

**VECTOR ERROR CORRECTION MODEL
AN EIEWS APPLICATION**

DATA

OBS	CONS	EX	GDP
1960	50.3571820065724	1.436314375543993	35.06
1961	50.44602981704844	1.414639086288515	35.66
1962	57.87973563390968	1.529995655139035	37.829999999999999
1963	72.30876266846817	1.746588470252854	41.4
1964	77.65894483497146	1.801413705288134	43.11
1965	80.01789097295138	1.808722671178829	44.24
1966	103.3959802648729	2.092188997670435	49.42
1967	111.4545479010655	2.158298758734808	51.639999999999999
1968	126.3149842090619	2.29246795297753	55.1
1969	138.3544445826076	2.384188257497977	58.03
1970	149.9101662576111	2.462792282858734	60.87
1971	164.6520943574338	2.562279713000837	64.260000000000001
1972	187.652510462732	2.71841967930946	69.03
1973	195.7883202671454	2.746364430735662	71.290000000000001
1974	214.2387909811739	2.846270638782701	75.269999999999999
1975	241.5956850190365	2.994864076100613	80.67
1976	288.8777280081801	3.241810436630907	89.11
1977	301.7071972796757	3.274087870642167	92.150000000000001
1978	303.5576321942626	3.245564334376805	93.53
1979	292.6453927075388	3.148417350269379	92.95
1980	271.2280624530767	2.991046123214344	90.68
1981	291.7390191562373	3.068353167398373	95.08
1982	305.7957032663952	3.105470734908046	98.47
1983	329.3366611200287	3.18630670588263	103.36
1984	366.2961416420144	3.320907902466133	110.3
1985	388.5460089277105	3.379248642613589	114.98
1986	433.4514842815714	3.522850164837219	123.04
1987	503.9316808933449	3.740863194219768	134.71
1988	513.4574511658142	3.732335910197094	137.57
1989	505.2288643136024	3.663467945135251	137.91
1990	583.8524371122994	3.874783893763601	150.68
1991	582.088640756102	3.827767743513527	152.07
1992	635.0129001548662	3.940019235309712	161.17
1993	716.5900930759865	4.115022930262929	174.14
1994	634.7767454295248	3.855543886233752	164.64
1995	706.742728301101	4.004661878406058	176.48

Here,

GDP = GDP

CONS = Consumption

EX= Export

UNIT ROOT TESTING USING AUGMENTED DICKEY FULLER

**AT LEVEL
GDP DATA**

CONSTANT

Null Hypothesis: GDP has a unit root				
Exogenous: Constant				
Lag Length: 4 (Automatic based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic				
			1.988269	0.9998
Test critical values:	1% level		-3.661661	
	5% level		-2.960411	
	10% level		-2.619160	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GDP)				
Method: Least Squares				
Date: 04/28/09 Time: 17:57				
Sample (adjusted): 1965 1995				
Included observations: 31 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	0.048411	0.024349	1.988269	0.0578
D(GDP(-1))	-0.147014	0.171264	-0.858406	0.3988
D(GDP(-2))	-0.244528	0.216968	-1.127026	0.2704
D(GDP(-3))	0.453140	0.224105	2.021994	0.0540
D(GDP(-4))	-0.797928	0.238180	-3.350101	0.0026
C	2.392465	1.819849	1.314650	0.2006
R-squared	0.494439	Mean dependent var		4.302258
Adjusted R-squared	0.393326	S.D. dependent var		4.621828
S.E. of regression	3.599908	Akaike info criterion		5.571679
Sum squared resid	323.9834	Schwarz criterion		5.849225
Log likelihood	-80.36102	Hannan-Quinn criter.		5.662152
F-statistic	4.889996	Durbin-Watson stat		1.741953
Prob(F-statistic)	0.002953			

