The Determinants of Consumer Import Demand in Barbados: An Econometric Investigation

by

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This paper aims to estimate the Imported Consumer Goods Demand function for Barbados using yearly data over the period 1973-1997, and to test for Cointegration using both the Engle and Granger two step method and the more powerful Johansen Cointegration test.

Relevance of Study

It is important to be able to obtain an estimate of the demand for imports in Barbados for two major reasons. Firstly, Barbados, as a small developing country has to rely to a large extent on foreign imports to satisfy the needs of its people. Moreover this demand for imports has at times, most noticeably in the 1990/91 period contributed to the country developing severe Balance of Payments (BOP) problems, which have resulted in economically painful structural adjustment programmes.

Consumer Imports of both necessities (food), and luxury items (expensive imported cars) have accounted for (32-50)% of total imports from 1958-1990. These Imports unlike Intermediate and Capital goods impact more negatively on our BOP position because they are not generally employed in foreign exchange earning activities. Hence estimating the demand for consumer imports is very important in any government's policy of Balance of Payments stabilisation and improvement.

The second major reason which illustrates the importance of estimating import demand is seen in the fact that taxes on imports form a major constituent of Government's tax revenue. Indeed Import and Stamp duties have averaged between 12 and 16 per cent of government's tax revenue for the period 1990-1997. Therefore the ability to control consumer import demand is pivotal to government's plans for budget sustainability.

The contribution of this study is that it attempts to apply relatively new Econometric techniques to facilitate a better understanding of Consumer Import Demand in Barbados. As a result, tests for Cointegration were conducted and Vector Autoregressive Modeling was used to determine the order of the cointegrating Equations.

This study builds on the work of three previous import studies conducted for Barbados namely 'The Demand for Imports the Case for Barbados 1954-1970', conducted by Mr. Wallace Joefield Napier. Secondly 'A Case study of Imports Income and Spending,' conducted by Dr. Delisle Worrell in 1988. The third most recent study entitled 'Modeling Aggregate Import Demand in Barbados', was conducted by Dr. Roland Craigwell in 1994.

The study conducted by Mr. Napier modeled import demand for several combinations of imports. The use of real GDP as an explanatory variable did not adequately capture import demand because consumer's demand for imports is not just attributed to the value of goods and services produced within a country but also (as was highlighted in Dr. Worrell's 1988 study) depends on money borrowed from abroad and held on deposit with commercial banks and money lent to government by the Central Bank of Barbados. This money when deposited in banks provides finance for additional credit for purchases by consumers, and also when the Central Bank issues additional currency, the extra money is available to the public for additional purchases. Hence consumers are able to spend on imports more money than is earned from income and this is why real National Expenditure which incorporates these features, is a better explanatory variable than real GDP.

In this regard the study conducted by Dr. Worrell was an improvement. However given what is presently known about the dangers of combining time series which are not stationary it is now imperative that Cointegration tests be conducted in any regression framework which involves the combination of non-stationary series. Indeed the concept of cointegration has implications for all previous results obtained in these studies since t and F ratios are based upon the underlying assumptions that the series being combined are stationary. If the series being combined are not cointegrated then the t and F ratios are not valid, they do not even have limiting distributions and any statistical inference made will be incorrect.

The study conducted by Dr. Craigwell addressed this major problem. Tests for both Cointegration and the rank of the cointegrating vector were conducted. In addition non-traditional variables were included in the model such as credit and the price index for both tradeable and non-tradeable goods. This paper seeks to model specifically the consumer import demand function for the small open economy of Barbados using variables specific to consumer imports such as the Import Price Level for Consumer Goods and Real Personal Credit. Another very important variable which should be included in modeling import demand for developing countries is Net International Reserves[1]. Tests for Cointegration were conducted using both the Engle and Granger two step method and the Johansen cointegration test.

The rest of the paper is divided into four sections. Section one discusses the problem of non-stationarity among variables, its implications for regressions and solutions to the problem. Section two highlights the model being investigated. Section three deals with the analysis of the results and section four highlights the important conclusions obtained.

