NARDL: Implementation Using Eviews Add-in

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The workfile containing the data used in this documentation can be downloaded at:

https://drive.google.com/drive/u/1/folders/1vCxOzxRMVBIzvaxBla_se-koGq95bfdf

NB: If you find this material including the add-in useful, kindly cite as appropriate.

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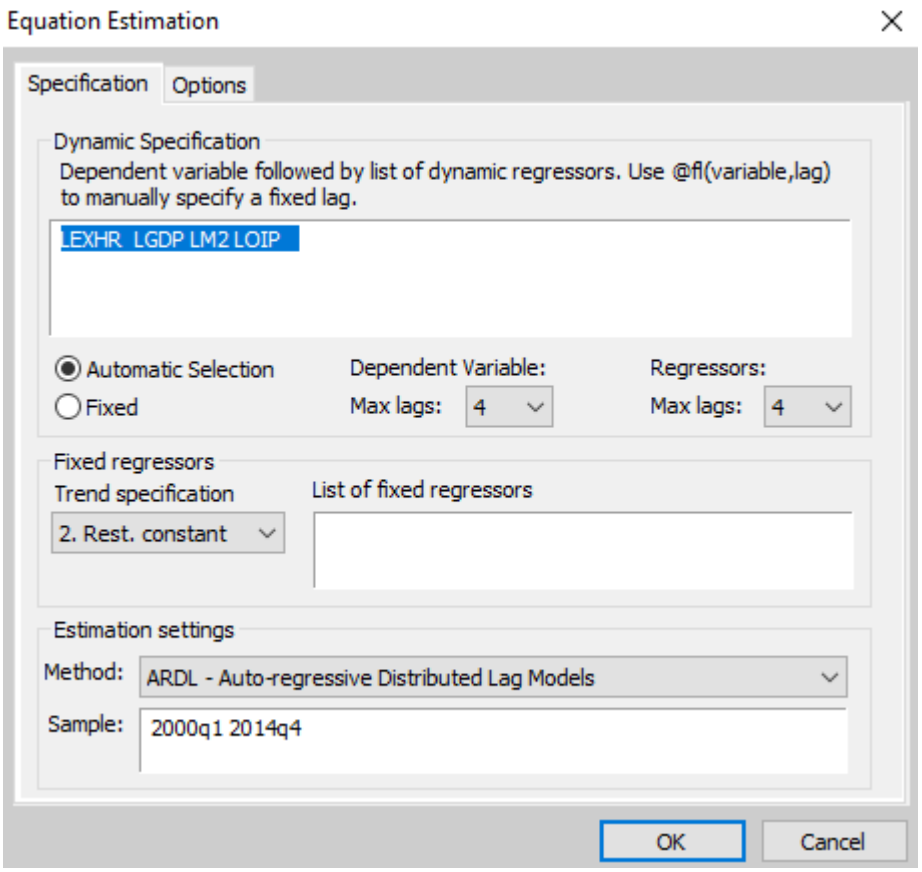
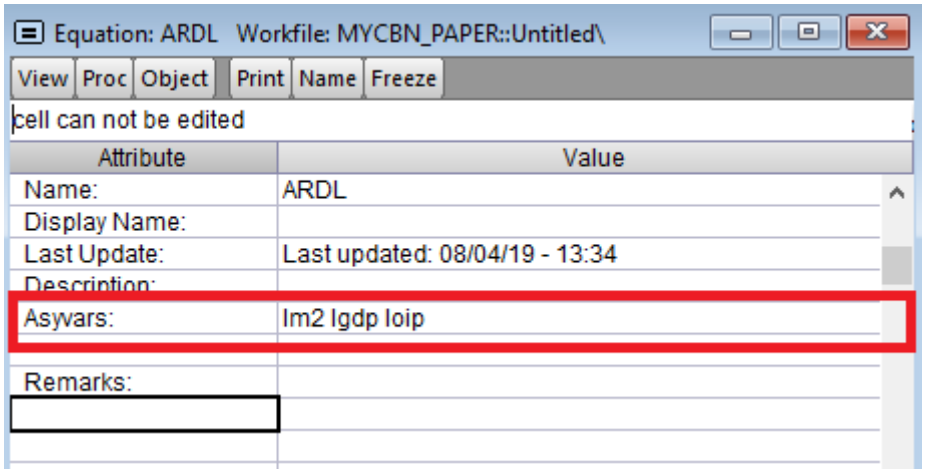
Features

- It is fully compatible with Eviews10 and ***should*** also work with Eviews 9.
- It allows for estimation of models with multiple asymmetric variables.
- It plots CUSUM and CUSUMSQ graphs.
- It plots multiplier graphs for all the specified threshold variables.
- It allows for the generation of the ARDL testable form through which series of hypothesis tests (e.g., asymmetry tests) can be conducted.
- The Make Nonlinear ARDL routine no longer produces the NARDL## equation objects automatically. Rather, the series to decompose must be specified using the Asyvars keyword as explained below.

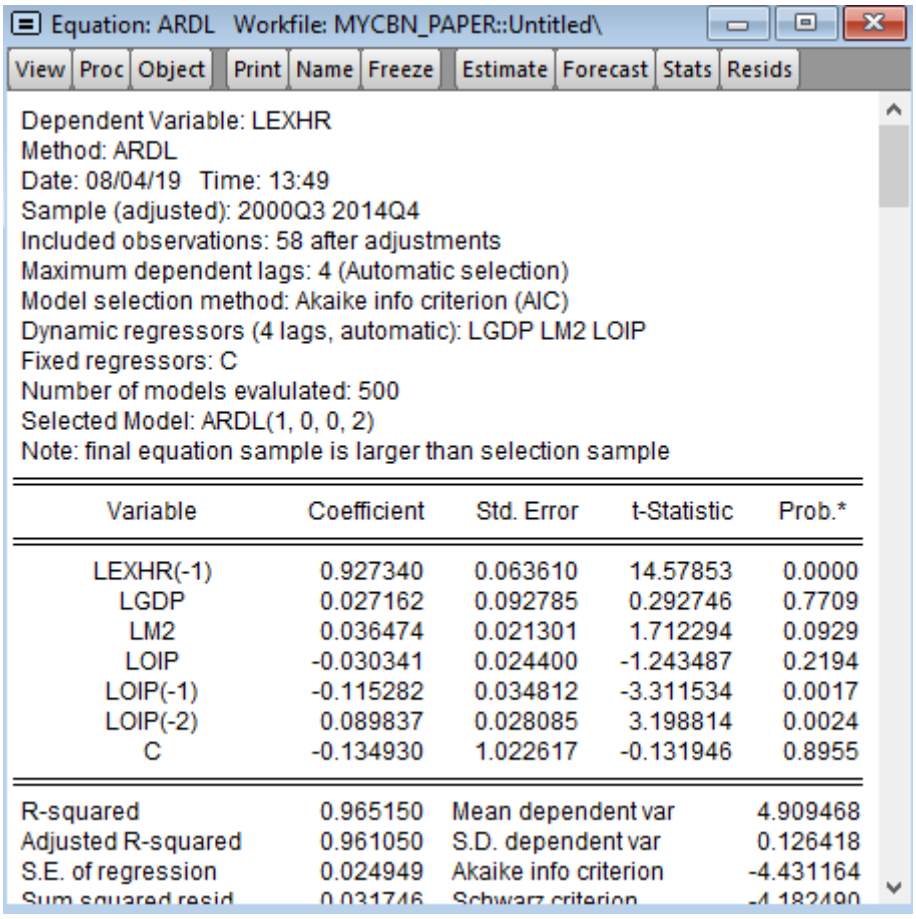
- **Working with multiple decomposed variables**
  - Estimate the ARDL model as usual. In this example, we want to study the asymmetry effects of lgdp lm2 and loip on lexhr. You are to ensure that your model satisfies basic regression requirements.