CONSTANT LINEAR TREND

Null Hypothesis: GDP has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 4 (Automatic based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0.705177	0.9638
Test critical values:	1% level		-4.284580	
	5% level		-3.562882	
	10% level		-3.215267	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GDP)				
Method: Least Squares				
Date: 04/28/09 Time: 18:01				
Sample (adjusted): 1965 1995				
Included observations: 31 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.093885	0.133137	-0.705177	0.4875
D(GDP(-1))	-0.081641	0.180933	-0.451220	0.6559
D(GDP(-2))	-0.126112	0.242081	-0.520951	0.6072
D(GDP(-3))	0.533780	0.235297	2.268537	0.0326
D(GDP(-4))	-0.696492	0.255008	-2.731253	0.0116
C	3.764396	2.209285	1.703898	0.1013
@TREND(1960)	0.554498	0.510118	1.086998	0.2878
R-squared	0.518160	Mean dependent var	4.302258	
Adjusted R-squared	0.397701	S.D. dependent var	4.621828	
S.E. of regression	3.586906	Akaike info criterion	5.588137	
Sum squared resid	308.7815	Schwarz criterion	5.911940	
Log likelihood	-79.61612	Hannan-Quinn criter.	5.693689	
F-statistic	4.301519	Durbin-Watson stat	1.706690	
Prob(F-statistic)	0.004410			

NONE

Null Hypothesis: GDP has a unit root					
Exogenous: None					
Lag Length: 4 (Automatic based on SIC, MAXLAG=9)					
			t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic			3.258945	0.9994	
Test critical values:	1% level		-2.641672		
	5% level		-1.952066		
	10% level		-1.610400		
*MacKinnon (1996) one-sided p-values.					
Augmented Dickey-Fuller Test Equation					
Dependent Variable: D(GDP)					
Method: Least Squares					
Date: 04/28/09 Time: 18:04					
Sample (adjusted): 1965 1995					
Included observations: 31 after adjustments					
	Coefficient	Std. Error	t-Statistic	Prob.	
	GDP(-1)	0.066455	0.020391	3.258945	0.0031
	D(GDP(-1))	-0.117162	0.172113	-0.680724	0.5021
	D(GDP(-2))	-0.235058	0.219864	-1.069105	0.2948
	D(GDP(-3))	0.486952	0.225721	2.157315	0.0404
	D(GDP(-4))	-0.791527	0.241443	-3.278322	0.0030
R-squared	0.459488	Mean dependent var		4.302258	
Adjusted R-squared	0.376332	S.D. dependent var		4.621828	
S.E. of regression	3.649980	Akaike info criterion		5.574010	
Sum squared resid	346.3811	Schwarz criterion		5.805298	
Log likelihood	-81.39716	Hannan-Quinn criter.		5.649404	
Durbin-Watson stat	1.724202				

**FIRST DIFFERENCED
GDP DATA**

CONSTANT

Null Hypothesis: D(GDP) has a unit root					
Exogenous: Constant					
Lag Length: 3 (Automatic based on SIC, MAXLAG=9)					
			t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic			-3.055706	0.0407	
Test critical values:	1% level		-3.661661		
	5% level		-2.960411		
	10% level		-2.619160		
*MacKinnon (1996) one-sided p-values.					
Augmented Dickey-Fuller Test Equation					
Dependent Variable: D(GDP,2)					
Method: Least Squares					
Date: 04/28/09 Time: 18:11					
Sample (adjusted): 1965 1995					
Included observations: 31 after adjustments					
	Coefficient	Std. Error	t-Statistic	Prob.	
	D(GDP(-1))	-1.074904	0.351769	-3.055706	0.0051
	D(GDP(-1),2)	0.017256	0.328943	0.052458	0.9586
	D(GDP(-2),2)	-0.001508	0.304697	-0.004949	0.9961
	D(GDP(-3),2)	0.641095	0.237160	2.703216	0.0119
	C	4.432053	1.586258	2.794030	0.0096
R-squared	0.760945	Mean dependent var		0.326774	
Adjusted R-squared	0.724167	S.D. dependent var		7.233193	
S.E. of regression	3.798858	Akaike info criterion		5.653968	
Sum squared resid	375.2145	Schwarz criterion		5.885257	
Log likelihood	-82.63651	Hannan-Quinn criter.		5.729362	
F-statistic	20.69037	Durbin-Watson stat		1.649583	
Prob(F-statistic)	0.000000				