Background to Unit Roots, Non-stationarity and Spurious Regressions

As we know most economic series are Non-stationary i.e. they trend upwards over time. Series such as GDP and Consumption appear to be rising into infinity. This occurs because most series exhibit either Trend or Difference stationarity.

Equation 1 gives an example of a series with a deterministic trend.

$$y_t = \gamma_0 + \gamma_1 t + \mu_t \qquad (1)$$

where μ follows an ARMA process. This series can drift slowly upwards or downwards as a result of stochastic or random shocks.

$$y_t = \gamma_1 + y_{t-1} + \mu_t \qquad (2)$$

Equation 2 is an example of a difference stationary process. This means that yt depends on its previous value yt-1 a drift term γ_1 and an error term which can be assumed to be white noise. This drift term causes yt to trend upwards over time.

There are serious implications if Trend Stationary and Difference stationary series are used in standard regressions as is illustrated in the following example:

Suppose we have the following regression: Eq 3

$$y_t = \alpha + \beta x_t + e_t \qquad (3)$$

If x_t trends upwards forever then the matrix $n^{-1}X'X$ will not tend to a finite positive and definite matrix. Therefore the standard asymptotic theory is inapplicable to models in which any of the regressors is characterised by Eq 1 or Eq 2. Hence if two or more trending variables are regressed then it is possible to obtain a very high value for R^2 even if the only common element relating the variables is the fact that they trend together. However the Durbin Watson statistic will tend to be very low i.e. tending towards zero. This result generally characterises Spurious or Nonsense Regressions.

Two obvious ways to keep standard assumptions from being violated when using such series are to detrend or difference them prior to use, these are two very different procedures. Detrending is only appropriate if the series is trend stationary and differencing is only appropriate if the series is difference stationary.

The major techniques for choosing between detrending and differencing involve testing for unit roots. The following example will illustrate what exactly is a unit root.

Suppose we have an AR1 process

$$A(L)y_t = e_t \qquad (4)$$

with $A(L) = 1-\rho L$.

The root of this function (i.e. the solution to $A(L)= 0$ is given as $L= 1/\rho$). So for Stationarity the requirement $|\rho|< 1$ is equivalent to requiring the root of $A(L)$ be greater than 1 in absolute value. Furthermore $A(L)$ has a unit root if $\rho =1$.

Therefore the stationarity of the process depends on the roots of the polynomial equation $A(L)=0$. If all roots are outside the unit circle, the process is stationary. If any root is equal or less than one in absolute value, the process is non-stationary. A root that is equal to 1 in absolute value is called a unit root. When a process has a unit root, as Eq 2 does it is said to be integrated of order 1. Some of the most popular tests for unit roots include the Augmented Dickey-Fuller test and the Phillips-Perron test.

As was stated previously Spurious regressions pose a very serious problem in Econometric analysis. How then can any statistical inference be conducted in the presence of this phenomenon?

The answer lies in the concept of cointegration. This states that a set of series integrated of the same order are said to be cointegrated if there exist a linear combination of the series with nonzeo weights which is integrated of a lower order (Gujarati, Basic Econometrics 1997). Cointegration is a measure of the long run equilibrium relationship among variables. Although variables which trend upwards may drift from equilibrium for a while, economic forces may be expected to act so as to restore equilibrium.

Therefore time series x and y are said to be cointegrated of order d,b where d ≥ 0 and b≥ 0

i.e. x_t, $y_t \sim CI(d,b)$ if

a) both series are integrated of order d
b) there exist a linear combination of these variables, i.e $y_t - ax_t$, which is integrated of order d-b. The vector [1,-a] is called the cointegrating vector.

For x_{nt} variables the generalisation is:

If Z_t is a $n*1$ vector of series $x_{1t},.........x_{nt}$ and

a) Each of them is I(d)
b) there exist $n*1$ vectors such that $Z_t\ \alpha \sim I(d\text{-}b)$

then $Z_t \sim CI(d\text{-}b)$

(NB) Condition a can be relaxed so that for example you can have cointegration between three variables two of which are I(2) and one being I(1).