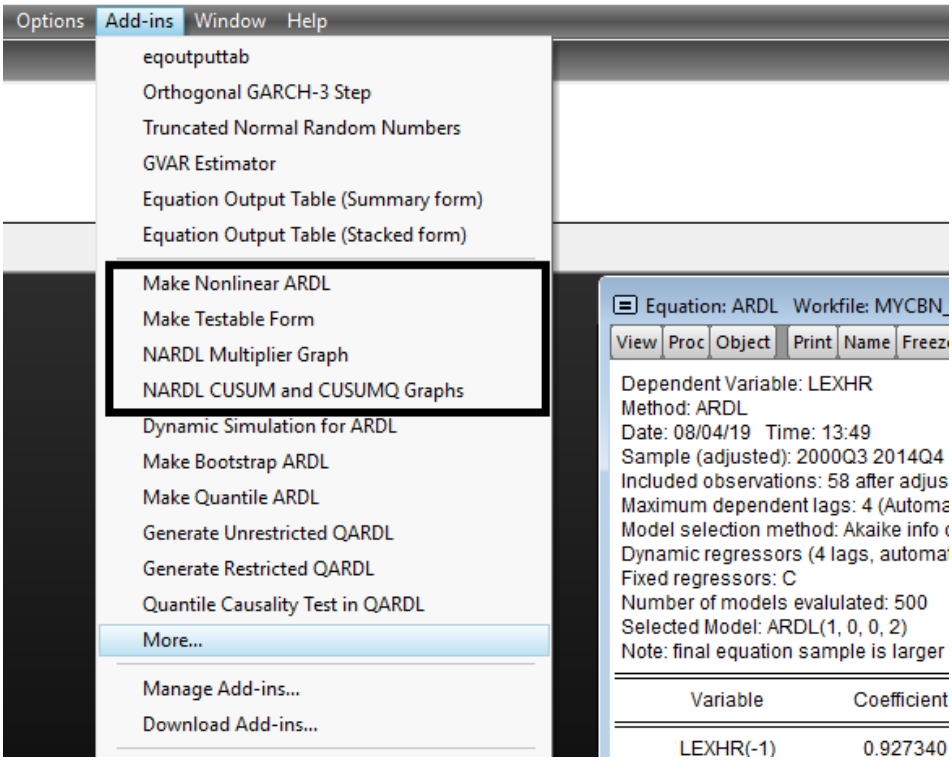
- List the asymmetric variable(s) for the ARDL using Label. To do this, click on **View→Label**. In the **Attribute** column, type **Asyvars**. This is a keyword and should be specified without space. In the corresponding **Value** column, list the asymmetric variable names. Note that other cells are not editable! In the figure below, we have listed three variables in the estimated ARDL model as asymmetric variables: lm2 lgdp loip. (Note also that the number of variables are going to increase. Therefore, be sure that you have enough sample size before engaging in multiple asymmetric variable analysis.) The dependent variable is NOT to be listed.



- You don't need to be particularly concerned about the order of the linear ARDL model since you are focused on the asymmetric model. The generated the asymmetric ARDL model will determine its own lag order, although using the same **maximum** lag order chosen for the linear ARDL model. The generated asymmetric ARDL can be re-estimated directly from its own equation output view and the new order determined. Our linear ARDL model is given in the figure below:

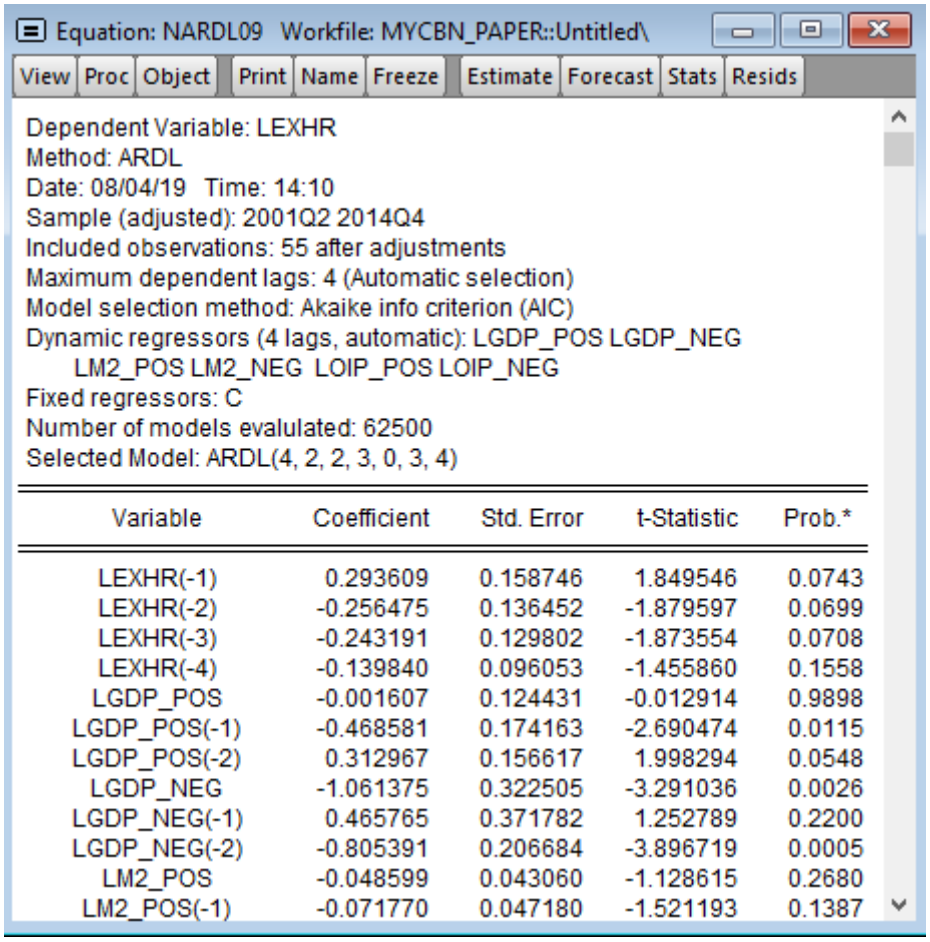


- Having listed the asymmetric variables as explained above, click **Add-ins→Make Nonlinear ARDL** to generate the nonlinear ARDL model. The boxed Add-ins are the relevant toolkits needed to do most of the analysis that you might want to carry out.