CONSTANT LINEAR TREND

Null Hypothesis: D(GDP) has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.916803	0.0233
Test critical values:	1% level		-4.284580	
	5% level		-3.562882	
	10% level		-3.215267	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GDP,2)				
Method: Least Squares				
Date: 04/28/09 Time: 18:24				
Sample (adjusted): 1965 1995				
Included observations: 31 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.646435	0.420352	-3.916803	0.0006
D(GDP(-1),2)	0.517339	0.383462	1.349129	0.1894
D(GDP(-2),2)	0.301154	0.316767	0.950711	0.3509
D(GDP(-3),2)	0.771295	0.229555	3.359964	0.0025
C	2.757933	1.669345	1.652105	0.1110
@TREND(1960)	0.200797	0.092016	2.182195	0.0387
R-squared	0.799194	Mean dependent var	0.326774	
Adjusted R-squared	0.759033	S.D. dependent var	7.233193	
S.E. of regression	3.550659	Akaike info criterion	5.544129	
Sum squared resid	315.1794	Schwarz criterion	5.821675	
Log likelihood	-79.93399	Hannan-Quinn criter.	5.634602	
F-statistic	19.89967	Durbin-Watson stat	1.736063	
Prob(F-statistic)	0.000000			

NONE

Null Hypothesis: D(GDP) has a unit root				
Exogenous: None				
Lag Length: 4 (Automatic based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0.277830	0.5774
Test critical values:	1% level		-2.644302	
	5% level		-1.952473	
	10% level		-1.610211	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GDP,2)				
Method: Least Squares				
Date: 04/28/09 Time: 18:25				
Sample (adjusted): 1966 1995				
Included observations: 30 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
	t			
D(GDP(-1))	-0.045384	0.163353	-0.277830	0.7834
D(GDP(-1),2)	-0.673401	0.210422	-3.200236	0.0037
D(GDP(-2),2)	-0.716984	0.277300	-2.585589	0.0159
D(GDP(-3),2)	0.058719	0.276690	0.212219	0.8337
D(GDP(-4),2)	-0.682358	0.246504	-2.768141	0.0105
R-squared	0.763291	Mean dependent var		0.357000
Adjusted R-squared	0.725417	S.D. dependent var		7.354855
S.E. of regression	3.853991	Akaike info criterion		5.687107
Sum squared resid	371.3312	Schwarz criterion		5.920640
Log likelihood	-80.30661	Hannan-Quinn criter.		5.761817
Durbin-Watson stat	2.082390			

SECOND DIFFERENCED

GDP DATA

CONSTANT

Null Hypothesis: D(GDP,2) has a unit root					
Exogenous: Constant					
Lag Length: 3 (Automatic based on SIC, MAXLAG=9)					
			t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic			-4.760247	0.0006	
Test critical values:	1% level		-3.670170		
	5% level		-2.963972		
	10% level		-2.621007		
*MacKinnon (1996) one-sided p-values.					
Augmented Dickey-Fuller Test Equation					
Dependent Variable: D(GDP,3)					
Method: Least Squares					
Date: 04/28/09 Time: 18:27					
Sample (adjusted): 1966 1995					
Included observations: 30 after adjustments					
	Coefficient	Std. Error	t-Statistic	Prob.	
	D(GDP(-1),2)	-3.176340	0.667264	-4.760247	0.0001
	D(GDP(-1),3)	1.468931	0.598738	2.453377	0.0215
	D(GDP(-2),3)	0.700831	0.426936	1.641535	0.1132
	D(GDP(-3),3)	0.715241	0.234918	3.044639	0.0054
	C	0.348842	0.710147	0.491225	0.6276
R-squared	0.915390	Mean dependent var		0.730667	
Adjusted R-squared	0.901852	S.D. dependent var		12.26178	
S.E. of regression	3.841442	Akaike info criterion		5.680584	
Sum squared resid	368.9169	Schwarz criterion		5.914117	
Log likelihood	-80.20877	Hannan-Quinn criter.		5.755294	
F-statistic	67.61804	Durbin-Watson stat		2.126615	
Prob(F-statistic)	0.000000				

CONSTANT LINEAR TREND

Null Hypothesis: D(GDP,2) has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 7 (Automatic based on SIC, MAXLAG=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-3.647883	0.0450
Test critical values: 1% level	-4.356068	
5% level	-3.595026	
10% level	-3.233456	

