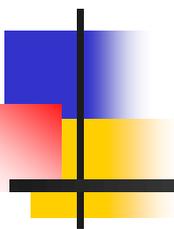


ARDL MODEL ESTIMATION



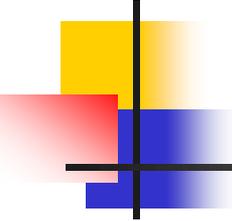
Dr. Tony Orji

Department of Economics

University of Nigeria, Nsukka

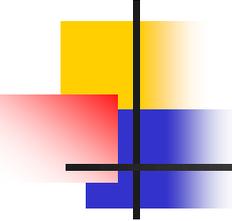
Email: anthony.orji@unn.edu.ng

Visit: www.successtonicsblog.com



INTRODUCTION

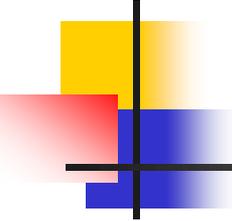
- The University is a place of learning, light and liberty.....Ben Disreali
- Excellence is in the Student, not just in the University.... Ben Disreali
- You have what it takes to succeed, if only you can pay the price of diligence, determination and discipline!



INTRODUCTION

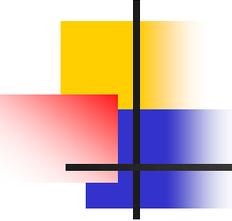
Types of Lag

- Autoregressive refers to lags in the dependent variable
- Distributed lag refers to lags of the explanatory variables
- Moving average refers to lags in the error term .



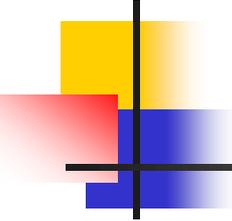
INTRODUCTION

- The autoregressive distributed lag (ARDL) model has been used for decades to model the relationship between (economic) variables in a single-equation time-series setup.



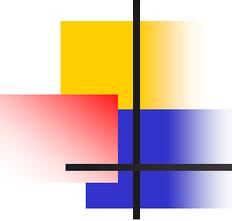
INTRODUCTION

- The existence of a long-run / cointegrating relationship can be tested based on the Error Correction representation. A bounds testing procedure is available to draw conclusive inference without knowing whether the variables are integrated of order zero or one, $I(0)$ or $I(1)$, respectively (Pesaran, Shin, and Smith, 2001).



INTRODUCTION contd...

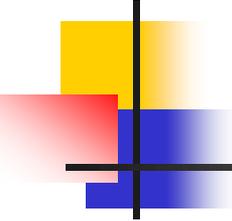
- Autoregressive Distributed Lag (ARDL) model is often used to estimate the impact of independent variable(s) on the dependent variable.
- The Autoregressive nature of the model implies that there is possibility of the lag value(s) of the dependent variable explaining their current value.



INTRODUCTION contd...

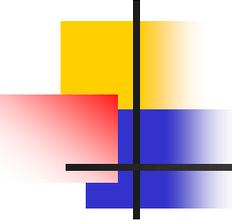
- An Autoregressive Distributed lag model or ARDL model refers to a model with lags of both the dependent and explanatory variables. An ARDL(1,1) model would have 1 lag on both variables:

$$y_t = \alpha_0 + \alpha_1 x_t + \alpha_2 x_{t-1} + \alpha_3 y_{t-1} + u_t$$



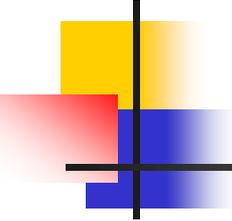
INTRODUCTION contd...

- This is different from distributed lag model where only the explanatory variables are in their lag forms.
- Theory has it that past values of variables such as Gross domestic product, Investment etc. have effect on their current values.



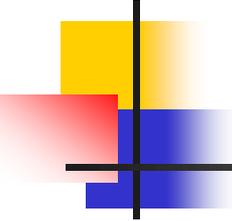
INTRODUCTION contd...

- So, estimating a model with any of these variables as dependent variable would require the use of an ARDL model.



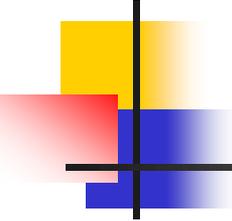
INTRODUCTION contd...

- Without much stress, we can successfully conduct ARDL model estimation using e-views 9. Although other versions of e-views can perform this task but using e-views 9 saves time, stress and rigorous steps associated with others.



INTRODUCTION contd...

- Here, we shall be making use of e-views 9. The superiority of this version over others is that after evaluating several models, it has the possibility of selecting the best lags for the model.



Estimation of ARDL Model ...

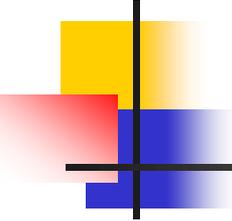
- Steps in estimating ARDL model using E-views 9 econometrics software.
- There are several steps involved in conducting autoregressive distributed lag model using E-views 9.

Estimation of ARDL Model ...

Assumptions of ARDL approach

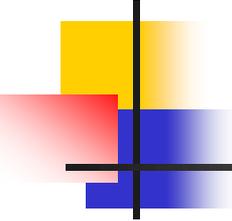
An ARDL is a least squares regression containing lags of the dependent and explanatory variables

1. First assumption we cant run ARDL if we have any variable $I(2)$
2. Lags must be appropriate
3. Error must be serially independent
4. Model must be dynamically stable
5. If variables are stationary at level we can apply ARDL
6. If variables are stationary at first difference we also can run ARDL
7. If variables are stationary at level and first difference here also we can run ARDL (mixture stationary).



Estimation of ARDL Model ...

- Importing data from file
- To begin with, we have to load the data we are using in E-views. The simplest way to do that using E-views 9 is to open the file with E-views 9, then click on next, next and finished.



Estimation of ARDL Model ...

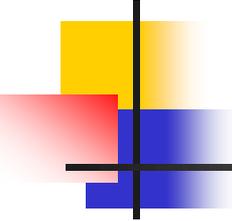
- Better still, one can decide to import the data into E-views by going to file-import-import from file. This will take you to the destination where the saved data is. Click on it and watch as it uploads.

Estimation of ARDL Model ...

The image shows a presentation software interface with a slide titled "Estimation of ARDL Model ...". The slide content is partially obscured by a software window. The software window has a menu bar with "File", "Edit", "Object", "View", "Proc", "Quick", "Options", "Add-ins", "Window", and "Help". The "File" menu is open, showing options: New, Open, Save (Ctrl+S), Save As..., Close, Import, Export, Print (Ctrl+P), Print Setup..., Run... (F10), and Exit. The "Import" submenu is also open, listing: Import from file..., Table from file..., Matrix from file..., Fetch from DB..., TSD File Import..., and DRI Basic Economics Database... Below the menu, a list of files is shown:

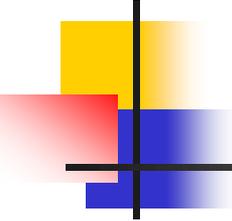
- 0 dr. to...\copy of data for training--good.xlsx
- 1 c:\users\chinanuife em...\chukzo.xlsx
- 2 shapera\shapera data.xlsx
- 3 shapera\data from 81.xlsx
- 4 dan project\dan estimation data.xls
- 5 paul pgd project\paul qrtly data for esti.xlsx
- 6 pg kingsl data\kingsley est.xlsx
- 7 emmanuel work\eco392.xlsx
- 8 pg kingsl data\monthly data set.xlsx
- 9 f:\ozoaniako.xlsx

The status bar at the bottom of the software window shows "Path = c:\users\chinanuife emmanuel\documents", "DB = none", and "WF = none". The presentation software interface includes a slide navigation pane on the left, a slide titled "Import data from file" (highlighted with a red box), and a taskbar at the bottom with various application icons and the system clock showing 10:52 PM on 12/1/2017.



Estimation of ARDL Model ...

- Now that we have loaded the data in E-views, the next thing of interest is to conduct test for structural break and unit root. However, we shall assume that these tests have been conducted and we are to estimate ARDL model.

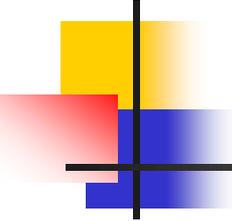


Estimation of ARDL Model ...