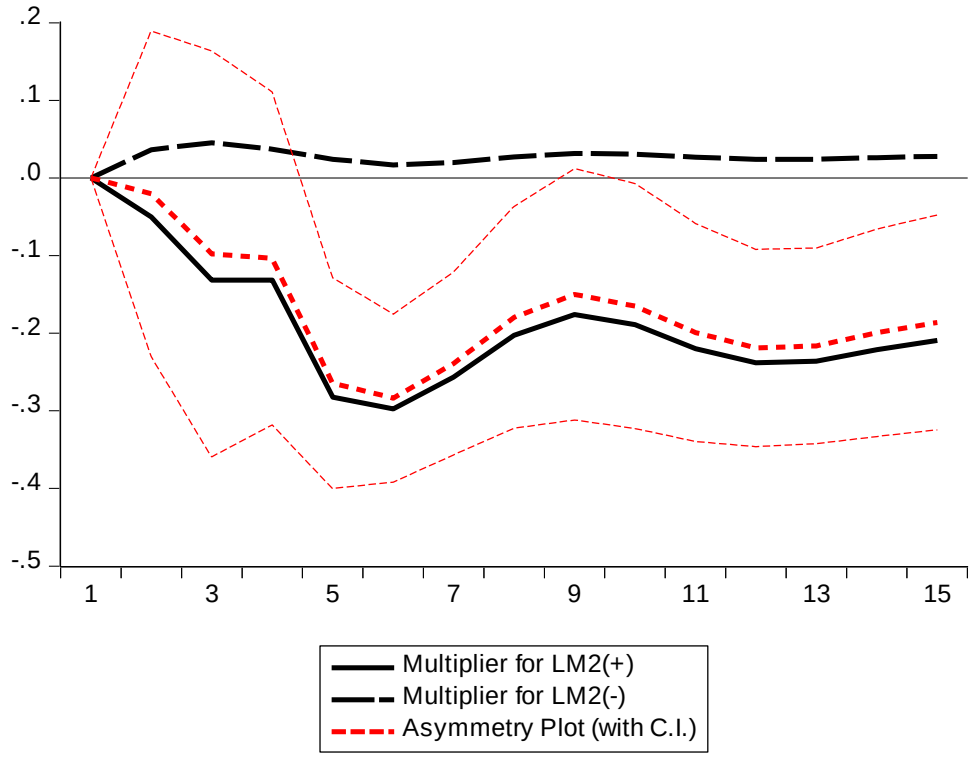


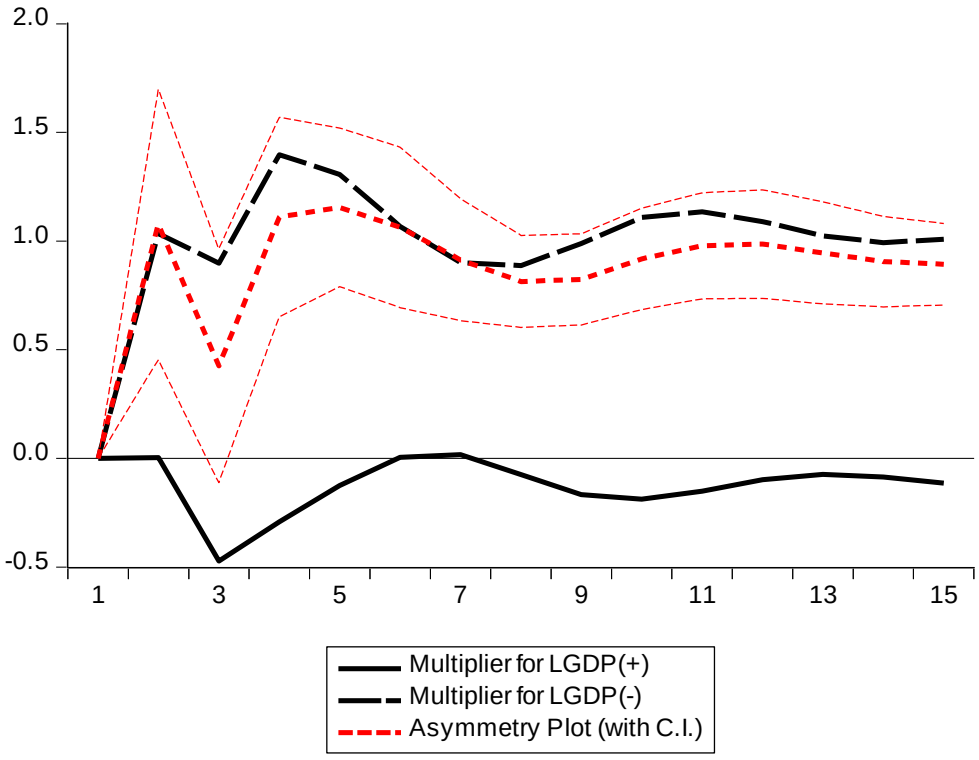
- After estimation, the workfile will be modified with additional series objects generated for the asymmetric variables with _POS and _NEG appended. The total number of new series objects generated will be twice the number of asymmetric variables listed with the keyword **Asyvars**.

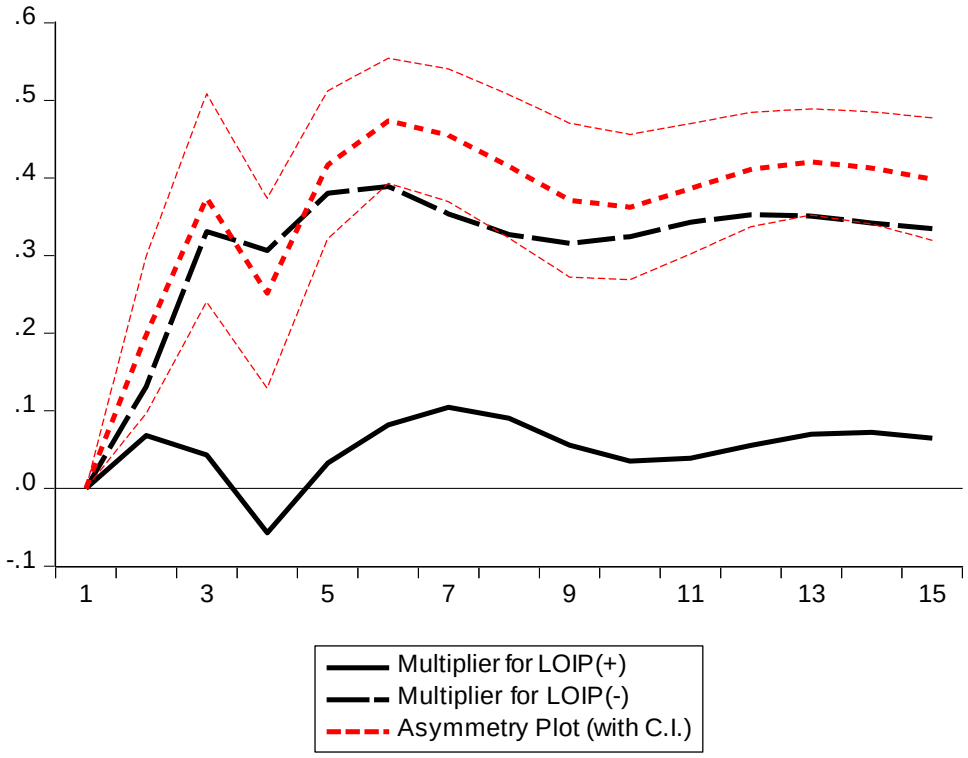
- The nonlinear/asymmetric ARDL model is reported in the figure below:



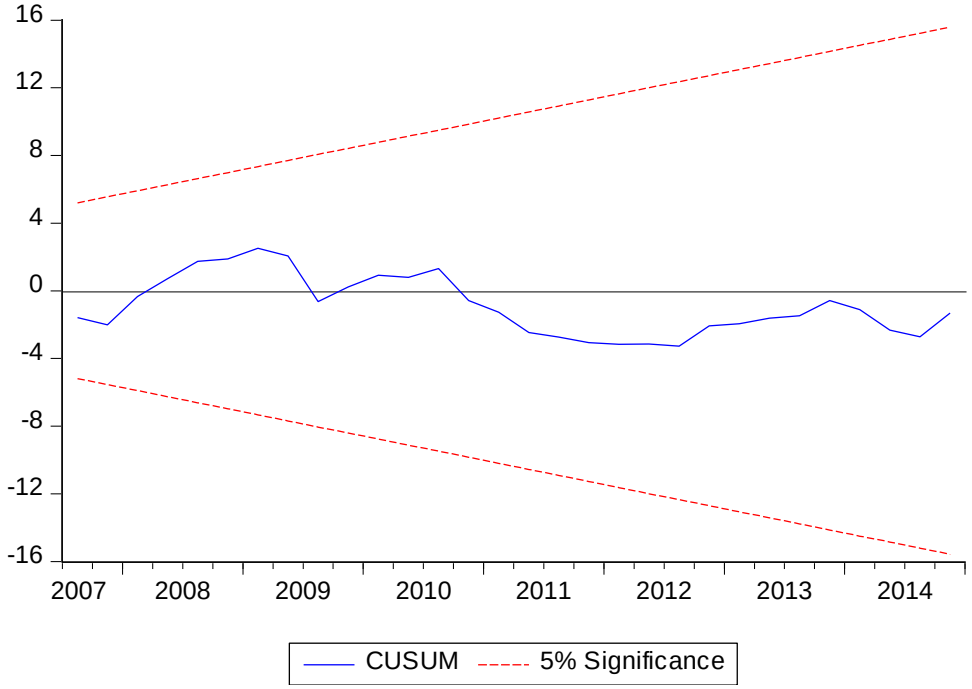
- Generate the multiplier graphs for the asymmetric variables: While the NARDL## is still in focus, click **Add-ins→ NARDL Multiplier Graph**. The process will communicate the asymmetric variables to the NARDL Multiplier Graph routine.
- Should you want to generate the multiplier graphs for a subset of asymmetric variables, you can simply edit the list through **View→Label** of the NARDL## equation object. The multiplier graphs will be generated for all the asymmetric variables listed: ***Multiplier effects have been computed as a unit change. Of course, if the variables were log-transformed, the effects should be interpreted as a percentage change.***