If cointegration exists among linear combinations of non-stationary variables then statistical inference is possible because the t and F ratios will have limiting distributions. Hence the t, F and R^2 statistics will be valid.

Tests for cointegration are divided into the Residual and Non-residual based tests. Examples of the former include the Augmented Dickey Fuller test and the Phillips-Perron test. The most popular non-residual based test is the Johansen which tests for the number of cointegrating vectors.

Johansen Procedure (Non-residual based test for Cointegration).

This procedure uses a type of econometric modeling known as Vector Autoregression or (VAR) modeling.

Before proceeding any further it is necessary to explain the concept of the VAR. This is a type of Simultaneous Equation modeling. In this modeling no priori distinction is made between endogenous and exogenous variables. Vector Autoregression stems from the fact that we are dealing with a vector of two or more variables and the Autoregression term is due to the fact that you have lagged values of the dependent variable on the Right Hand Side.

The theory behind the Johansen procedure is based on the fact that if a vector of n variables all integrated of order e.g. 1 are combined and the resultant matrix as given by Johansen is not full (=n) and not 0 then the Linear combination of the variables is stationary and the resultant matrix's rank gives the number of co-integrating vectors present in the system. The Non-residual based test is regarded as superior to the Engle and Granger method since the statistical properties are better and the power of the test is higher.

Secondly a major feature in favour of the VAR is that it does not assume which variables are Exogenous and which are Endogenous. Hence if the number of cointegrating vectors found by the Johansen procedure are greater than 1, then there is a possibility that the model under consideration consists of more than 1 equation. If on the other hand the number of cointegrating vectors is 1 and the estimated coefficients have the same size and sign as those of the Engle and Granger procedure then this serves to confirm their results.

A direct descendant of Cointegration is The Error Correction Model (ECM), which is a short run dis-equilibrium model. Engle and Granger (1987) established a virtual equivalence between Error Correction and Cointegration through the Granger Representation Theorem which states that if a series has an ECM representation, then cointegration should exist and the converse should also apply. This model uses the lagged error term of the long run model as one of the explanatory variables in a regression of the first difference of the dependent variable against first difference of the explanatory variables and the difference dependent variable lagged one period.

DATA ANALYSIS

The data series used in the analysis were obtained from various issues of the Central Bank of Barbados's Annual Statistical Digest, the Economic and Financial Statistics, the Statistical Service Abstract of Statistics for 1969 and from Dr Delisle Worrell's, 1988 study on Import Income and Spending in Barbados.

Real National Expenditure

Estimates of Real National Expenditure at 1980 prices were obtained for the period 1973-1986 from the study conducted by Dr. Worrell. Proxy values were obtained for subsequent periods by obtaining estimates of Expenditure on GDP for Consumer expenditure and Capital formation, summing them then deflating the result by the Retail price index using 1980 as the base year.

Retail Price Index (RPI)

The data for the RPI was obtained from various issues of the Annual Statistical Digest and the Statistical Abstract at constant 1980 prices.

Consumer Import Price Index (CIPI)

This index was obtained by using the weight of consumer goods in proportion to the total for all imported goods, and expressing its value as 1. Next the weight for all the different categories of Consumer goods, e.g. food and beverages were expressed as a percentage of 1 and the appropriate index for each category of Consumer Imports multiplied by this weight. Then the resulting indices were added together to get an aggregate index for consumer goods for each year at constant 1980 prices.

To compensate for the lack of data after 1990, the correlation between the CIPI and the RPI was investigated, the CIPI was then regressed against the RPI and on the basis of the results proxy values for the CIPI were obtained by a forecast from ~~forecast~~ 1991 to 1997.

Consumer Imports.

The Nominal values of Consumer Imports as given in the Annual statistical Digest were deflated by the Consumer Import Price Index for the corresponding years using 1980 as the Base year.