- We select the variables starting from the dependent variable to the last of the independent variables and open as equation. See below

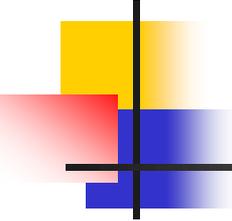
Estimation of ARDL Model ...

The screenshot displays the EViews software interface. The main window shows a workfile named 'COPY OF DATA FOR TRAINING - GOOD' with a range of 1960-2014 and 55 observations. A list of variables is visible on the left, including 'bmsy', 'c', 'logcapexp', 'logio', 'logm1', 'logoexp', 'logrgdp', 'resid', and 'year'. A context menu is open over the 'logcapexp' variable, showing options such as 'Open', 'Preview', 'Copy', 'Paste', 'Fetch from DB...', 'Update...', 'Store to DB...', 'Export to file...', 'Manage Links & Formulae...', 'Rename...', and 'Delete'. A sub-menu is also visible, offering options like 'as Group', 'as Equation...', 'as Factor...', 'as VAR...', 'as System...', and 'as Multiple series'. The taskbar at the bottom shows various application icons and system information, including the path 'c:\users\chinanuife emmanuel\documents', 'DB = none', 'WF = copy of data for training--good', and the date '12/1/2017'.



Estimation of ARDL Model ...

- Click on the method dialogue box and select ARDL at the end. Also, within this window, we are to select the maximum lags for both the dependent and independent variables. For the purpose of our study, let's assume lags 6 for both the dependent and the independent variables.



Estimation of ARDL Model ...

- Note that it is logical to select higher lags and allow the system to make adjustment than to restrict the system on lesser lags.
- Still on the same window, we select the information criterion of interest. Note that the choice of selecting information depends on the results each produces. Here, we are selecting AIC

Estimation of ARDL Model ...

- To choose ARDL, open the equation estimation box and scroll down the "method menu. Different Methods will appear and you will choose ARDL

The screenshot displays the EViews software interface. The main window shows a workfile named "DATA FOR TRAINING" with a range of 1960 to 2014 and 55 observations. The "Equation Estimation" dialog box is open, showing the "Specification" tab. The "Equation specification" field contains the text: `logrgdp c logcapexpp logio logm1 logoexp`. The "Estimation settings" section shows the "Method" dropdown menu open, listing various estimation methods. The "ARDL - Auto-regressive Distributed Lag Models" option is highlighted at the bottom of the list. The "Command" window is visible at the bottom left, and the "Filter" and "Order" options are visible in the top right of the dialog box.

Estimation of ARDL Model ...

The screenshot displays the EViews software interface. The main window shows a list of objects on the left, including 'bmsy', 'c', 'logcapexpp', 'logio', 'logm1', 'logoexp', 'logrgdp', 'resid', and 'year'. The 'Equation Estimation' dialog box is open, showing the following settings:

- Specification:** Dynamic Specification (selected), with the dependent variable followed by a list of dynamic regressors: LOGRGDP LOGOEXP LOGM1 LOGIO LOGCAPEXPP.
- Dynamic Specification:** Automatic Selection, Fixed.
- Dependent Variable:** (empty field).
- Regressors:** Max lags: 6.
- Fixed regressors:** Trend specification: Constant (Level).
- Estimation settings:** Method: ARDL - Auto-regressive Distributed Lag Models, Sample: 1960 2014.

The taskbar at the bottom shows the system tray with the date 11:33 PM and 12/1/2017, and the path c:\users\chinanuife emmanuel\documents.

Regression Output

Equation: UNTITLED Workfile: COPY OF DATA ...

View	Proc	Object	Print	Name	Freeze	Estimate	Forecast	Stats	Resids
				LOGOEXP(-4)		0.620093	0.212393	3.803790	0.0000
				LOGOEXP(-5)		-0.680145	0.183387	-3.708803	0.0012
				LOGM1		2.178977	0.832976	2.615894	0.0158
				LOGM1(-1)		-0.925100	0.743435	-1.244358	0.2265
				LOGIO		-0.474799	0.945390	-0.502225	0.6205
				LOGIO(-1)		-1.672364	1.096770	-1.524808	0.1416
				LOGIO(-2)		1.268483	1.063053	1.193246	0.2455
				LOGIO(-3)		-1.580481	1.043332	-1.514840	0.1440
				LOGIO(-4)		-2.201236	0.997254	-2.207296	0.0380
				LOGIO(-5)		-1.115564	0.984200	-1.133473	0.2692
				LOGIO(-6)		2.213080	0.964843	2.293721	0.0317
				LOGCAPEXPP		0.050638	0.232333	0.217956	0.8295
				LOGCAPEXPP(-1)		-0.394644	0.262399	-1.503982	0.1468
				LOGCAPEXPP(-2)		0.122837	0.253691	0.484202	0.6330
				LOGCAPEXPP(-3)		-0.133909	0.255729	-0.523637	0.6058
				LOGCAPEXPP(-4)		-0.349960	0.259959	-1.346211	0.1919
				C		19.01179	5.461784	3.480875	0.0021

R-squared	0.991064	Mean dependent var	4.876843
Adjusted R-squared	0.980503	S.D. dependent var	1.900713
S.E. of regression	0.265399	Akaike info criterion	0.486097
Sum squared resid	1.549603	Schwarz criterion	1.528528
Log likelihood	15.09063	Hannan-Quinn criter.	0.881594
F-statistic	93.84366	Durbin-Watson stat	1.791332
Prob(F-statistic)	0.000000		

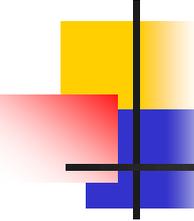
*Note: p-values and any subsequent tests do not account for model selection.

Table: UNTITLED Workfile: COPY OF DATA FOR TR...

View	Proc	Object	Print	Name	Edit+/-	CellFmt	Grid+/-	Title	Comments+/-
				A				B	
				C				D	
				E					
1				Dependent Variable: LOGRGDP					
2				Method: ARDL					
3				Date: 12/01/17 Time: 23:34					
4				Sample (adjusted): 1966 2014					
5				Included observations: 49 after adjustments					
6				Maximum dependent lags: 6 (Automatic selection)					
7				Model selection method: Akaike info criterion (AIC)					
8				Dynamic regressors (6 lags, automatic): LOGOEXP LOGM1 LOGIO					
9				LOGCAPEXPP					
10				Fixed regressors: C					
11				Number of models evaluated: 14406					
12				Selected Model: ARDL(6, 5, 1, 6, 4)					
13									
14				Variable	Coefficient	Std. Error	t-Statistic	Prob.*	
15									
16				LOGRGDP(-1)	0.590039	0.159031	3.710201	0.0012	
17				LOGRGDP(-2)	-0.438168	0.187409	-2.338028	0.0289	
18				LOGRGDP(-3)	-0.252803	0.197520	-1.279888	0.2139	
19				LOGRGDP(-4)	-0.104219	0.215080	-0.484559	0.6328	
20				LOGRGDP(-5)	-0.330099	0.207648	-1.589709	0.1262	
21				LOGRGDP(-6)	0.194304	0.200804	0.967627	0.3437	
22				LOGOEXP	0.501787	0.210525	2.383505	0.0262	
23				LOGOEXP(-1)	0.063382	0.210839	0.300618	0.7665	
24				LOGOEXP(-2)	-0.226859	0.209579	-1.082449	0.2908	
25				LOGOEXP(-3)	-0.336115	0.201666	-1.666693	0.1098	
26									

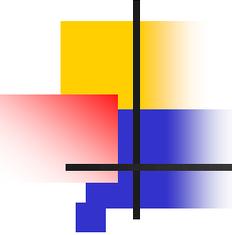
Path = c:\users\chinanuife emmanuel\documents DB = none WF = copy of data for training--good

11:38 PM 12/1/2017



Cointegration Tests ...

- It is also interesting to check for the existence of long run association among the variables in our model. This can be done using bound testing approach proposed by Pesaran and Shin (2001).