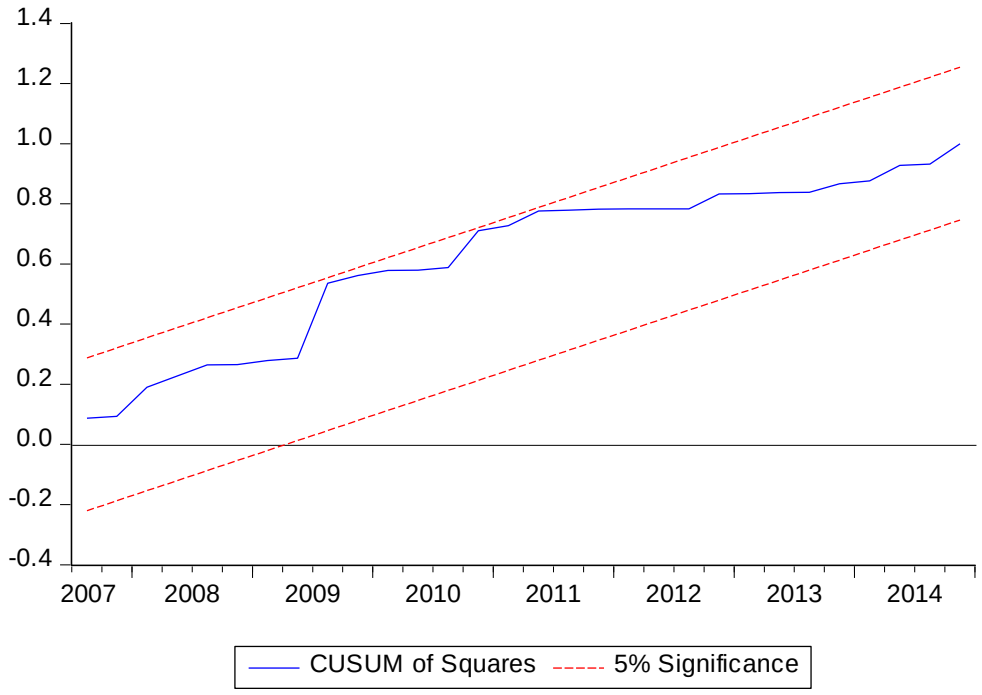

.2
.1
.0
-.1
-.2
-.3
-.4
-.5
1
3
5
7
9
11
13
15
Multiplier for LM2(+)
Multiplier for LM2(-)
Asymmetry Plot (with C.I.)


2.0
1.5
1.0
0.5
0.0
-0.5
1
3
5
7
9
11
13
15
Multiplier for LGDP(+)
Multiplier for LGDP(-)
Asymmetry Plot (with C.I.)



- While the NARDL## is still in focus, click **Add-ins→ NARDL CUSUM and CUSUMQ Graph**. The CUSUM and CUSUMSQ graphs for the NARDL model are generated. It can also be used to generate the CUSUM and CUSUMQ graphs for linear model.





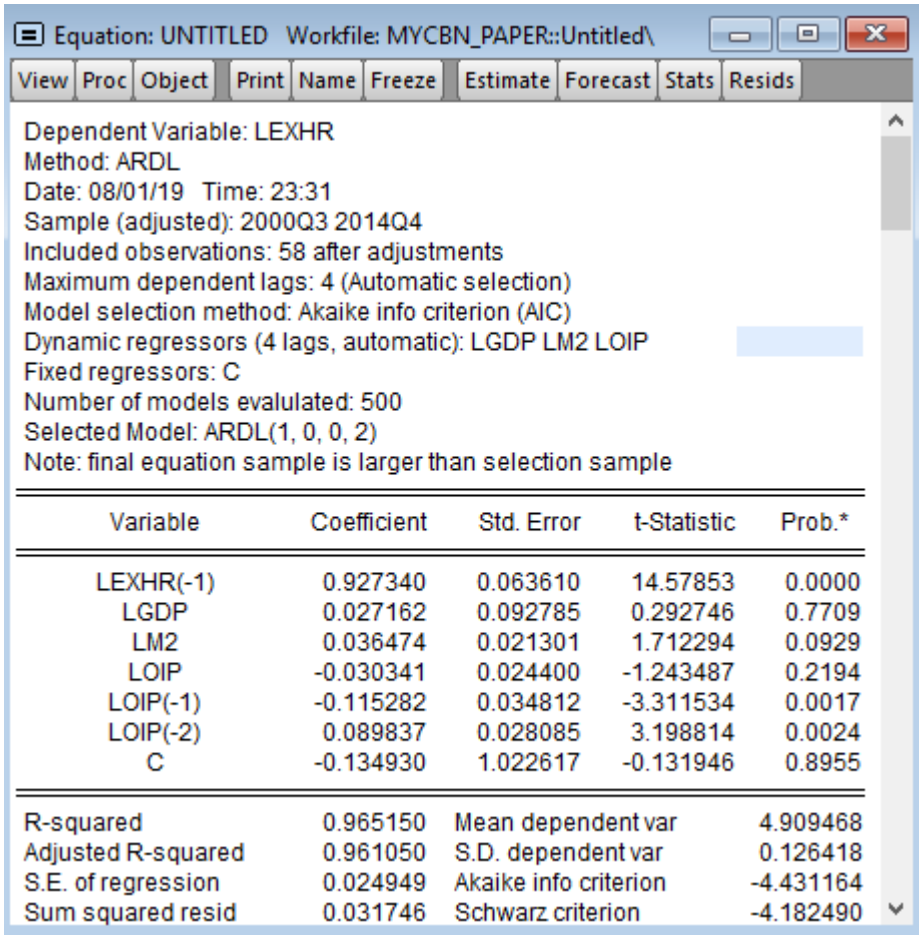
- **Testing the short and the long-run asymmetry**

Rather than do the summary for the hypothesis testing, I consider it more appropriate to deliver the full menu so that each analyst can carry out the test of her choice.

Thus the present NARDL add-in comes with a new routine called **Make Testable Form**, which generates an independent equation object called **LRFORM##** for which all the conventional hypothesis-testing tools are available. The equation object **LRFORM##** reports the same results as does the upper panel of the inbuilt routine **Long Run Form and Bounds Test**. It, however, differs from the latter because it's not hardwired and can be used for hypothesis testing. The **Make Testable Form** routine also works with the linear ARDL model specification.

You can generate LRFORM## as follows:

- Estimate a linear ARDL model:



Equation: UNTITLED Workfile: MYCBN_PAPER::Untitled\

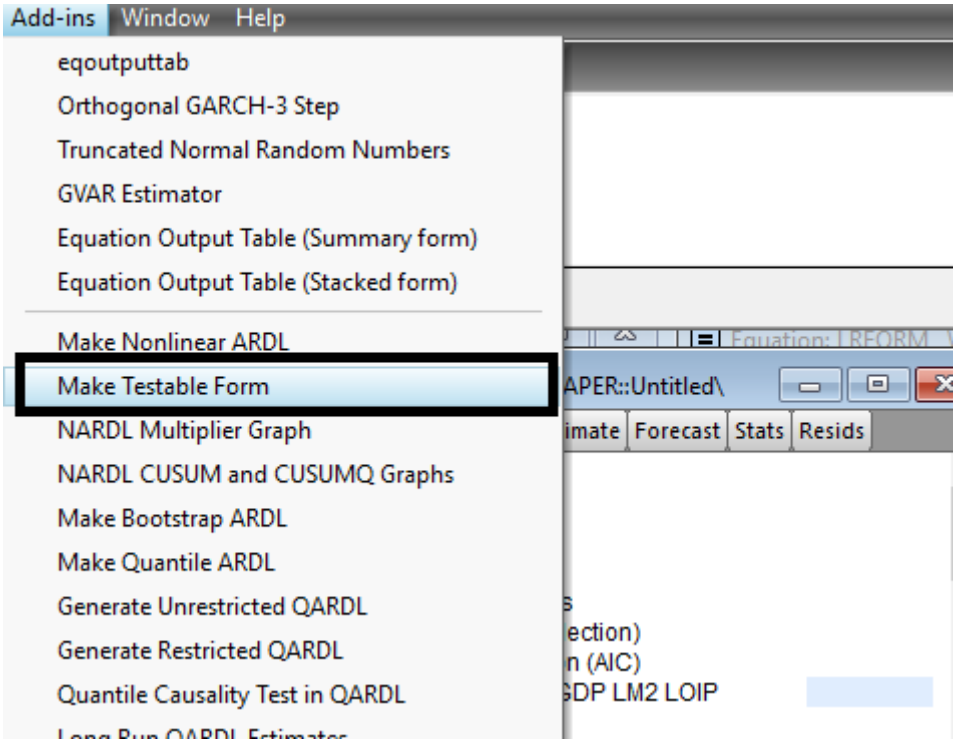
View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LEXHR
Method: ARDL
Date: 08/01/19 Time: 23:31
Sample (adjusted): 2000Q3 2014Q4
Included observations: 58 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LGDP LM2 LOIP
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(1, 0, 0, 2)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LEXHR(-1)	0.927340	0.063610	14.57853	0.0000
LGDP	0.027162	0.092785	0.292746	0.7709
LM2	0.036474	0.021301	1.712294	0.0929
LOIP	-0.030341	0.024400	-1.243487	0.2194
LOIP(-1)	-0.115282	0.034812	-3.311534	0.0017
LOIP(-2)	0.089837	0.028085	3.198814	0.0024
C	-0.134930	1.022617	-0.131946	0.8955