Real Net International Reserves

Nominal Values for this series were obtained from the Central Bank's Economic and Financial Statistics and were standardised by deflating them by the Retail Price Index.

Real Personal Credit

Nominal values for this series were obtained from the Central Bank's Economic and Financial Statistics and were standardised by deflating them by the Retail Price Index.

MODEL SPECIFICATION and the ECONOMETRIC METHODOLOGY

In Economic literature the demand for imports is assumed to be a function of real income and and the relative price of imports to domestic prices. Hence the real demand for consumer imports is proposed to be a function of real National Expenditure and the ratio of the consumer Import Price Index to the Retail Price Index. The reason for using Real National Expenditure has already been explained however, the justification for using the latter stems intuitively from the fact that if the price of imports goes up, in theory Consumers would reduce their purchase of Imports relative to local purchases and vice versa. Hence a negative correlation should exist between relative prices and import demand.

However for developing countries the specification of the Import Demand function has to take into account factors such as the credit restrictions on individuals which directly influences their ability to purchase imported goods. This factor is captured by including real Personal Credit into the model. Secondly the ability to purchase imports depends on the country's ability to pay for those imports, which to a large extent depends upon the country's Net International Reserves. Taking this into account the variable real Net International Reserves was included in the model.

Hence we get Model 1

$$lim = c(1)+c(2)lx2-c(3)lxr+c(4)lrcr1+c(5)lresv2+U_t \qquad (5)$$

lim = the log of Real Consumer Imports at 1980 prices

lx2 = the log of Real National Expenditure at 1980 prices.

lxr = the log of the ratio of the Consumer Import Price Index to the Retail Price Index

lrcr1= the log of real personal credit

lresv2= the log of real net international reserves

c's = represent the parameters to be estimated

Ut= the error term in year t

The signs of the First Partial Derivatives are expected to be as follows:

lim/lx2 = + lim/lxr = - lim/lrcr1 = + lim/lresv2 = +

The lower case letters denote the natural logarithms of the corresponding variables. Log-linear form is assumed following the standard assumption of trade theory which relates imports to the explanatory variables through a multiplicative form that can be derived within a cost minimisation framework(Urbain1992).

However given the nature of the problem which arises when Non-stationary series are combined linearly, an Error Correction model using both the Engle and Granger procedure and the Johansen (VAR) procedure was estimated.

Since Barbados is a very small developing country and can obtain any quantity of Imports it wants at the prevailing prices, the assumption was made that Supply is infinitely elastic, hence only the demand equation is needed to complete the model. To estimate this model I draw on the work of Yash P Mera and his estimation of an Error Correction Model for M2 in the United States.

The Engle and Granger Residual based test for Cointegration

Under this method Eq5 explores the long run Equilibrium relationship between series.

Hence the coefficients from Eq5 become

c(2)=long run expenditure elasticity

c(3)= long run relative price elasticity

c(4)= long run credit elasticity

c(5) = long run reserve elasticity

A key assumption which must be fulfilled in order to estimate the short run Error Correction model is for the Residuals Ut to be Stationary i.e. I(0).

If cointegration exist then the short run disequilibrium model can be estimated as:

$$dlim = b_0 + (b_1)dlx2(-1) + (b_2)dlim(-1) + (b_3)dxrt(-1) + (b_4)dlresv(-1) + (b_5)dlrcr1(-1) + (d)Ut + e_t \quad (6)$$

where d = 1^{st} order difference operator

-1 = 1^{st} lag

Ut= the lag value of the long term random disturbance term

Eq 6 gives the short run determinants of Real Consumer Imports.

(d) Ut is the Error Correction mechanism and d is the Error Correction coefficient which shows you the amount by which the system corrects itself each period so that the actual level of Real Consumer Imports approaches the desired level.

RESULTS AND INTERPRETATION

The following are the results of the Augmented Dickey-Fuller and Phillips-Perron test for stationarity testing at the first difference using the 5% level value as the critical value.