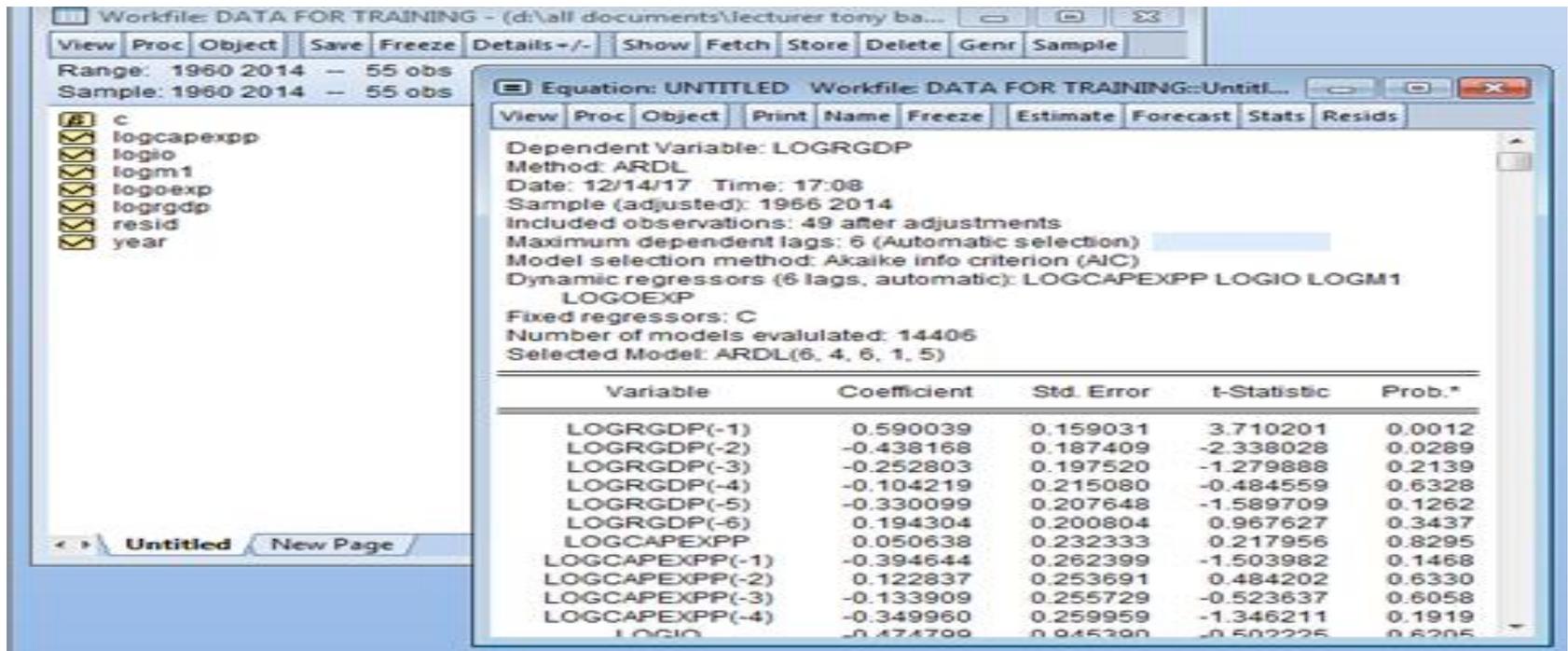


Cointegration Tests ...

- It is common to see time series variables wandering about in the short run. However, there should be long run association or convergence among them. This is the idea behind cointegration analysis.

Cointegration Tests ...

- To perform the cointegration analysis or bounds test procedure in eviews 9:
- After estimating the model as shown below:



The screenshot displays the EViews software interface. The main window shows the 'Equation: UNTITLED' results for a model estimated using the ARDL method. The dependent variable is LOGRGDP, and the model includes six lags of LOGRGDP and LOGCAPEXPP as dynamic regressors. The results table below provides the coefficients, standard errors, t-statistics, and probabilities for each variable in the model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOGRGDP(-1)	0.590039	0.159031	3.710201	0.0012
LOGRGDP(-2)	-0.438168	0.187409	-2.338028	0.0289
LOGRGDP(-3)	-0.252803	0.197520	-1.279888	0.2139
LOGRGDP(-4)	-0.104219	0.215080	-0.484559	0.6328
LOGRGDP(-5)	-0.330099	0.207648	-1.589709	0.1262
LOGRGDP(-6)	0.194304	0.200804	0.967627	0.3437
LOGCAPEXPP	0.050638	0.232333	0.217956	0.8295
LOGCAPEXPP(-1)	-0.394644	0.262399	-1.503982	0.1468
LOGCAPEXPP(-2)	0.122837	0.253691	0.484202	0.6330
LOGCAPEXPP(-3)	-0.133909	0.255729	-0.523637	0.6058
LOGCAPEXPP(-4)	-0.349960	0.259959	-1.346211	0.1919
LOGIO	-0.474709	0.945300	-0.502225	0.6205

Cointegration Tests ...

- Place your cursor on "view" and you will see a drop down

The screenshot shows the EViews software interface. The main window is titled 'Equation: UNTITLED' and has a menu bar with 'View', 'Proc', 'Object', 'Print', 'Name', 'Freeze', 'Estimate', 'Forecast', 'Stats', and 'Resids'. The 'View' menu is open, showing a list of options: Representations, Estimation Output, Actual, Fitted, Residual, ARMA Structure..., Gradients and Derivatives, Covariance Matrix, Model Selection Summary, Coefficient Diagnostics, Residual Diagnostics, and Stability Diagnostics. The 'Actual, Fitted, Residual' option is selected, and a table of coefficients is displayed.

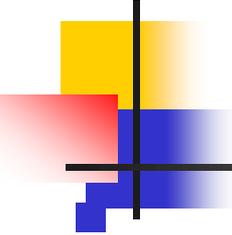
Label		Std. Error	t-Statistic	Prob.*
LOGRGDP(-3)	-0.252803	0.159031	3.710201	0.0012
LOGRGDP(-4)	-0.104219	0.187409	-2.338028	0.0289
LOGRGDP(-5)	-0.330099	0.197520	-1.279888	0.2139
LOGRGDP(-6)	0.194304	0.215080	-0.484559	0.6328
LOGCAPEXPP	0.050638	0.207648	-1.589709	0.1262
LOGCAPEXPP(-1)	-0.394644	0.200804	0.967627	0.3437
LOGCAPEXPP(-2)	0.122837	0.232333	0.217956	0.8295
LOGCAPEXPP(-3)	-0.133909	0.262399	-1.503982	0.1468
LOGCAPEXPP(-4)	-0.349960	0.253691	0.484202	0.6330
LOGIO	-0.474799	0.255729	-0.523637	0.6058

Cointegration Tests ...

Place your cursor on coefficient diagnostics, see the drop down and click on bounds test

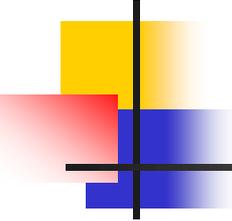
The screenshot shows the EViews software interface. The main window displays a list of objects: c, logcapexpp, logio, logm1, logoexp, logrgdp, resid, and year. A secondary window titled 'Equation: UNTITLED' is open, showing a list of coefficient diagnostics. The 'Coefficient Diagnostics' menu is expanded, and the 'Bounds Test' option is highlighted. The following table shows the coefficient estimates for the equation:

Label	Estimate
LOGRGDP(-3)	-0.252803
LOGRGDP(-4)	-0.104219
LOGRGDP(-5)	-0.330099
LOGRGDP(-6)	0.194304
LOGCAPEXPP	0.050638
LOGCAPEXPP(-1)	-0.394644
LOGCAPEXPP(-2)	0.122837
LOGCAPEXPP(-3)	-0.133909
LOGCAPEXPP(-4)	-0.349960
LOGIO	-0.474700



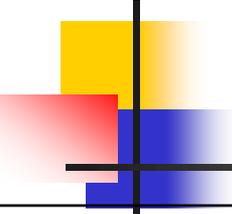
Cointegration Tests ...

- In conducting cointegration test, the null hypothesis is
- H_0 : there is no long run association among the variables in our model
- Decision Rule is to reject H_0 if the F-statistic value from lies above the upper bound of Pesaran test statistic table.



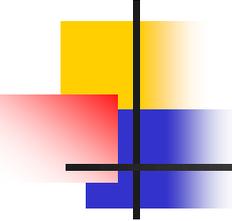
Cointegration Tests ...

- Note that Pesaran table has lower (I0) bound and upper (I1) bound. The critical values are arranged in descending order from 10%, 5%, 2.5% and 1%. So, you can see our bound test result below



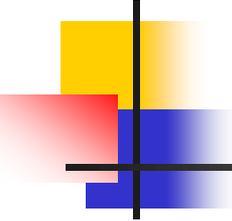
Cointegration Tests ...