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

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(GDP,3)
 Method: Least Squares
 Date: 04/28/09 Time: 19:00
 Sample (adjusted): 1970 1995
 Included observations: 26 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1),2)	-5.814145	1.593841	-3.647883	0.0022
D(GDP(-1),3)	4.007776	1.505976	2.661248	0.0171
D(GDP(-2),3)	3.252723	1.369128	2.375763	0.0303
D(GDP(-3),3)	2.936704	1.160643	2.530239	0.0223
D(GDP(-4),3)	2.014007	0.969006	2.078425	0.0541
D(GDP(-5),3)	1.538677	0.748311	2.056200	0.0565
D(GDP(-6),3)	1.496765	0.554521	2.699203	0.0158
D(GDP(-7),3)	0.863206	0.344801	2.503489	0.0235
C	0.721197	2.329196	0.309633	0.7608
@TREND(1960)	0.007553	0.099647	0.075797	0.9405
R-squared	0.948404	Mean dependent var		0.841154
Adjusted R-squared	0.919382	S.D. dependent var		13.06362
S.E. of regression	3.709206	Akaike info criterion		5.743236
Sum squared resid	220.1314	Schwarz criterion		6.227119
Log likelihood	-64.66207	Hannan-Quinn criter.		5.882577
F-statistic	32.67807	Durbin-Watson stat		1.821467
Prob(F-statistic)	0.000000			

NONE

Null Hypothesis: D(GDP,2) has a unit root				
Exogenous: None				
Lag Length: 3 (Automatic based on SIC, MAXLAG=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.807223	0.0000
Test critical values:	1% level		-2.644302	
	5% level		-1.952473	
	10% level		-1.610211	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GDP,3)				
Method: Least Squares				
Date: 04/28/09 Time: 19:01				
Sample (adjusted): 1966 1995				
Included observations: 30 after adjustments				
	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1),2)	-3.133773	0.651888	-4.807223	0.0001
D(GDP(-1),3)	1.426386	0.583733	2.443559	0.0216
D(GDP(-2),3)	0.672544	0.416817	1.613524	0.1187
D(GDP(-3),3)	0.703501	0.230264	3.055190	0.0051
R-squared	0.914573	Mean dependent var		0.730667
Adjusted R-squared	0.904716	S.D. dependent var		12.26178
S.E. of regression	3.784979	Akaike info criterion		5.623524
Sum squared resid	372.4777	Schwarz criterion		5.810350
Log likelihood	-80.35285	Hannan-Quinn criter.		5.683291
Durbin-Watson stat	2.103159			

DECISION:

Above ADF operation reveals that GDP is stationary at second difference. So we will use second differenced data of GDP as VAR or VECM model requires stationary data.

HYPOTHESIS SETTING ABOUT DATA

ADF TEST

Null: There is Unit Root in the Data

Alternative: Data is stationary

CORRELOGRAM Q STATISTICS

Null: Data is stationary

Alternative: It is unit root

CORRELOGRAM

GDP AT LEVEL

Date: 04/28/09 Time: 19:03						
Sample: 1960 1995						
Included observations: 36						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. *****	. *****	1	0.911	0.911	32.416	0.000
. *****	. .	2	0.831	0.012	60.224	0.000
. *****	.* .	3	0.732	-0.156	82.456	0.000
. *****	. .	4	0.642	-0.019	100.06	0.000
. *****	. .	5	0.560	0.012	113.88	0.000
. ***	* .	6	0.471	-0.096	123.99	0.000
. ***	. .	7	0.395	0.002	131.34	0.000
. **	. .	8	0.316	-0.051	136.23	0.000
. **	* .	9	0.237	-0.077	139.09	0.000
. *	. .	10	0.169	-0.001	140.58	0.000
. *	. .	11	0.107	0.001	141.21	0.000
. .	. .	12	0.049	-0.056	141.35	0.000

GDP AT FIRST DIFFERENCED

Date: 04/28/09 Time: 19:04						
Sample: 1960 1995						
Included observations: 35						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
** .	** .	1	-0.245	-0.245	2.2890	0.130
. .	. .	2	0.037	-0.024	2.3436	0.310
. **	. **	3	0.314	0.338	6.3398	0.096
** .	* .	4	-0.302	-0.174	10.152	0.038
. *	. .	5	0.157	0.032	11.223	0.047
. *	. *	6	0.117	0.106	11.831	0.066
* .	. .	7	-0.200	-0.042	13.685	0.057
. .	** .	8	-0.003	-0.212	13.686	0.090
. *	. *	9	0.130	0.128	14.529	0.105
. .	. *	10	-0.058	0.147	14.701	0.143
. .	. .	11	0.041	-0.010	14.792	0.192
. .	* .	12	-0.011	-0.161	14.800	0.253

DECISION

GDP is stationary at First differenced as per Correlogram Q statistics result. Here I have taken Lag number one third of data size.

FINAL DECISION

We have taken ADF testing as benchmark so GDP is stationary at second difference, that is DD(GDP).