Table 1

Levels	ADF Value	5% Critical Value	Phillips-Perron	5% Critical Value
No of lags 1				
lim	-2.325141	-2.9665	-2.598790	-3.6661
lx2	-1.509344	-2.9422	-0.984192	-2.9399
lxr	-1.136092	-2.9399	-1.127211	-2.9378
lresv2	-2.447060	-2.9969	-2.403244	-2.9907
lrcr1	-2.608937	-2.9665	-3.883251	-2.9705
First Difference				
lim	-4.20415	-2.9705	-2.598790	-3.6661
lx2	-3.505831	-2.9446	-5.348471	-2.9422
lxr	-5.646644	-2.9422	-9.084408	-2.9399
lresv2	-2.875278	-3.0038	-4.275273	-2.9969
lrcr1	-2.465599	-2.9627	-3.574003	-2.9665

For both the ADF and PP tests

Ho: Series has a unit root (Non-stationary)

H:1 series is stationary

This is a one tailed test .

Results Levels

All five variables were inside the acceptance region at the 5 % level in the levels for both tests hence the Null Hypothesis was accepted i.e. the series were not stationary in the levels.

First Difference

Since the ADF values are outside the acceptance region the Null hypothesis was rejected . Hence all variables according to the Phillips-Perron test were Stationary in the First Difference i.e. I(1). There was a slight discrepancy between the ADF and PP tests for lcr1 at the 5% level, however at the 10% level the ADF test indicated the series was stationary.

RESULTS

EQ5

Table 2 shown in the appendix shows the results for the regression.

The most striking result appears with the coefficient associated with the log of the Real Personal Credit Variable (lcr1). It has the wrong sign ant the t statistic tends to indicate that it is not significant in the model. A Wald test on the coefficient (Table 3) shows from the value that the coefficient is not significantly different from zero.

Therefore the model was re-estimated using only lresv2, lx2 and lxr as the regressors. The results (Table 4) show that the fit of the model is reasonable. The Durbin Watson statistic of 1.54 is inconclusive on the presence of positive or negative Autocorrelation at the 5% per cent level but does not reject the Null Hypothesis of no Autocorrelation at the 1% level. Further tests for Autocorrelation were conducted, such the Breusch-Godfrey Serial Correlation LM test. The resuls indicate that at the 5% level of significance the Null Hypothesis of No Autocorrelation of any order could not be rejected.

Hence these results strongly suggest the presence of Cointegration among the variables. The ADF test (Table 5)and the Philllips Perron test (Table 6) were conducted on the residuals of the Regression. However due to the fact that the critical values given, are for the tests involving one and not a combination of series, the results were inconclusive. Overall the regression strongly indicates the presence of cointegration.

The next step in the Engle and Granger method involved estimating the short run Error Correction model Eq 6.

The result (Table 7) appear reasonable, however it must be noted that due to the small sample size, large number of regressors and loss of obsevations due to differencing there was the problem of low power of the tests. The results obtained rejected the presence of Autocorrelation of the residuals and confirmed that they were approximately Normally distributed. There was also no evidence of heteroscedasticity. The high value for R^2 given the fact the model was estimated in first differences, shows that the model fits the data quite well. In contrast the t statistics indicate some of the variables included in the Error Correction mechanism were insignificant.

JOHANSEN RESULTS

Since the Johansen test is considered a superior test especially in small samples, to the Engle and Granger test, the variables were tested for Cointegration using the VAR framework. This was done by checking the Schwarz value.

Three elements of the VAR are obtained from the Schwarz

(a)The optimal lag length which was given by the Minimum Schwarz value

(b)The model to use for the VAR if it is Unrestricted

(c)The rank of the matrix associated with the VAR, if the rank $0<r<n$ then the correct model is a Vector Error correction model. If $r=0$ or $r=n$ then the appropriate model is an Pure VAR.