Test Statistic	Value	K
F-statistic	4.507318	4
Critical Value Bounds		
Sig.	I0 bound	I1 bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49



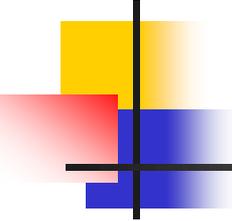
Cointegration Tests ...

- It could be observed from the bound test table that the value of F-statistic is greater than the upper bound of Pesaran test statistic at 5%. This implies that there is long run association or relationship or convergence.



Cointegration Tests ...

- With the establishment of long run association among the variables, we can now test for the cointegrating and long run form. Note that e-views 9 makes it simpler to test for the short run and long run at the same time using cointegration and long run form.



Cointegration Tests

- Other version of e-views requires that we estimate the long run, generate the error correction mechanism and then estimate the short run form. Where the coefficient of the error correction mechanism would adjust for short run dynamics in the system.

Cointegration Tests ...

- Place your cursor on coefficient diagnostics, see the drop down and click on Cointegration and Long Run Form

The screenshot shows the EViews software interface. On the left, a list of variables is displayed: c, logcapexp, logio, logm1, logoexp, logrgdp, resid, and year. The main window displays the 'Equation: UNTITLED' with a table of coefficients. The 'Coefficient Diagnostics' menu is open, and the 'Cointegration and Long Run Form' option is highlighted.

Label	Coefficient
LOGRGDP(-3)	-0.252803
LOGRGDP(-4)	-0.104219
LOGRGDP(-5)	-0.330099
LOGRGDP(-6)	0.194304
LOGCAPEXPP	0.050638
LOGCAPEXPP(-1)	-0.394644
LOGCAPEXPP(-2)	0.122837
LOGCAPEXPP(-3)	-0.133909
LOGCAPEXPP(-4)	-0.349960
LOGIO	-0.474700

The 'Coefficient Diagnostics' menu includes the following options:

- Representations
- Estimation Output
- Actual,Fitted,Residual
- ARMA Structure...
- Gradients and Derivatives
- Covariance Matrix
- Model Selection Summary
- Coefficient Diagnostics**
- Residual Diagnostics
- Stability Diagnostics
- Label

The 'Cointegration and Long Run Form' option is highlighted in the dropdown menu.

Cointegration Tests ...

- Place your cursor on coefficient diagnostics, see the drop down and click on Cointegration and Long Run Form
- Short Run Form

Equation: UNTITLED Workfile: DATA FOR TRAINING::Untitled\

ARDL Cointegrating And Long Run Form
 Dependent Variable: LOGRGDP
 Selected Model: ARDL(6, 4, 6, 1, 5)
 Date: 12/14/17 Time: 17:58
 Sample: 1960 2014
 Included observations: 49

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGRGDP(-1))	0.930985	0.398085	2.338662	0.0288
D(LOGRGDP(-2))	0.492818	0.359087	1.372419	0.1838
D(LOGRGDP(-3))	0.240014	0.302914	0.792352	0.4366
D(LOGRGDP(-4))	0.135795	0.249012	0.545337	0.5910
D(LOGRGDP(-5))	-0.194304	0.200804	-0.967627	0.3437
D(LOGCAPEXPP)	0.050638	0.232333	0.217956	0.8295
D(LOGCAPEXPP(-1))	-0.122837	0.253691	-0.484202	0.6330
D(LOGCAPEXPP(-2))	0.133909	0.255729	0.523637	0.6058
D(LOGCAPEXPP(-3))	0.349960	0.259959	1.346211	0.1919
D(LOGIO)	-0.474799	0.945390	-0.502225	0.6205
D(LOGIO(-1))	-1.268483	1.063053	-1.193246	0.2455
D(LOGIO(-2))	1.580481	1.043332	1.514840	0.1440
D(LOGIO(-3))	2.201236	0.997254	2.207296	0.0380
D(LOGIO(-4))	1.115564	0.984200	1.133473	0.2692
D(LOGIO(-5))	-2.213080	0.964843	-2.293721	0.0317
D(LOGM1)	2.178977	0.832976	2.615894	0.0158
D(LOGOEXP)	0.501787	0.210525	2.383505	0.0262
D(LOGOEXP(-1))	0.226859	0.209579	1.082449	0.2908
D(LOGOEXP(-2))	0.336115	0.201666	1.666693	0.1098
D(LOGOEXP(-3))	-0.826095	0.212593	-3.885798	0.0008
D(LOGOEXP(-4))	0.680145	0.183387	3.708803	0.0012
CointEq(-1)	-1.340947	0.433028	-3.096676	0.0053

Cointeq = LOGRGDP - (-0.5258*LOGCAPEXPP -2.6570*LOGIO + 0.9351 *LOGM1 + 0.1105*LOGOEXP + 14.1779)

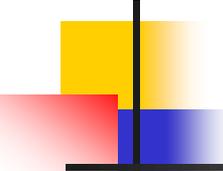
Cointegration Tests ...

- Place your cursor on coefficient diagnostics, see the drop down and click on Cointegration and Long Run Form
- Long Run Coefficient

View	Proc	Object	Name	Freeze	Estimate	Forecast	Stats	Resids
			D(LOGRGDP(-2))		0.492818	0.359087	1.372419	0.1838
			D(LOGRGDP(-3))		0.240014	0.302914	0.792352	0.4366
			D(LOGRGDP(-4))		0.135795	0.249012	0.545337	0.5910
			D(LOGRGDP(-5))		-0.194304	0.200804	-0.967627	0.3437
			D(LOGCAPEXPP)		0.050838	0.232333	0.217956	0.8295
			D(LOGCAPEXPP(-1))		-0.122837	0.253691	-0.484202	0.6330
			D(LOGCAPEXPP(-2))		0.133909	0.255729	0.523637	0.6058
			D(LOGCAPEXPP(-3))		0.349960	0.259959	1.346211	0.1919
			D(LOGIO)		-0.474799	0.945390	-0.502225	0.6205
			D(LOGIO(-1))		-1.268483	1.063053	-1.193246	0.2455
			D(LOGIO(-2))		1.580481	1.043332	1.514840	0.1440
			D(LOGIO(-3))		2.201236	0.997254	2.207296	0.0380
			D(LOGIO(-4))		1.115564	0.984200	1.133473	0.2692
			D(LOGIO(-5))		-2.213080	0.964843	-2.293721	0.0317
			D(LOGM1)		2.178977	0.832976	2.615894	0.0158
			D(LOGOEXP)		0.501787	0.210525	2.383505	0.0262
			D(LOGOEXP(-1))		0.226859	0.209579	1.082449	0.2908
			D(LOGOEXP(-2))		0.336115	0.201666	1.666693	0.1098
			D(LOGOEXP(-3))		-0.826095	0.212593	-3.885798	0.0008
			D(LOGOEXP(-4))		0.680145	0.183387	3.708803	0.0012
			CointEq(-1)		-1.340947	0.433028	-3.096676	0.0053

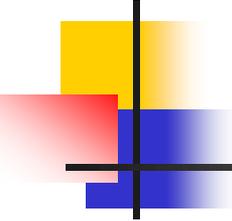
Cointeq = LOGRGDP - (-0.5258*LOGCAPEXPP - 2.6570*LOGIO + 0.9351*LOGM1 + 0.1105*LOGOEXP + 14.1779)

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGCAPEXPP	-0.525775	0.124679	-4.217037	0.0004
LOGIO	-2.656989	0.497562	-5.340015	0.0000
LOGM1	0.935069	0.107961	8.661172	0.0000
LOGOEXP	0.110478	0.093511	1.181445	0.2500
C	14.177881	2.542056	5.577327	0.0000



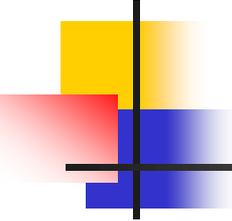
Cointegration Tests ...

- The a priori expectation of the coefficient of Cointegrating equation (cointeq) or ECM (-1) is that it should be negative and statistically significant at 5 percent. The value is converted to percentage and thus measures the speed of adjustment of short run disequilibrium to long run equilibrium. Put differently, it measures the speed of convergence of short run towards long run equilibrium.



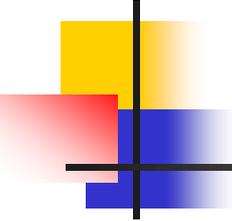
Cointegration Tests ...

