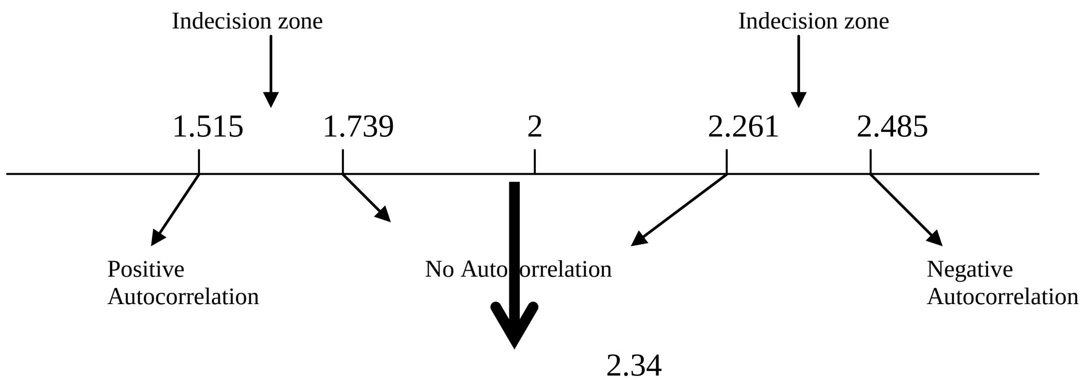
Dependent Variable: LOG(M1)
Method: Least Squares
Date: 04/11/05 Time: 18:33
Sample(adjusted): 1986:2 2004:4
Included observations: 75 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.633916	1.379609	0.459489	0.6473
LOG(GDP)	0.230506	0.118149	1.950974	0.0551
LOG(CETES)	-0.067891	0.026876	-2.526113	0.0138
LOG(CPI/(CPI(-1)))	-0.424697	0.228520	-1.858467	0.0673
LOG(M1(-1))	0.802079	0.039167	20.47836	0.0000

R-squared	0.981977	Mean dependent var	18.36332
Adjusted R-squared	0.980948	S.D. dependent var	0.536450
S.E. of regression	0.074047	Akaike info criterion	-2.303905
Sum squared resid	0.383802	Schwarz criterion	-2.149406
Log likelihood	91.39643	F-statistic	953.5034
Durbin-Watson stat	**1.951057**	Prob(F-statistic)	0.000000

This number corresponds to the value that Eviews calculates for the DW statistic. Now we have to contrast this number with the d_u and d_l values from a statistic tableau:

In this case: k=5, (k'=4), n=75 ➔ d_u=1.739, d_l=1.515



Therefore, according to DW statistic criterion, we fail to reject H_0 ➔ No Autocorrelation

5] Additional Estimation using M2 as an alternative Money Aggregate

Using as endogenous variable M2, a broader measure of money that includes saving accounts and other deposits, plus M1, we had the following results:

Dependent Variable: M2
Method: Least Squares
Date: 04/17/05 Time: 18:17
Sample(adjusted): 1986:2 2004:4
Included observations: 61 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.342665	0.949671	1.413822	0.1630
LOG(DGP)	0.092866	0.079027	1.175123	0.2450
LNR	0.003612	0.011721	0.308170	0.7591
M2T0	0.853366	0.081774	10.43566	0.0000
DPIB	0.000296	0.000594	0.497904	0.6205
AR(5)	0.105016	0.111419	0.942529	0.3500

R-squared	0.924105	Mean dependent var	15.20202
Adjusted R-squared	0.917206	S.D. dependent var	0.054835
S.E. of regression	0.015778	Akaike info criterion	-5.367195
Sum squared resid	0.013692	Schwarz criterion	-5.159568
Log likelihood	169.6994	F-statistic	133.9378
Durbin-Watson stat	2.063693	Prob(F-statistic)	0.000000

Inverted AR Roots	.64	.20 -.61i	.20+.61i	-.52+.37i
	-.52 -.37i			

Main Features of the model:

i. No spherical residuals. Serial correlation of higher level is found, i.e., even though DW statistic rejects the existence of an AR(1) process, Eviews finds evidence that the error term follows an AR(5) process.

ii. Main theoretical explanatory variables, as the interest rate, the lagged dependent variable and the GDP, are found to be statistically non significant. Overall, even though the model presents a high R^2, doesn't seem to have nice econometric properties.