R-squared	0.965150	Mean dependent var	4.909468
Adjusted R-squared	0.961050	S.D. dependent var	0.126418
S.E. of regression	0.024949	Akaike info criterion	-4.431164
Sum squared resid	0.031746	Schwarz criterion	-4.182490

- While the equation object is still in focus, click on **Add-ins→Make Testable Form**. The **Make Testable Form** routine generates **LRFORM##**, which will be listed in the workfile with ## indicating the index number.



Equation: LRFORM01 Workfile: MYCBN_PAPER::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

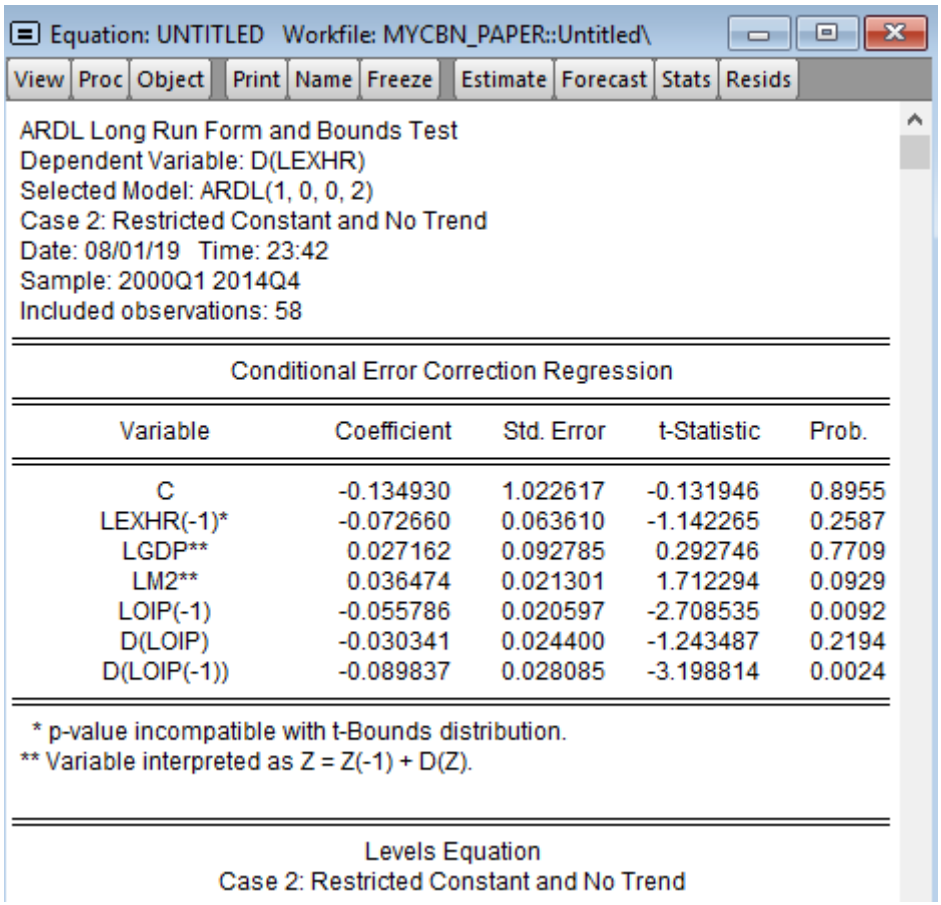
Dependent Variable: D(LEXHR)
Method: Least Squares
Date: 08/01/19 Time: 23:51
Sample (adjusted): 2000Q3 2014Q4
Included observations: 58 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.134930	1.022617	-0.131946	0.8955
LEXHR(-1)	-0.072660	0.063610	-1.142265	0.2587
LGDP	0.027162	0.092785	0.292746	0.7709
LM2	0.036474	0.021301	1.712294	0.0929
LOIP(-1)	-0.055786	0.020597	-2.708535	0.0092
D(LOIP)	-0.030341	0.024400	-1.243487	0.2194
D(LOIP(-1))	-0.089837	0.028085	-3.198814	0.0024

R-squared	0.458084	Mean dependent var	0.008924
Adjusted R-squared	0.394329	S.D. dependent var	0.032059
S.E. of regression	0.024949	Akaike info criterion	-4.431164
Sum squared resid	0.031746	Schwarz criterion	-4.182490
Log likelihood	135.5038	Hannan-Quinn criter.	-4.334301
F-statistic	7.185081	Durbin-Watson stat	1.869802
Prob(F-statistic)	0.000014		

Figure ?: Output using Make Testable Form

The output is the same as the hardwired output produced by the ARDL Long Run Form. See the figure below. With this at hand, an analyst can go about hypothesis testing as she would using the LS method.



Equation: UNTITLED Workfile: MYCBN_PAPER::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LEXHR)
Selected Model: ARDL(1, 0, 0, 2)
Case 2: Restricted Constant and No Trend
Date: 08/01/19 Time: 23:42
Sample: 2000Q1 2014Q4
Included observations: 58

Conditional Error Correction Regression

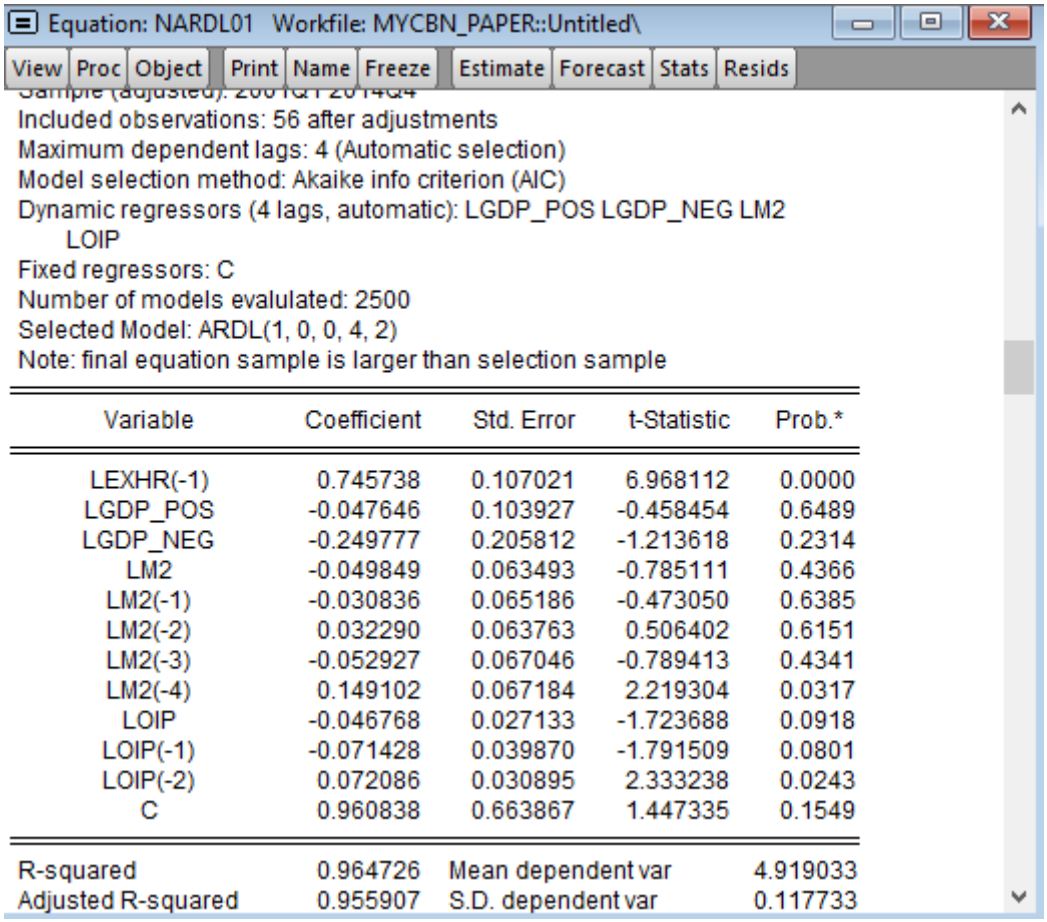
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.134930	1.022617	-0.131946	0.8955
LEXHR(-1)*	-0.072660	0.063610	-1.142265	0.2587
LGDP**	0.027162	0.092785	0.292746	0.7709
LM2**	0.036474	0.021301	1.712294	0.0929
LOIP(-1)	-0.055786	0.020597	-2.708535	0.0092
D(LOIP)	-0.030341	0.024400	-1.243487	0.2194
D(LOIP(-1))	-0.089837	0.028085	-3.198814	0.0024