- Assume for instance that the coefficient of our ECM or cointegrating equation is -1.340947 and that the probability is 0.0053 .
- Interpreting this result, we could say that the ECM was inline with a priori expectation (i.e. has negative value and statistically significant at 5%).



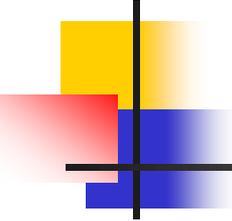
Cointegration Tests ...

- Also, it could be seen that annually, about 134% of the disequilibrium in the short run is corrected towards long run equilibrium. We can also say that about 134% gap between long run equilibrium value and the actual value of the dependent variable(LogRGDP) has been corrected. It can be also said that speed of adjustment towards long run equilibrium is 134% annually (since data is annual). Also we can say that system corrects its previous period disequilibrium at a speed of 134% annually.
- ****Don't worry about this...that's just what our data suggest****



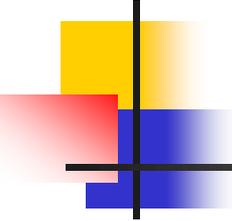
Cointegration Tests ...

- Lastly, the coefficients of the short run and long run model could be interpreted in the same way we interpret impact models. The only difference is whether the variables are in rate, log or not.
- But the interpretation of the ECM coefficient is very vital.



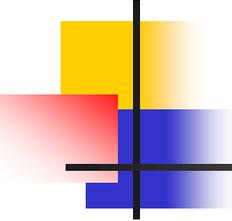
Other tests ...

- **Serial correlation test**
- Serial correlation test is a residual diagnostic test. It is used to ensure that the residual of our model, that is, the Selected Model: ARDL(6, 5, 1, 6, 4) is not correlated with the independent variables.
H0 = there is no serial correlation
- Decision rule is to reject H0 if prob. Chi-Square of Observed R-Squared (obs*resid) is less than 0.05. Otherwise, the null hypothesis may not be rejected at 5 percent level.



Other tests ...

- **Serial correlation test**
- To conduct this test from our regression output, go to view and select residual diagnostic test, select Breusch-Godfrey serial correlation LM test.
- In the dialogue box that appears requesting for number of lags, select two.



Other tests ...

- **Serial correlation test**
- The result of our model shows that the prob. Chi-Square of Obs*R-squared (0.0503) is greater than 0.05. this means that we are not to reject H0. This means no serial correlation in our model.

Other tests ...

■ Stability test

- Click on view on the page of the estimated result and you will see a drop down, then click on "representation"

The screenshot shows the EViews software interface. The main window displays the 'Equation: UNTITLED' window with the 'View' menu open. The 'View' menu is expanded to show 'Stability Diagnostics' selected. The 'Stability Diagnostics' submenu is also open, showing a list of variables and their corresponding t-statistics and probabilities.

Label	Estimate	Std. Error	t-Statistic	Prob.*
LOGRGDP(-3)	-0.252803	0.159031	3.710201	0.0012
LOGRGDP(-4)	-0.104219	0.187409	-2.338028	0.0289
LOGRGDP(-5)	-0.330099	0.197520	-1.279888	0.2139
LOGRGDP(-6)	0.194304	0.215080	-0.484559	0.6328
LOGCAPEXPP	0.050638	0.207648	-1.589709	0.1262
LOGCAPEXPP(-1)	-0.394644	0.200804	0.967627	0.3437
LOGCAPEXPP(-2)	0.122837	0.232333	0.217956	0.8295
LOGCAPEXPP(-3)	-0.133909	0.262399	-1.503982	0.1468
LOGCAPEXPP(-4)	-0.349960	0.253691	0.484202	0.6330
LOGIO	-0.474799	0.255729	-0.523637	0.6058

Other tests ...

■ Stability test

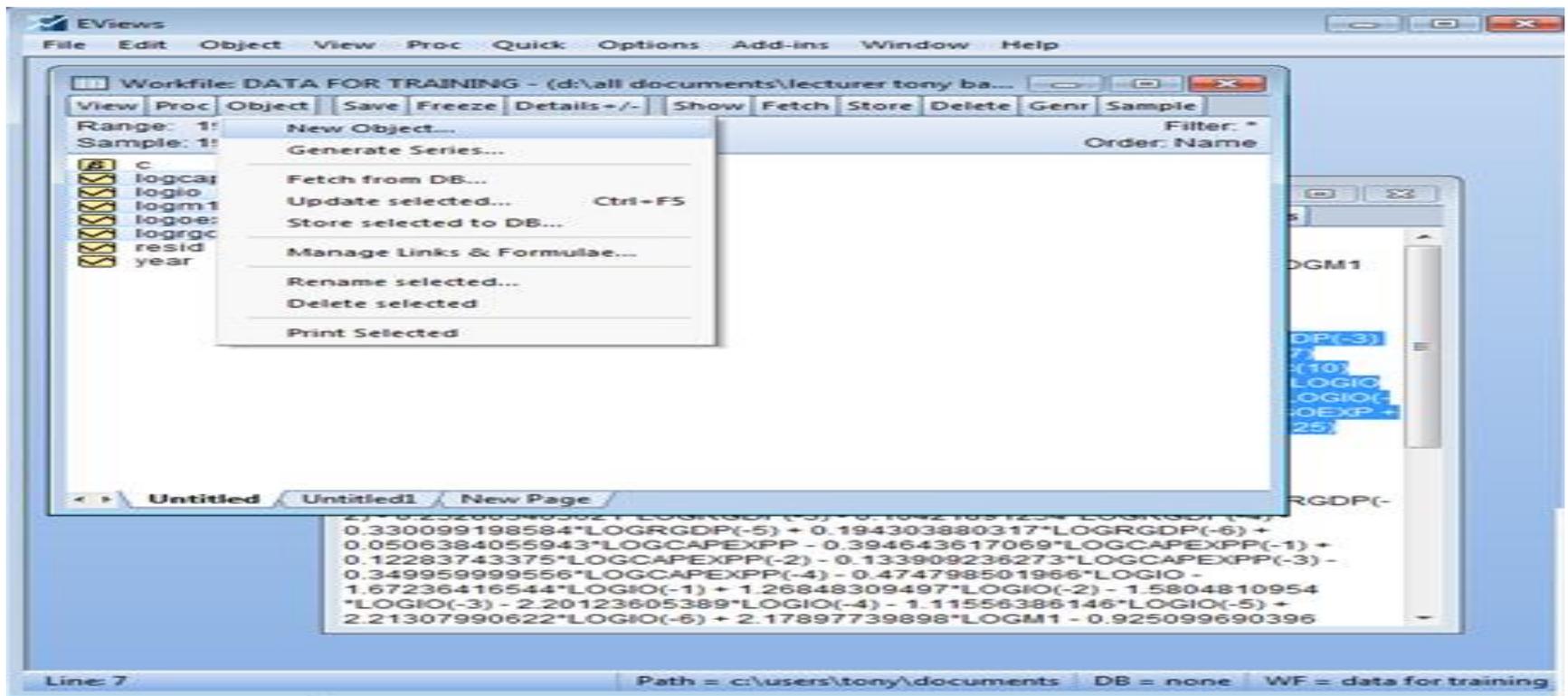
- It will show the equation form and the representation which this ARDL is using in the background. Here you have to highlight the estimation equation and copy it like in the image below.