To determine the optimal number of lags, lag pairs ranging from 1,1 up to 1,2 were tried. N.B. after 1,2 there were too few observations to conduct the Johansen test. Each time a different lag pair was tried the model with the lowest Schwarz value was examined and the Rank and model were noted. As Table 8 shows the lowest value obtained with the maximum number of lag pairs 1,2 was model 4 with a Schwarz of -23.42553 [2]and a Rank=2. This model assumes the data follows a linear trend with an intercept and trend term.

Since the rank was not full i.e. $r=2<n=4$ an Error Correction model (Table 9) was estimated. This showed that there was a cointegration relationship between the Variables.

CONCLUSION

This paper has sought to use the relatively new techniques of Cointegration and Error correction in an Econometric investigation of the Demand for Consumer imports. The results obtained from the Johansen procedure indicate that the series are cointegrated. The study points to the fact that nontraditional variables such as real Net International Reserves are important in explaining Consumer Import demand and can hence be used by governments to gauge Consumer Import demand for a particular year. However it must be stressed that the results are only preliminary, further estimation is required. It is believed an expansion of the data series coupled with the inclusion of more explanatory variables will produce a more accurate model.

LIMITATIONS

Given the limitations in terms of sample size only 24 observations, all the test conducted had the problem of reduced power. Secondly the lack of appropriate tables for determining Cointegration for a linear combination of variables compromised the effectiveness of the Engle and Granger methodology.

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Notes:

1. Khawaja Sarmad[3] in his 1989 study of "The Determinants of Import Demand in Pakistan" stated that for developing countries factors such as foreign exchange availability must be taken into account.

2. Model 5 was discarded because it assumed the data followed a quadratic trend which cannot apply to a linear combination of variables.

APPENDIX

TABLES

Table 2

LS // Dependent Variable is LIM
Date: 07/24/98 Time: 20:21
Sample: 1973 1996
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRESV2	0.078620	0.030328	2.592294	0.0179
LX2	0.919353	0.191696	4.795886	0.0001
LXR	-0.417837	0.171463	-2.436898	0.0248
LRCR1	-0.120530	0.110169	-1.094041	0.2876
C	-0.876980	1.153332	-0.760388	0.4564

R-squared	0.877917	Mean dependent var	5.781804
Adjusted R-squared	0.852216	S.D. dependent var	0.178206
S.E. of regression	0.068507	Akaike info criterion	-5.178586
Sum squared resid	0.089171	Schwarz criterion	-4.933158
Log likelihood	33.08851	F-statistic	34.15811
Durbin-Watson stat	1.677363	Prob(F-statistic)	0.000000

Table 3

Wald Test:
Equation: EQ1

Null Hypothesis: C(4)= 0

F-statistic	1.196925	Probability	0.287614
Chi-square	1.196925	Probability	0.273937

Table 4

LS // Dependent Variable is LIM
Date: 07/24/98 Time: 20:26
Sample: 1973 1996
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRESV2	0.073468	0.030108	2.440177	0.0241
LX2	0.789819	0.151502	5.213271	0.0000
LXR	-0.418026	0.172304	-2.426087	0.0248
C	-0.488013	1.102553	-0.442621	0.6628

R-squared	0.870227	Mean dependent var	5.781804
Adjusted R-squared	0.850761	S.D. dependent var	0.178206
S.E. of regression	0.068843	Akaike info criterion	-5.200828
Sum squared resid	0.094788	Schwarz criterion	-5.004485
Log likelihood	32.35541	F-statistic	44.70500
Durbin-Watson stat	1.540055	Prob(F-statistic)	0.000000

Augmented Dickey-Fuller Unit Root Test on RESID5

Table 5

ADF Test Statistic	-3.882767	1% Critical Value*	-3.7667
		5% Critical Value	-3.0038
		10% Critical Value	-2.6417

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
LS // Dependent Variable is D(RESID5)
Date: 07/25/98 Time: 21:21
Sample(adjusted): 1975 1996
Included observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID5(-1)	-0.939476	0.241960	-3.882767	0.0010
D(RESID5(-1))	0.267962	0.155111	1.727548	0.1003
C	-0.002551	0.010180	-0.250590	0.8048