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 2: Restricted Constant and No Trend

Figure ?: Hardwired Eviews Output

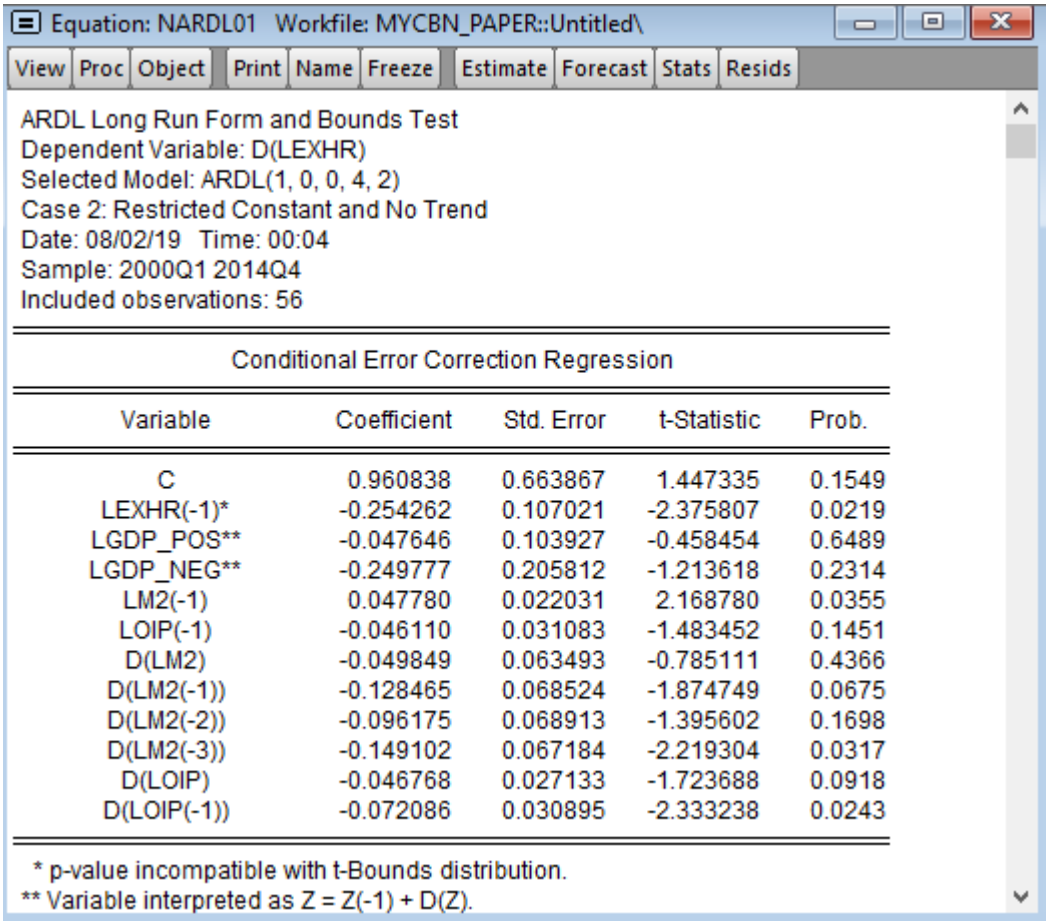
More importantly, it can be used with the NARDL method. To do so, first make the NARDL using **Make Nonlinear ARDL** from which the Make Testable Form routine can be used. Thus asymmetry test can be tested from the generated LS output. Using the above estimate, we make the nonlinear ARDL:



Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LEXHR(-1)	0.745738	0.107021	6.968112	0.0000
LGDP_POS	-0.047646	0.103927	-0.458454	0.6489
LGDP_NEG	-0.249777	0.205812	-1.213618	0.2314
LM2	-0.049849	0.063493	-0.785111	0.4366
LM2(-1)	-0.030836	0.065186	-0.473050	0.6385
LM2(-2)	0.032290	0.063763	0.506402	0.6151
LM2(-3)	-0.052927	0.067046	-0.789413	0.4341
LM2(-4)	0.149102	0.067184	2.219304	0.0317
LOIP	-0.046768	0.027133	-1.723688	0.0918
LOIP(-1)	-0.071428	0.039870	-1.791509	0.0801
LOIP(-2)	0.072086	0.030895	2.333238	0.0243
C	0.960838	0.663867	1.447335	0.1549

R-squared	0.964726	Mean dependent var	4.919033
Adjusted R-squared	0.955907	S.D. dependent var	0.117733

The hardwired from Eviews output is reported as:



Equation: NARDL01 Workfile: MYCBN_PAPER::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

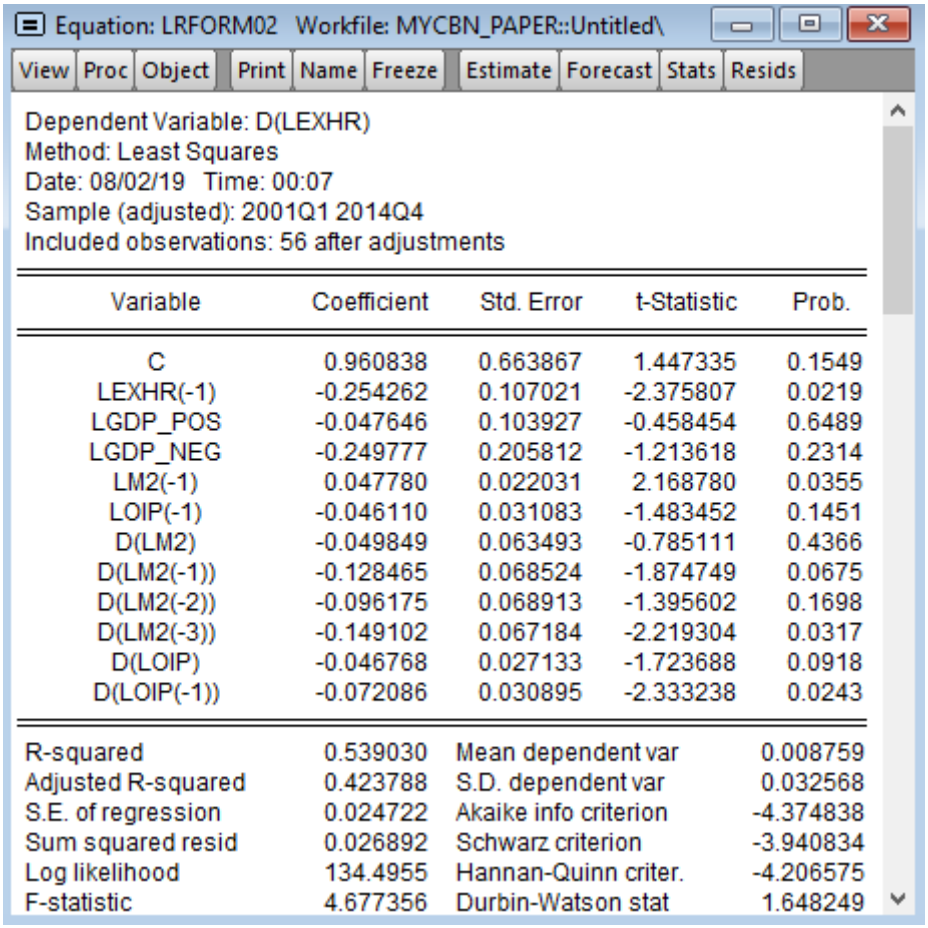
ARDL Long Run Form and Bounds Test
Dependent Variable: D(LEXHR)
Selected Model: ARDL(1, 0, 0, 4, 2)
Case 2: Restricted Constant and No Trend
Date: 08/02/19 Time: 00:04
Sample: 2000Q1 2014Q4
Included observations: 56