The screenshot displays the EViews software interface. The main window shows a workfile named "DATA FOR TRAINING" with a range and sample from 1960 to 2014 (55 observations). The left-hand pane lists variables: c, logcapexpp, logio, logm1, logoexp, logrgdp, resid, and year. A secondary window titled "Equation: UNTITLED" is open, showing the estimation command and the resulting equation. The estimation command is: `ARDL(DEPLAGS=6, REGLAGS=6) LOGRGDP LOGCAPEXPP LOGIO LOGM1 LOGOEXP @`. The estimation equation is:
$$\text{LOGRGDP} = C(1)*\text{LOGRGDP}(-1) + C(2)*\text{LOGRGDP}(-2) + C(3)*\text{LOGRGDP}(-3) + C(4)*\text{LOGRGDP}(-4) + C(5)*\text{LOGRGDP}(-5) + C(6)*\text{LOGRGDP}(-6) + C(7)*\text{LOGCAPEXPP} + C(8)*\text{LOGCAPEXPP}(-1) + C(9)*\text{LOGCAPEXPP}(-2) + C(10)*\text{LOGCAPEXPP}(-3) + C(11)*\text{LOGCAPEXPP}(-4) + C(12)*\text{LOGIO} + C(13)*\text{LOGIO}(-1) + C(14)*\text{LOGIO}(-2) + C(15)*\text{LOGIO}(-3) + C(16)*\text{LOGIO}(-4) + C(17)*\text{LOGIO}(-5) + C(18)*\text{LOGIO}(-6) + C(19)*\text{LOGM1} + C(20)*\text{LOGM1}(-1) + C(21)*\text{LOGOEXP} + C(22)*\text{LOGOEXP}(-1) + C(23)*\text{LOGOEXP}(-2) + C(24)*\text{LOGOEXP}(-3) + C(25)*\text{LOGOEXP}(-4) + C(26)*\text{LOGOEXP}(-5) + C(27)$$
. The substituted coefficients are:
$$\text{LOGRGDP} = 0.590038639041*\text{LOGRGDP}(-1) - 0.438167922544*\text{LOGRGDP}(-2) - 0.252803403621*\text{LOGRGDP}(-3) - 0.10421891254*\text{LOGRGDP}(-4) - 0.33099198594*\text{LOGRGDP}(-5) + 0.194303880317*\text{LOGRGDP}(-6) + 0.0506384055943*\text{LOGCAPEXPP} - 0.394643617069*\text{LOGCAPEXPP}(-1) + 0.12283743375*\text{LOGCAPEXPP}(-2) - 0.133909236273*\text{LOGCAPEXPP}(-3) - 0.349959999556*\text{LOGCAPEXPP}(-4) - 0.474798501966*\text{LOGIO} - 1.67236416544*\text{LOGIO}(-1) + 1.26848309497*\text{LOGIO}(-2) - 1.5804810954*\text{LOGIO}(-3) - 2.20123605389*\text{LOGIO}(-4) - 1.11556386146*\text{LOGIO}(-5) + 2.21307990622*\text{LOGIO}(-6) + 2.17897739898*\text{LOGM1} - 0.925099690396$$

Other tests ...

■ **Stability test**

- Then go to Object option above and then new object



The screenshot displays the EViews software interface. The main window is titled "Workfile: DATA FOR TRAINING - (d:\all documents\lecturer tony ba...". The "Object" menu is open, showing options such as "New Object...", "Generate Series...", "Fetch from DB...", "Update selected...", "Store selected to DB...", "Manage Links & Formulae...", "Rename selected...", "Delete selected", and "Print Selected". The "New Object..." option is highlighted. The background shows a list of objects including "C", "logcap", "logio", "logm1", "logoe", "logrg", "resid", and "year". The bottom status bar indicates "Line: 7", "Path = c:\users\tony\documents", "DB = none", and "WF = data for training".

Other tests ...

- **Stability test**
- Then click on new object and ok.

The screenshot shows the EViews software interface. The main window displays a list of objects: c, logcapexpp, logio, logm1, logoexp, logrgdp, resid, and year. A 'New Object' dialog box is open, with 'Equation' selected in the 'Type of object' list. The 'Name for object' field is set to 'Untitled'. The background shows the EViews main window with a list of objects and a command window displaying a complex equation:

$$\begin{aligned} & 0.330099198584 \cdot \text{LOGRGDP}(-5) + 0.194303880317 \cdot \text{LOGRGDP}(-6) + \\ & 0.0506384055943 \cdot \text{LOGCAPEXPP} - 0.394643617069 \cdot \text{LOGCAPEXPP}(-1) + \\ & 0.12283743375 \cdot \text{LOGCAPEXPP}(-2) - 0.133909236273 \cdot \text{LOGCAPEXPP}(-3) - \\ & 0.349959999556 \cdot \text{LOGCAPEXPP}(-4) - 0.474798501966 \cdot \text{LOGIO} - \\ & 1.67236416544 \cdot \text{LOGIO}(-1) + 1.26848309497 \cdot \text{LOGIO}(-2) - 1.5804810954 \\ & \cdot \text{LOGIO}(-3) - 2.20123805389 \cdot \text{LOGIO}(-4) - 1.11556386146 \cdot \text{LOGIO}(-5) + \\ & 2.21307990622 \cdot \text{LOGIO}(-6) + 2.17897739898 \cdot \text{LOGM1} - 0.925099690396 \end{aligned}$$

Other tests ...

■ Stability test

- An equation estimation dialogue box appears and then you paste the estimation equation which you copied earlier and press OK.

Equation Estimation

Specification Options

Equation specification
Dependent variable followed by list of regressors including ARMA and PDL terms, OR an explicit equation like $Y=c(1)+c(2)*X$.

+ C(4)*LOGRGRDP(-4) + C(5)*LOGRGRDP(-5) + C(6)*LOGRGRDP(-6) + C(7)*LOGCAPEXPP + C(8)*LOGCAPEXPP(-1) + C(9)*LOGCAPEXPP(-2) + C(10)*LOGCAPEXPP(-3) + C(11)*LOGCAPEXPP(-4) + C(12)*LOGIO + C(13)*LOGIO(-1) + C(14)*LOGIO(-2) + C(15)*LOGIO(-3) + C(16)*LOGIO(-4) + C(17)*LOGIO(-5) + C(18)*LOGIO(-6) + C(19)*LOGM1 + C(20)*LOGM1(-1) + C(21)*LOGOEXP + C(22)*LOGOEXP(-1) + C(23)*LOGOEXP(-2) + C(24)*LOGOEXP(-3) + C(25)*LOGOEXP(-4) + C(26)*LOGOEXP(-5) + C(27)

Estimation settings
Method: **LS - Least Squares (NLS and ARMA)**
Sample: 1960 2014

OK Cancel

0.12283743375*LOGCAPEXPP(-2) - 0.133909236273*LOGCAPEXPP(-3) - 0.349959999556*LOGCAPEXPP(-4) - 0.474798501966*LOGIO - 1.67236416544*LOGIO(-1) + 1.26848309497*LOGIO(-2) - 1.5804810954*LOGIO(-3) - 2.20123605389*LOGIO(-4) - 1.11556386146*LOGIO(-5) + 2.21307990622*LOGIO(-6) + 2.17897739898*LOGM1 - 0.925099690396

Path = c:\users\tony\documents DB = none WF = data for training

Other tests ...

■ Stability test

- It will show the same ARDL output in OLS format here.

The screenshot displays the EViews software interface. The main window shows a workfile named 'DATA FOR TRAINING' with a sample range of 1960 to 2014. A list of objects is visible on the left, including 'c', 'logcapexp', 'logio', 'logm1', 'logoexp', 'logrgdp', 'resid', and 'year'. A secondary window titled 'Equation: UNTITLED' is open, showing the following information:

Dependent Variable: LOGRGDP
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 12/15/17 Time: 23:02
Sample (adjusted): 1966 2014
Included observations: 49 after adjustments

The ARDL equation is displayed as:

$$\text{LOGRGDP} = C(1)*\text{LOGRGDP}(-1) + C(2)*\text{LOGRGDP}(-2) + C(3)*\text{LOGRGDP}(-3) + C(4)*\text{LOGRGDP}(-4) + C(5)*\text{LOGRGDP}(-5) + C(6)*\text{LOGRGDP}(-6) + C(7)*\text{LOGCAPEXPP} + C(8)*\text{LOGCAPEXPP}(-1) + C(9)*\text{LOGCAPEXPP}(-2) + C(10)*\text{LOGCAPEXPP}(-3) + C(11)*\text{LOGCAPEXPP}(-4) + C(12)*\text{LOGIO} + C(13)*\text{LOGIO}(-1) + C(14)*\text{LOGIO}(-2) + C(15)*\text{LOGIO}(-3) + C(16)*\text{LOGIO}(-4) + C(17)*\text{LOGIO}(-5) + C(18)*\text{LOGIO}(-6) + C(19)*\text{LOGM1} + C(20)*\text{LOGM1}(-1) + C(21)*\text{LOGOEXP} + C(22)*\text{LOGOEXP}(-1) + C(23)*\text{LOGOEXP}(-2) + C(24)*\text{LOGOEXP}(-3) + C(25)*\text{LOGOEXP}(-4) + C(26)*\text{LOGOEXP}(-5) + C(27)$$

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.590039	0.159031	3.710201	0.0012
C(2)	-0.438168	0.187409	-2.338028	0.0289
C(3)	-0.252803	0.197520	-1.279888	0.2139
C(4)	-0.104219	0.215080	-0.484559	0.6328
C(5)	-0.330099	0.207648	-1.589709	0.1262
C(6)	0.194304	0.200804	0.967627	0.3437
C(7)	0.050638	0.232333	0.217956	0.8295
C(8)	-0.394644	0.262399	-1.503982	0.1468
C(9)	0.122837	0.253691	0.484202	0.6330
C(10)	-0.133909	0.255729	-0.523637	0.6058

At the bottom of the window, the path is shown as 'Path = c:\users\tony\documents | DB = none | WF = data for training'.