In this similar fashion I have come to decision that EX data is stationary at first difference while CONS is at second difference.

COINTEGRATION TEST

- Now perform cointegration analysis using Johansen Cointegration Test
- *GDP*, *EX* and *CONS* are found cointegrated. There exists 1 cointegrated vector or 1 error term as per *Trace* and *Maximum Eigenvalue* shown below. It implies that there exists a long run relationship among three variables. If we get one or more than one cointegrated vector (error terms) in the model, we say that there exists a long run relationship among the variables.
- Cointegration is tested in non-stationary data only
- We choose option no. 3 in the EVIEWS screen as each data has some sort of trend from plotting
- We adopted 2 lag length or we can select from lag selection
- All variables are endogenous. No exogenous variables in the model.

JOHANSEN CO-INTEGRATION TEST

Date: 04/28/09 Time: 19:15
 Sample (adjusted): 1963 1995
 Included observations: 33 after adjustments
 Trend assumption: Linear deterministic trend
 Series: GDP EX CONS
 Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.770788	57.01501	29.79707	0.0000
At most 1	0.222804	8.402391	15.49471	0.4234
At most 2	0.002551	0.084307	3.841466	0.7715

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.770788	48.61262	21.13162	0.0000
At most 1	0.222804	8.318084	14.26460	0.3473
At most 2	0.002551	0.084307	3.841466	0.7715

Max-eigenvalue 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

Unrestricted Cointegrating Coefficients (normalized by b*S11*b=l):

GDP	EX	CONS
-1.586883	-0.864775	0.248986
0.705227	-6.073701	-0.121876
-0.328385	-2.038385	0.077166

Unrestricted Adjustment Coefficients (alpha):

D(GDP)	D(EX)	D(CONS)
1.665349	0.052324	11.45003
0.918264	0.035825	5.734617
-0.087033	-0.001444	-0.637156

1 Cointegrating Equation(s): Log likelihood -8.168178

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EX	CONS
1.000000	0.544952	-0.156902
	(0.43567)	(0.00182)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-2.642715
	(0.87368)
D(EX)	-0.083032
	(0.02729)
D(CONS)	-18.16986
	(5.90095)

2 Cointegrating Equation(s): Log likelihood -4.009135

Normalized cointegrating coefficients (standard error in parentheses)

GDP	EX	CONS
1.000000	0.000000	-0.157849
		(0.00190)
0.000000	1.000000	0.001738
		(0.00154)

Adjustment coefficients (standard error in parentheses)

D(GDP)	-1.995131	-7.017411
	(0.90131)	(3.18422)
D(EX)	-0.057767	-0.262840
	(0.02715)	(0.09590)
D(CONS)	-14.12565	-44.73205
	(6.14261)	(21.7011)

Null Hypothesis: Number of cointegration equation or error term(s)

VECTOR AUTOREGRESSION MODEL

- Since our target is to find out how and in what ways GDP is affected by other variables, we must put GDP variable first in EViews screen followed by EX and CONS while going for estimating VECM model.
- We need to set variables such as GDP, EX and CONS in the EViews program in such a way so that these variables become stationary. For your information, Eviews automatically do one difference in case of VECM (restricted Var) operation. So we put the variable in the following manner in EViews that is DGDP, EX and DCONS.
- As we have already noticed that the variables are cointegrated, we go for VECM model (restricted Var). If variables are not cointegrated, we should go for unrestricted Var.
- We select one cointegrated vector and choose 2 lag length
- We choose option 3 as data appears to have trend from plotting.
- VECM (restricted Var) is tested using stationary data.
- No exogenous variable.. All variables are endogenous.
- As per Nasiruddin Ahmed (2001), *the main feature of the ECM (Error Correction Model) is its capability to correct for any disequilibrium that may shock the system from time to time. The error correction term picks up such disequilibrium and guides the variables of the system back to equilibrium.*
- ECM is true in case of single equation while in case of VECM there is a system of equations.