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.960838	0.663867	1.447335	0.1549
LEXHR(-1)*	-0.254262	0.107021	-2.375807	0.0219
LGDP_POS**	-0.047646	0.103927	-0.458454	0.6489
LGDP_NEG**	-0.249777	0.205812	-1.213618	0.2314
LM2(-1)	0.047780	0.022031	2.168780	0.0355
LOIP(-1)	-0.046110	0.031083	-1.483452	0.1451
D(LM2)	-0.049849	0.063493	-0.785111	0.4366
D(LM2(-1))	-0.128465	0.068524	-1.874749	0.0675
D(LM2(-2))	-0.096175	0.068913	-1.395602	0.1698
D(LM2(-3))	-0.149102	0.067184	-2.219304	0.0317
D(LOIP)	-0.046768	0.027133	-1.723688	0.0918
D(LOIP(-1))	-0.072086	0.030895	-2.333238	0.0243

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Again, this hardwired output cannot be used for hypothesis testing. Thus, we generate its equivalence using LS:



Equation: LRFORM02 Workfile: MYCBN_PAPER::Untitled\

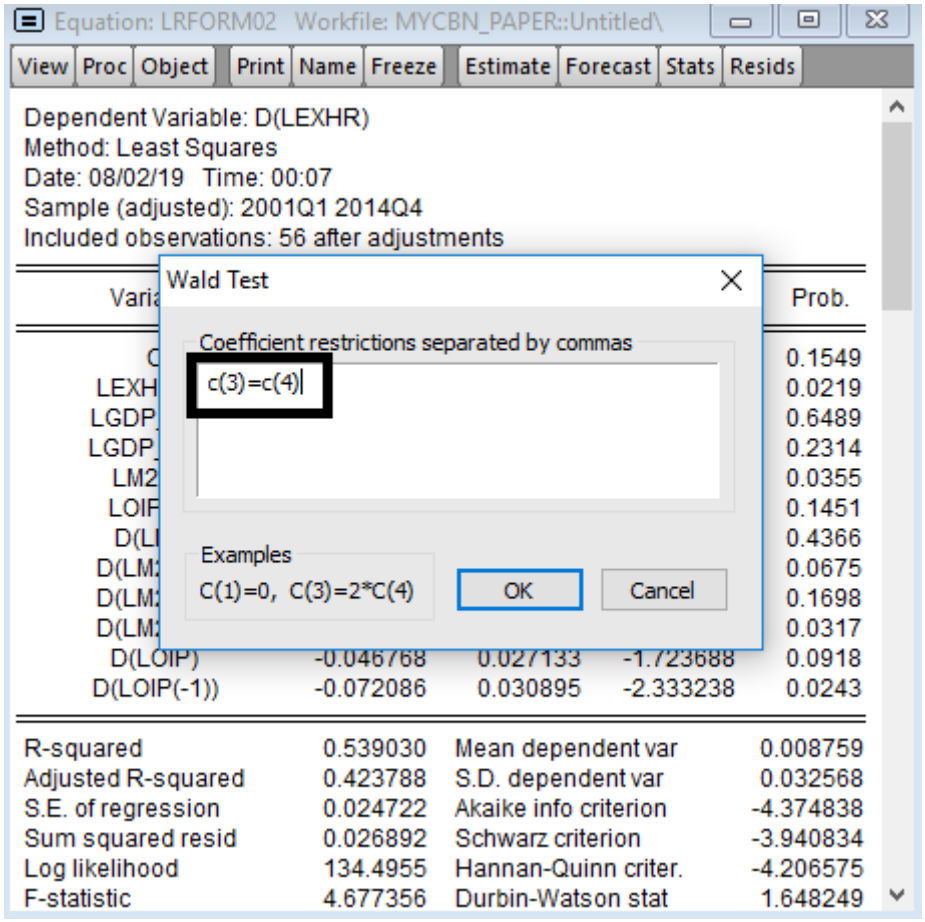
View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

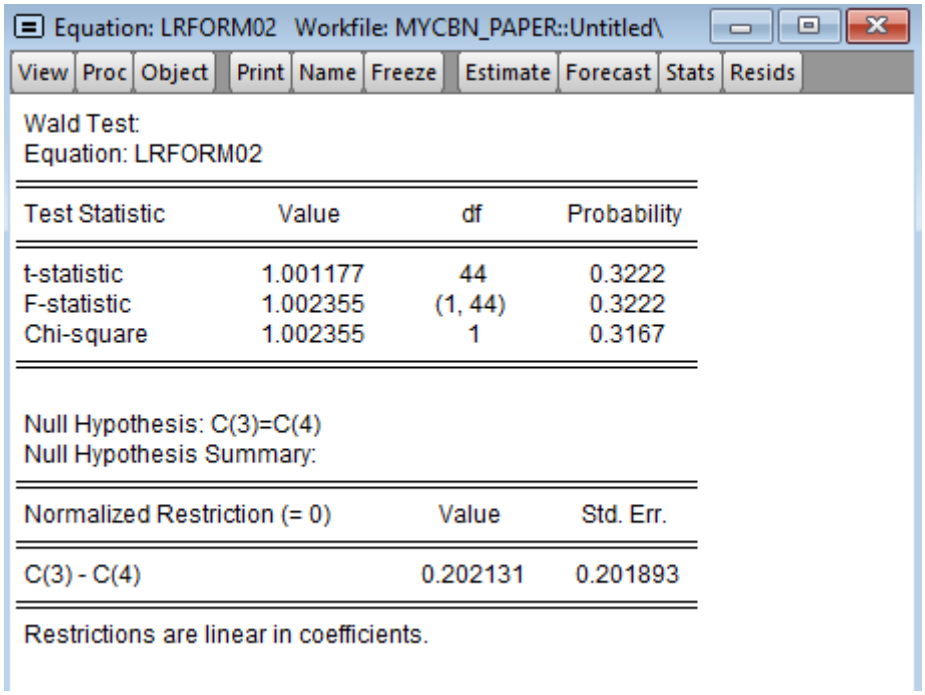
Dependent Variable: D(LEXHR)
Method: Least Squares
Date: 08/02/19 Time: 00:07
Sample (adjusted): 2001Q1 2014Q4
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.960838	0.663867	1.447335	0.1549
LEXHR(-1)	-0.254262	0.107021	-2.375807	0.0219
LGDP_POS	-0.047646	0.103927	-0.458454	0.6489
LGDP_NEG	-0.249777	0.205812	-1.213618	0.2314
LM2(-1)	0.047780	0.022031	2.168780	0.0355
LOIP(-1)	-0.046110	0.031083	-1.483452	0.1451
D(LM2)	-0.049849	0.063493	-0.785111	0.4366
D(LM2(-1))	-0.128465	0.068524	-1.874749	0.0675
D(LM2(-2))	-0.096175	0.068913	-1.395602	0.1698
D(LM2(-3))	-0.149102	0.067184	-2.219304	0.0317
D(LOIP)	-0.046768	0.027133	-1.723688	0.0918
D(LOIP(-1))	-0.072086	0.030895	-2.333238	0.0243

R-squared	0.539030	Mean dependent var	0.008759
Adjusted R-squared	0.423788	S.D. dependent var	0.032568
S.E. of regression	0.024722	Akaike info criterion	-4.374838
Sum squared resid	0.026892	Schwarz criterion	-3.940834
Log likelihood	134.4955	Hannan-Quinn criter.	-4.206575
F-statistic	4.677356	Durbin-Watson stat	1.648249

The two outputs are the same! However, for this particular example there is no short-run asymmetry. To test for the long-run asymmetry, we carry out the Wald test:

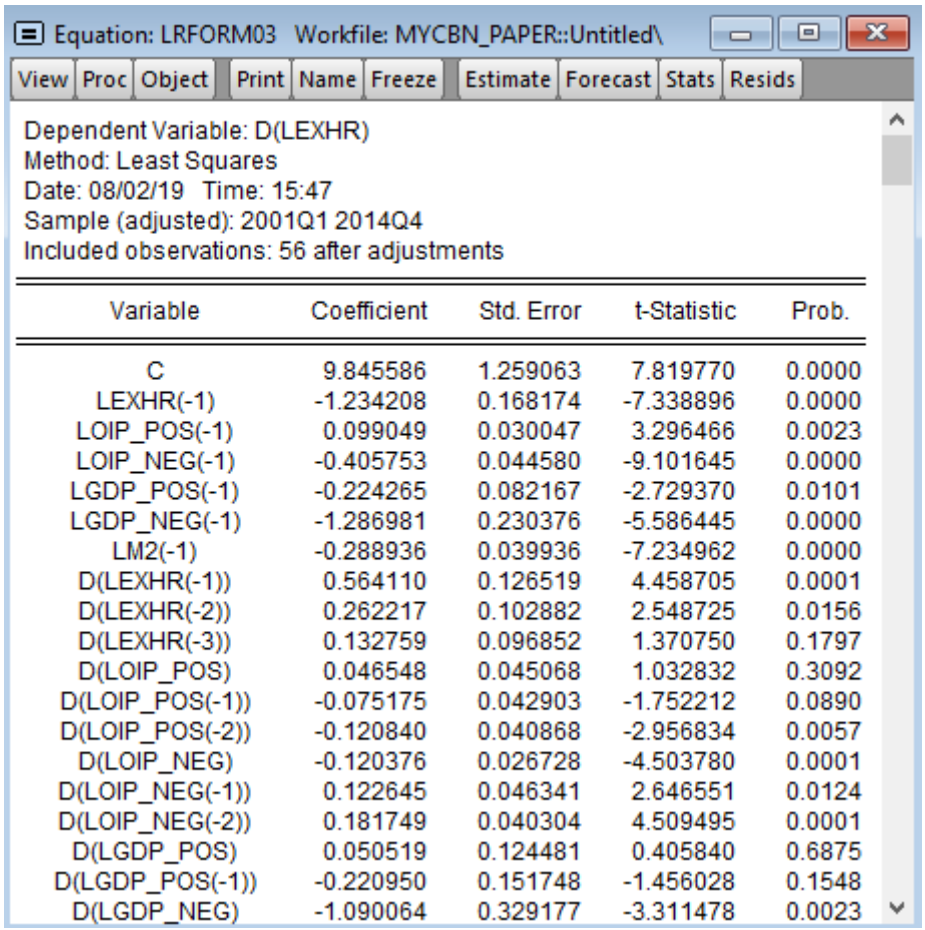




The null of no long-run asymmetry is not rejected.

- **Testing for Asymmetry in Model with Multiple Decomposed Series**

From the analysis in Example 1, we generate the following model from which we plan to test the asymmetry for the short and long run.



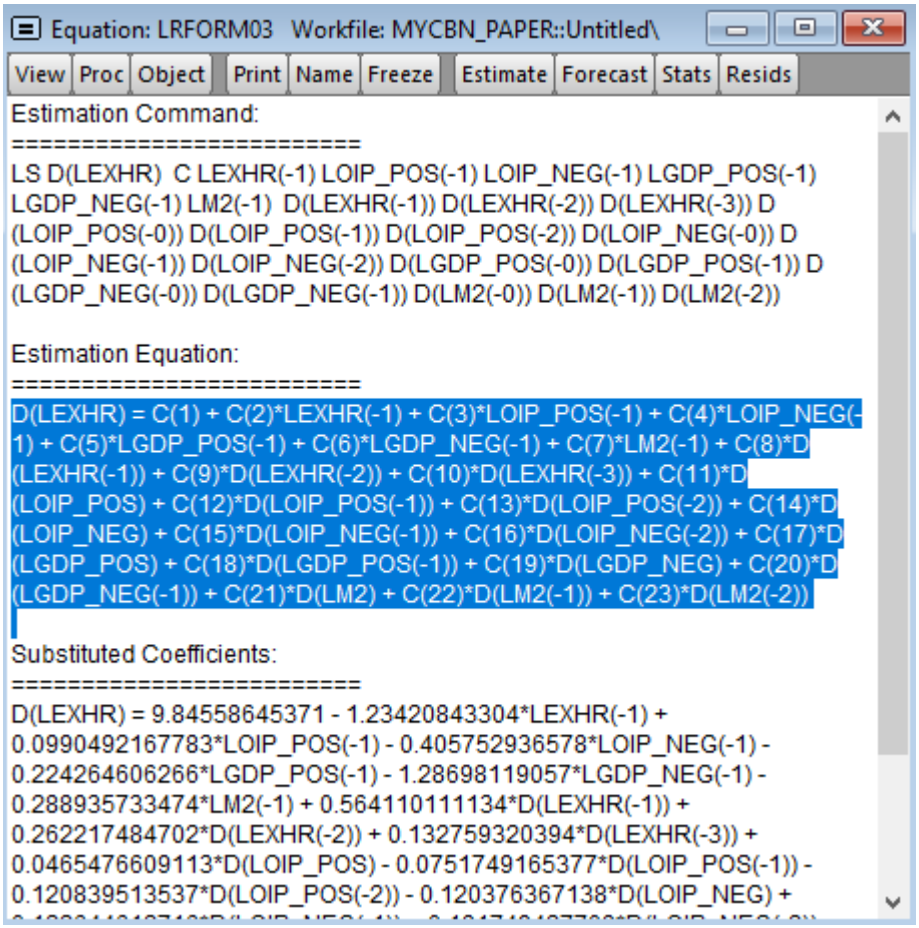
Equation: LRFORM03 Workfile: MYCBN_PAPER::Untitled\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: D(LEXHR)
Method: Least Squares
Date: 08/02/19 Time: 15:47
Sample (adjusted): 2001Q1 2014Q4
Included observations: 56 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.845586	1.259063	7.819770	0.0000
LEXHR(-1)	-1.234208	0.168174	-7.338896	0.0000
LOIP_POS(-1)	0.099049	0.030047	3.296466	0.0023
LOIP_NEG(-1)	-0.405753	0.044580	-9.101645	0.0000
LGDP_POS(-1)	-0.224265	0.082167	-2.729370	0.0101
LGDP_NEG(-1)	-1.286981	0.230376	-5.586445	0.0000
LM2(-1)	-0.288936	0.039936	-7.234962	0.0000
D(LEXHR(-1))	0.564110	0.126519	4.458705	0.0001
D(LEXHR(-2))	0.262217	0.102882	2.548725	0.0156
D(LEXHR(-3))	0.132759	0.096852	1.370750	0.1797
D(LOIP_POS)	0.046548	0.045068	1.032832	0.3092
D(LOIP_POS(-1))	-0.075175	0.042903	-1.752212	0.0890
D(LOIP_POS(-2))	-0.120840	0.040868	-2.956834	0.0057
D(LOIP_NEG)	-0.120376	0.026728	-4.503780	0.0001
D(LOIP_NEG(-1))	0.122645	0.046341	2.646551	0.0124
D(LOIP_NEG(-2))	0.181749	0.040304	4.509495	0.0001
D(LGDP_POS)	0.050519	0.124481	0.405840	0.6875
D(LGDP_POS(-1))	-0.220950	0.151748	-1.456028	0.1548
D(LGDP_NEG)	-1.090064	0.329177	-3.311478	0.0023

To help with proper assignment of the estimated coefficients to their placeholders, it is recommended that Representations is generated for the model. This is given in figure below:



- From the figure, the LR asymmetry test involving LOIP can be stated as

  $$H0: C(3)=C(4)$$

  and that involving LGDP as

  $$H0: C(5)=C(6)$$

- The short run asymmetry test is given by

  $$H0: C(11)+C(12)+C(13)=C(14)+C(15)+C(16)$$

  for LOIP and

  $$H0: C(17)+C(18)=C(19)+C(20)$$

  for LGDP.

- Joint test is given by

  $$H0: C(3)=C(4), C(11)+C(12)+C(13)=C(14)+C(15)+C(16)$$

  for LOIP and by

  $$H0: C(5)=C(6), C(17)+C(18)=C(19)+C(20)$$

  for LGDP.