Other tests ...

■ Stability test

- From here press the view button and go to stability diagnostics

The screenshot shows the EViews software interface. The main window displays a workfile named 'DATA FOR TRAINING' with a range of 1960 to 2014 and 55 observations. A list of objects is visible on the left, including 'c', 'logcapexpp', 'logio', 'logm1', 'logoexp', 'logrgdp', 'resid', and 'year'. A secondary window titled 'Equation: UNTITLED' is open, showing a menu with 'Stability Diagnostics' selected. This menu is open, displaying various diagnostic tests such as 'Chow Breakpoint Test...', 'Quandt-Andrews Breakpoint Test...', 'Multiple Breakpoint Test...', 'Chow Forecast Test...', 'Ramsey RESET Test...', 'Recursive Estimates (OLS only) ...', 'Leverage Plots...', and 'Influence Statistics...'. Below the menu, a table of coefficients is visible:

Label	Coefficient	Standard Error	t-Statistic	Probability > t
C(1)	0.5900	0.0000	0.0000	0.0000
C(2)	-0.4381	0.0000	0.0000	0.0000
C(3)	-0.2528	0.0000	0.0000	0.0000
C(4)	-0.1042	0.0000	0.0000	0.0000
C(5)	-0.3300	0.0000	0.0000	0.0000
C(6)	0.1943	0.0000	0.0000	0.0000
C(7)	0.0506	0.0000	0.0000	0.0000
C(8)	-0.394644	0.262399	-1.503982	0.1468
C(9)	0.122837	0.253691	0.484202	0.6330
C(10)	-0.133809	0.255729	-0.523637	0.6059

At the bottom of the EViews window, the status bar shows: Path = c:\users\tony\documents | DB = none | WF = data for training

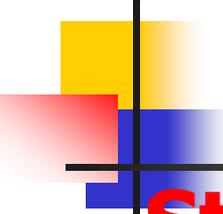
Other tests ...

■ Stability test

- Click on Recursive Estimates (OLS only).. You will get following options.

The screenshot shows the EViews software interface. The main window displays a workfile named 'DATA FOR TRAINING' with 55 observations from 1960 to 2014. A dialog box titled 'Recursive Estimation' is open, showing the 'Output' section with the 'CUSUM Test' selected. The 'Coefficient display list' shows coefficients c(1) through c(18). Below the dialog box, a table displays the results of the recursive estimation, including coefficients, standard errors, t-statistics, and probabilities for coefficients C(1) through C(10).

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.590039	0.159031	3.710201	0.0012
C(2)	-0.438168	0.187409	-2.338028	0.0289
C(3)	-0.252803	0.197520	-1.279888	0.2139
C(4)	-0.104219	0.215080	-0.484559	0.6328
C(5)	-0.330099	0.207648	-1.589709	0.1262
C(6)	0.194304	0.200804	0.967627	0.3437
C(7)	0.050638	0.232333	0.217956	0.8295
C(8)	-0.394644	0.262399	-1.503982	0.1468
C(9)	0.122837	0.253691	0.484202	0.6330
C(10)	-0.133009	0.255729	-0.523637	0.6059



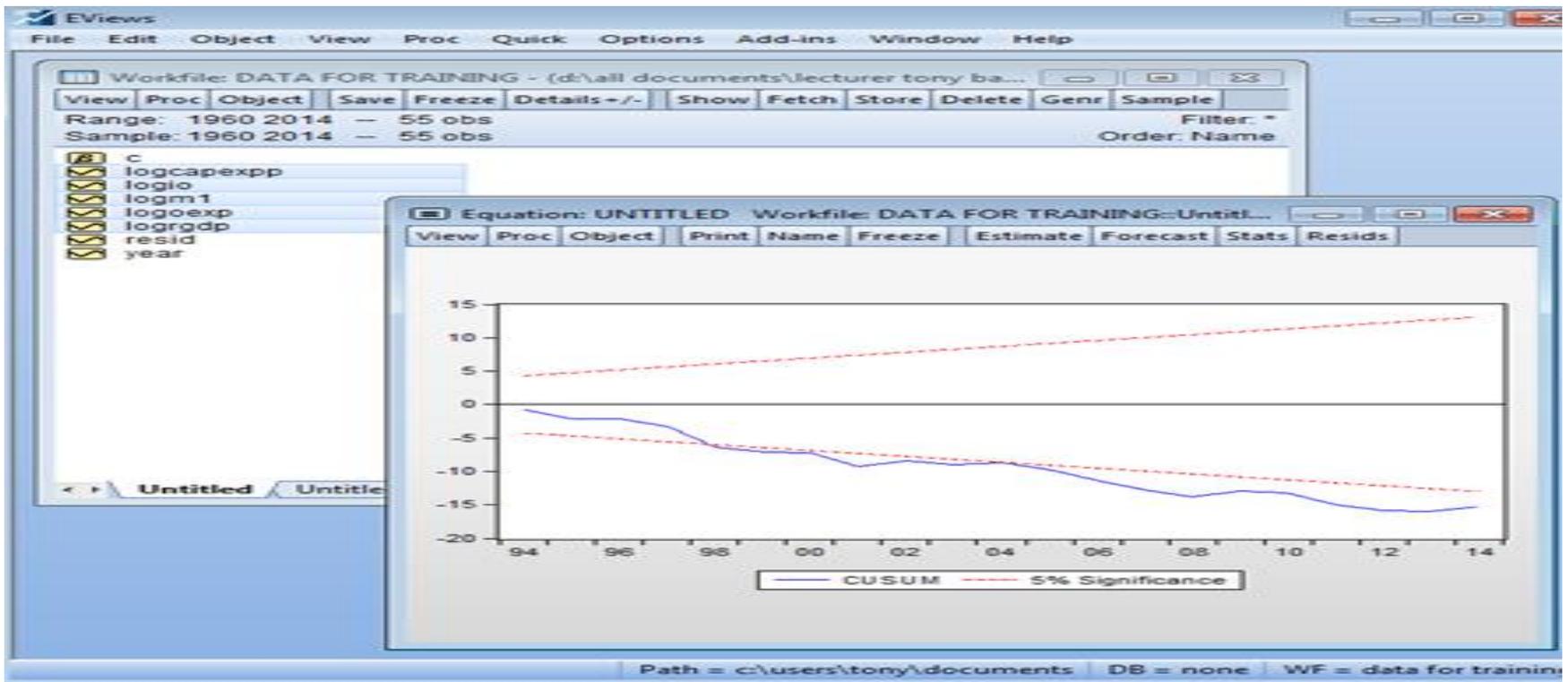
Other tests ...

■ **Stability test**

- Here select the CUSUM test and press OK to get the CUSUM chart for the ARDL and then do it again for CUSUM sq. This way you can generate your CUSUM and CUSUMsq charts, which were not there in the default package.

Other tests ...

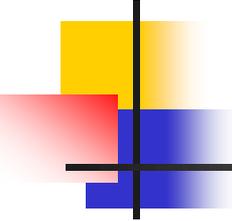
- **Stability test**
- **Cusum Test**



Other tests ...

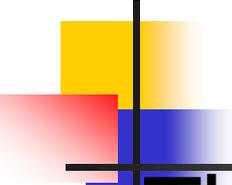
- **Stability test**
- **Cusum of Squares Test**





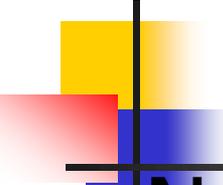
Wald Test...

- Another important test which we shall consider is the Wald test. This test is conducted on the coefficients of the estimated model. Thus, it is a coefficient diagnostic test.



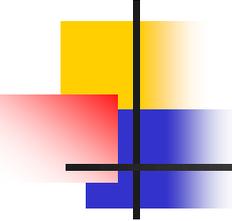
Wald Test...

- The essence of Wald test is to examine the joint significance of the coefficients from estimated model.
- Some times, looking at individual impact of variables, one may observe that they are statistically insignificant. However, combination of this variables could produce significant result.