R-squared	0.451724	Mean dependent var	0.004219
Adjusted R-squared	0.394011	S.D. dependent var	0.060404
S.E. of regression	0.047022	Akaike info criterion	-5.988169
Sum squared resid	0.042010	Schwarz criterion	-5.839391
Log likelihood	37.65322	F-statistic	7.827055
Durbin-Watson stat	2.114523	Prob(F-statistic)	0.003315

Phillips-Perron Unit Root Test on RESID5

Table 6

PP Test Statistic	-5.266941	1% Critical Value*	-3.7497
		5% Critical Value	-2.9969
		10% Critical Value	-2.6381

*MacKinnon critical values for rejection of hypothesis of a unit root.

Lag truncation for Bartlett kernel: 2 (Newey-West suggests: 2)	
Residual variance with no correction	0.002583
Residual variance with correction	0.003783

Phillips-Perron Test Equation
LS // Dependent Variable is D(RESID5)
Date: 07/25/98 Time: 21:22
Sample(adjusted): 1974 1996
Included observations: 23 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID5(-1)	-0.949663	0.172948	-5.491030	0.0000
C	-0.007948	0.011092	-0.716553	0.4815

R-squared	0.589454	Mean dependent var	-0.007382
Adjusted R-squared	0.569904	S.D. dependent var	0.081108
S.E. of regression	0.053192	Akaike info criterion	-5.784761
Sum squared resid	0.059417	Schwarz criterion	-5.686023
Log likelihood	35.88917	F-statistic	30.15141
Durbin-Watson stat	1.326285	Prob(F-statistic)	0.000019

Table 7

LS // Dependent Variable is DLIM
Date: 07/26/98 Time: 19:11
Sample(adjusted): 1975 1996
Included observations: 22 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLRESV2(-1)	0.163766	0.041591	3.937546	0.0012
DLIM(-1)	0.384549	0.206974	1.857957	0.0817
DLX2(-1)	0.062824	0.291885	0.215236	0.8323
DLXR(-1)	0.285909	0.241911	1.181877	0.2545
UT	-0.671895	0.349406	-1.922963	0.0725
C	0.010768	0.013361	0.805930	0.4321

R-squared	0.754210	Mean dependent var	0.022785
Adjusted R-squared	0.677401	S.D. dependent var	0.105667
S.E. of regression	0.060017	Akaike info criterion	-5.399264
Sum squared resid	0.057632	Schwarz criterion	-5.101707
Log likelihood	34.17526	F-statistic	9.819240
Durbin-Watson stat	1.902013	Prob(F-statistic)	0.000195

Johansen Cointegration Test Summary

Table 8

Date: 07/26/98 Time: 20:42
Sample: 1973 1996
Included observations: 21
Series: LIM LRESV2 LX2 LXR
Lags interval: 1 to 2

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Model and Rank				
0	151.2206	151.2206	152.0361	152.0361	153.7199
1	166.0666	166.1403	166.7646	174.6561	176.2185
2	171.1099	180.3606	180.8730	189.3278	190.5212
3	173.0835	184.8584	185.0404	195.4147	196.5712
4	173.1572	186.7268	186.7268	197.1106	197.1106
	Akaike Information Criteria by Model and Rank				
0	-20.99156	-20.99156	-20.97400	-20.97400	-21.03912
1	-22.21499	-22.19820	-22.18623	-22.91400	-22.99136
2	-22.50483	-23.33824	-23.33942	-24.09701	-24.16305
3	-22.50231	-23.55230	-23.54583	-24.46243	-24.54876
4	-22.31886	-23.51597	-23.51597	-24.40967	-24.40967
	Schwarz Criteria by Model and Rank				
0	-20.59365	-20.59365	-20.52634	-20.52634	-20.54172
1	-21.71760	-21.68838	-21.63910	-22.35443	-22.39449
2	-21.90796	-22.71650	-22.69281	-23.42553	-23.46670
3	-21.80597	-22.81865	-22.79974	-23.67904	-23.75293
4	-21.52303	-22.67040	-22.67040	-23.51436	-23.51436
L.R. Test:	Rank = 1	Rank = 2	Rank = 2	Rank = 2	Rank = 2