VECTOR ERROR CORRECTION MODEL OUTCOME

Vector Error Correction Estimates			
Date: 04/28/09 Time: 19:34			
Sample (adjusted): 1964 1995			
Included observations: 32 after adjustments			
Standard errors in () & t-statistics in []			
Cointegrating Eq:	CointEq1		
DGDP(-1)	1.000000		
EX(-1)	-0.070407		
	(0.07890)		
	[-0.89239]		
DCONS(-1)	-0.154861		
	(0.00449)		
	[-34.5047]		
C	-0.957881		
Error Correction:	D(DGDP)	D(EX)	D(DCONS)
CointEq1	29.36364	0.617032	208.0079
	(9.49235)	(0.30107)	(64.2423)
	[3.09340]	[2.04945]	[3.23786]
D(DGDP(-1))	-23.43787	-0.499782	-161.2299
	(15.9132)	(0.50472)	(107.697)
	[-1.47286]	[-0.99021]	[-1.49707]
D(DGDP(-2))	-4.675905	-0.159440	-30.56817
	(3.93239)	(0.12472)	(26.6136)
	[-1.18907]	[-1.27833]	[-1.14859]
D(EX(-1))	19.49527	0.647038	146.5129
	(62.6168)	(1.98603)	(423.778)
	[0.31134]	[0.32579]	[0.34573]
D(EX(-2))	-38.96146	-0.436148	-267.6225
	(62.9742)	(1.99737)	(426.197)
	[-0.61869]	[-0.21836]	[-0.62793]
D(DCONS(-1))	3.380974	0.074264	23.24749

	(2.14833)	(0.06814)	(14.5395)
	[1.57377]	[1.08988]	[1.59892]
D(DCONS(-2))	0.675738	0.023574	4.385334
	(0.60010)	(0.01903)	(4.06136)
	[1.12604]	[1.23855]	[1.07977]
C	3.098183	0.086804	20.42156
	(1.30597)	(0.04142)	(8.83856)
	[2.37232]	[2.09562]	[2.31051]
R-squared	0.824033	0.325637	0.839042
Adj. R-squared	0.772709	0.128947	0.792097
Sum sq. resids	277.0088	0.278667	12687.87
S.E. equation	3.397357	0.107755	22.99263
F-statistic	16.05555	1.655588	17.87252
Log likelihood	-79.93905	30.48956	-141.1287
Akaike AIC	5.496190	-1.405598	9.320543
Schwarz SC	5.862624	-1.039164	9.686977
Mean dependent	0.258438	0.070565	1.798030
S.D. dependent	7.126065	0.115456	50.42639
Determinant resid covariance (dof adj.)		0.002424	
Determinant resid covariance		0.001023	
Log likelihood		-26.05326	
Akaike information criterion		3.315828	
Schwarz criterion		4.552543	

SYSTEM EQUATIONS

$$D(DGDP) = C(1)*(DGDP(-1) - 0.0704070787894*EX(-1) - 0.154861218042*DCONS(-1) - 0.957880949027) + C(2)*D(DGDP(-1)) + C(3)*D(DGDP(-2)) + C(4)*D(EX(-1)) + C(5)*D(EX(-2)) + C(6)*D(DCONS(-1)) + C(7)*D(DCONS(-2)) + C(8)$$

$$D(EX) = C(9)*(DGDP(-1) - 0.0704070787894*EX(-1) - 0.154861218042*DCONS(-1) - 0.957880949027) + C(10)*D(DGDP(-1)) + C(11)*D(DGDP(-2)) + C(12)*D(EX(-1)) + C(13)*D(EX(-2)) + C(14)*D(DCONS(-1)) + C(15)*D(DCONS(-2)) + C(16)$$

$$D(DCONS) = C(17)*(DGDP(-1) - 0.0704070787894*EX(-1) - 0.154861218042*DCONS(-1) - 0.957880949027) + C(18)*D(DGDP(-1)) + C(19)*D(DGDP(-2)) + C(20)*D(EX(-1)) + C(21)*D(EX(-2)) + C(22)*D(DCONS(-1)) + C(23)*D(DCONS(-2)) + C(24)$$

System: UNTITLED				
Estimation Method: Least Squares				
Date: 04/28/09 Time: 19:35				
Sample: 1964 1995				
Included observations: 32				
Total system (balanced) observations 96				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	29.36364	9.492346	3.093402	0.0028
C(2)	-23.43787	15.91316	-1.472861	0.1451
C(3)	-4.675905	3.932392	-1.189074	0.2383
C(4)	19.49527	62.61681	0.311342	0.7564
C(5)	-38.96146	62.97423	-0.618689	0.5381
C(6)	3.380974	2.148335	1.573765	0.1199
C(7)	0.675738	0.600100	1.126042	0.2639
C(8)	3.098183	1.305972	2.372320	0.0204
C(9)	0.617032	0.301071	2.049454	0.0441
C(10)	-0.499782	0.504722	-0.990213	0.3254
C(11)	-0.159440	0.124725	-1.278335	0.2052
C(12)	0.647038	1.986034	0.325794	0.7455
C(13)	-0.436148	1.997370	-0.218361	0.8278
C(14)	0.074264	0.068139	1.089880	0.2794
C(15)	0.023574	0.019034	1.238548	0.2195
C(16)	0.086804	0.041422	2.095620	0.0396
C(17)	208.0079	64.24231	3.237865	0.0018
C(18)	-161.2299	107.6971	-1.497067	0.1387
C(19)	-30.56817	26.61365	-1.148590	0.2545