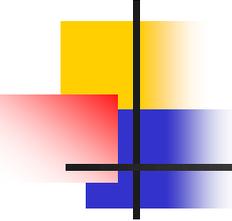
Wald Test...

- Now, this is where Wald test comes to play.
- This test follows Chi-square distribution. As a result of that, the probability Chi-square of F-statistic is considered during interpretation.



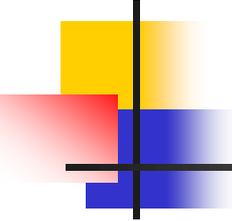
Wald Test...

- The null hypothesis for this test is that the coefficients of the variable of interest (in most cases, we consider the coefficient of a variable and its lags) is zero.



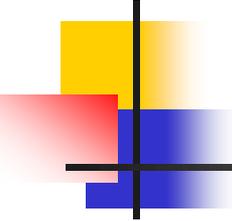
Wald Test...

- Consider performing a Wald test on LOGOEXP whose coefficients and some of its lag coefficient are statistically zero.
- We can perform Wald test on them to check if they can jointly impact significantly on LOGRGDP. To do this, we check the positions of the coefficients of LOGOEXP.



Wald Test...

- That is, assuming that the positions of the coefficients of LOGOEXP and its lags are C7, C8, C9, C10, C11, and C12. See C7 is coefficient of LOGOEXP, C8 is the coefficient of LOGOEXP(-1), C9 is the coefficient of LOGOEXP(-2), C10 is the coefficient of LOGOEXP(-3), C11 is the coefficient of LOGOEXP(-4) and C12 is the coefficient of LOGOEXP(-4). We can conduct coefficient restriction test on them. The null hypothesis is that:



Wald Test...

- $H_0: C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=0$
- The decision is to reject the null hypothesis if the probability Chi-square of F-statistic from the result is less than 0.05. Otherwise, the null hypothesis should not be rejected.
- Note that rejecting the null hypothesis means that the coefficients of LOGOEXP jointly affect LOGRGDP.

Wald Test...

Go to view, coefficient diagnostics, click on Wald Test- Coefficient Restrictions and put in the numbers of the coefficient you want to test

The screenshot shows the EViews software interface. The main window displays the 'Equation: UNTITLED' dialog box with the following information:

- Dependent Variable: LOGRGDP
- Method: ARDL
- Date: 12/16/17 Time: 10:05
- Sample (adjusted): 1966 2014
- Included observations: 49 after adjustments
- Maximum order of lags: 5
- Model selection criteria: AIC
- Dynamic regression: LOGM
- Fixed regression: LOGM
- Number of lags: 5
- Selected Model: ARDL(5)

The 'Wald Test' dialog box is open, showing the following text:

Coefficient restrictions separated by commas
C(7)=0, C(8)=0, C(9)=0, C(10)=0, C(11)=0, C(12)=0

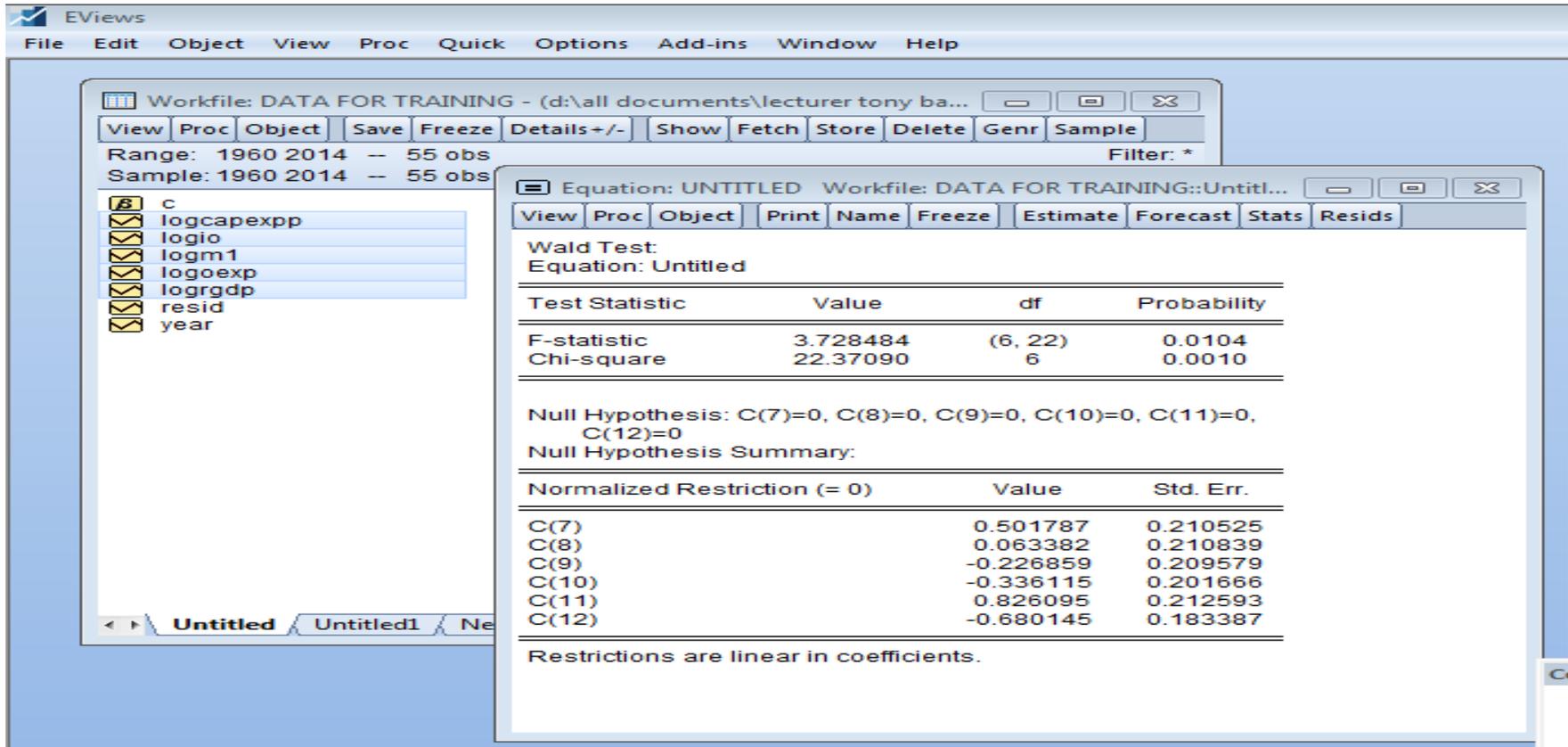
Examples
C(1)=0, C(3)=2*C(4)

Buttons: OK, Cancel

The background window shows a list of variables on the left and a table of coefficients on the right. The table has columns for 'Var', 'C(1)', 'C(2)', 'C(3)', and 'Prob.*'. The variables listed are LOGR, LOGR, LOGR, LOGRGDP(-4), LOGRGDP(-5), LOGRGDP(-6), LOGOEXP, LOGOEXP(-1), LOGOEXP(-2), LOGOEXP(-3), LOGOEXP(-4), and LOGOEXP(-5).

Result of Wald Test...

Click ok and the result of the wald test will show as follows



Workfile: DATA FOR TRAINING - (d:\all documents\lecturer tony ba...)

Range: 1960 2014 -- 55 obs
Sample: 1960 2014 -- 55 obs

Equation: UNTITLED Workfile: DATA FOR TRAINING::Untitl...

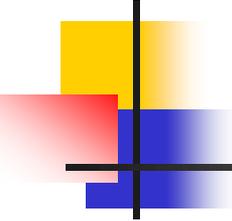
Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.728484	(6, 22)	0.0104
Chi-square	22.37090	6	0.0010

Null Hypothesis: C(7)=0, C(8)=0, C(9)=0, C(10)=0, C(11)=0, C(12)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	0.501787	0.210525
C(8)	0.063382	0.210839
C(9)	-0.226859	0.209579
C(10)	-0.336115	0.201666
C(11)	0.826095	0.212593
C(12)	-0.680145	0.183387

Restrictions are linear in coefficients.



Wald Test...

- The result shows that the probability Chi-square of F-statistic is less than 0.05. This implies that the null hypothesis can be rejected. This mean that the coefficients of LOGOEXP can jointly affect (explain) LOGRGDP.

Hope you have learnt
something today?





THANK

YOU

VERY

MUCH

GOD BLESS YOU