Vector Error Correction Estimates

Table 9

Date: 07/26/98 Time: 20:43
Sample(adjusted): 1976 1996
Included observations: 21 after adjusting endpoints
Standard errors & t-statistics in parentheses

Cointegrating Eq:	CointEq1
LIM(-1)	1.000000
LRESV2(-1)	-0.260333 (0.01261) (-20.6425)
LX2(-1)	-1.211178 (0.04764) (-25.4222)
LXR(-1)	-0.271259 (0.05226) (-5.19068)
@TREND(57)	-0.005814 (0.00090) (-6.45213)
C	4.482241

Error Correction:	D(LIM)	D(LRESV2)	D(LX2)	D(LXR)
CointEq1	-1.295979 (0.66294) (-1.95490)	7.836592 (3.69281) (2.12212)	-0.119644 (0.58039) (-0.20614)	0.991857 (0.91939) (1.07882)
D(LIM(-1))	0.846313 (0.59722) (1.41708)	-3.396405 (3.32677) (-1.02093)	0.274959 (0.52286) (0.52588)	-0.712946 (0.82826) (-0.86078)
D(LIM(-2))	-0.255022 (0.20776) (-1.22750)	0.800497 (1.15729) (0.69170)	-0.208921 (0.18189) (-1.14863)	0.003854 (0.28813) (0.01338)
D(LRESV2(-1))	0.040248 (0.09208) (0.43711)	1.484849 (0.51290) (2.89502)	0.109230 (0.08061) (1.35503)	0.071472 (0.12769) (0.55971)
D(LRESV2(-2))	-0.261361 (0.16252) (-1.60818)	0.720677 (0.90530) (0.79606)	-0.025130 (0.14228) (-0.17662)	0.221090 (0.22539) (0.98092)

Vector Error Correction Estimates

D(LX2(-1))	-0.162886 (0.56382) (-0.28890)	7.743883 (3.14070) (2.46566)	0.158568 (0.49361) (0.32124)	0.370968 (0.78193) (0.47443)
D(LX2(-2))	-1.068019 (0.75315) (-1.41808)	1.445573 (4.19531) (0.34457)	0.055292 (0.65937) (0.08386)	0.995465 (1.04449) (0.95306)
D(LXR(-1))	0.096146 (0.27279) (0.35246)	3.856460 (1.51953) (2.53793)	-0.030411 (0.23882) (-0.12734)	-0.063158 (0.37831) (-0.16695)
D(LXR(-2))	-0.753485 (0.42669) (-1.76587)	2.569962 (2.37685) (1.08125)	-0.215425 (0.37356) (-0.57668)	0.535708 (0.59176) (0.90528)
C	0.022131 (0.01539) (1.43770)	-0.035988 (0.08575) (-0.41970)	0.006102 (0.01348) (0.45276)	-0.012697 (0.02135) (-0.59473)
R-squared	0.824757	0.689683	0.730032	0.195805
Adj. R-squared	0.681375	0.435787	0.509149	-0.462172
Sum sq. resids	0.039423	1.223275	0.030217	0.075824
S.E. equation	0.059866	0.333477	0.052412	0.083025
Log likelihood	36.12051	0.053765	38.91311	29.25291
Akaike AIC	-5.325537	-1.890610	-5.591499	-4.671480
Schwarz SC	-4.828146	-1.393218	-5.094108	-4.174089
Mean dependent	0.027323	0.031641	0.018523	-0.009698
S.D. dependent	0.106057	0.443960	0.074809	0.068661

Determinant Residual Covariance	3.83E-11
Log Likelihood	174.6561
Akaike Information Criteria	-22.91400
Schwarz Criteria	-22.35443