C(20)	146.5129	423.7781	0.345730	0.7306
C(21)	-267.6225	426.1971	-0.627931	0.5320
C(22)	23.24749	14.53950	1.598919	0.1142
C(23)	4.385334	4.061361	1.079770	0.2838
C(24)	20.42156	8.838559	2.310508	0.0237
Determinant residual covariance				
		0.001023		
Equation: $D(DGDP) = C(1) * (DGDP(-1) - 0.0704070787894 * EX(-1) - 0.154861218042 * DCONS(-1) - 0.957880949027) + C(2) * D(DGDP(-1)) + C(3) * D(DGDP(-2)) + C(4) * D(EX(-1)) + C(5) * D(EX(-2)) + C(6) * D(DCONS(-1)) + C(7) * D(DCONS(-2)) + C(8)$				
Observations: 32				
R-squared	0.824033	Mean dependent var	0.258438	
Adjusted R-squared	0.772709	S.D. dependent var	7.126065	
S.E. of regression	3.397357	Sum squared resid	277.0088	
Prob(F-statistic)	1.926382			
Equation: $D(EX) = C(9) * (DGDP(-1) - 0.0704070787894 * EX(-1) - 0.154861218042 * DCONS(-1) - 0.957880949027) + C(10) * D(DGDP(-1)) + C(11) * D(DGDP(-2)) + C(12) * D(EX(-1)) + C(13) * D(EX(-2)) + C(14) * D(DCONS(-1)) + C(15) * D(DCONS(-2)) + C(16)$				
Observations: 32				
R-squared	0.325637	Mean dependent var	0.070565	
Adjusted R-squared	0.128947	S.D. dependent var	0.115456	
S.E. of regression	0.107755	Sum squared resid	0.278667	
Prob(F-statistic)	2.040340			
Equation: $D(DCONS) = C(17) * (DGDP(-1) - 0.0704070787894 * EX(-1) - 0.154861218042 * DCONS(-1) - 0.957880949027) + C(18) * D(DGDP(-1)) + C(19) * D(DGDP(-2)) + C(20) * D(EX(-1)) + C(21) * D(EX(-2)) + C(22) * D(DCONS(-1)) + C(23) * D(DCONS(-2)) + C(24)$				
Observations: 32				
R-squared	0.839042	Mean dependent var	1.798030	
Adjusted R-squared	0.792097	S.D. dependent var	50.42639	
S.E. of regression	22.99263	Sum squared resid	12687.87	
Prob(F-statistic)	1.897928			

GRANGER CAUSALITY: WALD STATISTICS

Granger causality test can be performed using Wald statistics.

Hypothesis:

Null Ho. Lagged values of coefficients in each equation are zero

Alt H1: Not zero

- Granger causality is done to see the short run causality running from independent variable to dependent variable.
- It is found that test statistics for granger test should follow chi-square distribution instead of F distribution. So we would follow Chi-square result.

DEPENDENT VARIABLES			
INDEPENDENT VARIABLES	DD(GDP) p-value	D(EX) p-value	D(DCONS) p-value
DD(GDP)	0.3133 c(2)=c(3)=0	0.4240 c(10)=c(11)=0	0.3097 c(18)=c(19)=0
D(EX)	0.1591 c(4)=c(5)=0	0.7799 c(12)=c(13)=0	0.2066 c(20)=c(21)=0
D(DCONS)	0.2870 c(6)=c(7)=0	0.4233 c(14)=c(15)=0	0.2780 c(22)=c(23)=0

The figure in the table are the p-values of chi-square for Wald statistics. The Granger causality in above figure shows that there is no short run causality running from lag of independent variables to dependent variables.

DECISION:

Since all values are not significant (as p values are more than 0.05) in the above table so we can not reject null meaning that there is no short causality running from independent variables to dependent variables.

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