```
1    *** STEP 0: PANEL DATA UNIT ROOT TEST ON EVIEWS
2    **LNRENCONS (intercept & trend) => result: I(1) stationay in 1st difference
3    *Breitung
4    //not stationary in levels
5    //I(1) stationary in 1st differences
6    *Im
7    //I(0) stationary in levels
8    //I(1) stationary in 1st differences
9
10
11   **FDI (intercept): => result: I(0) stationary in levels
12   *Breitung:
13   //I(0) stationary in levels
14   //I(1) stationary in 1st differences
15   *Im:
16   //I(0) stationary in levels
17   //I(1) stationary in 1st differences
18
19   **IQ (intercept): => result: I(1) stationary in 1st difference
20   *Breitung:
21   //not stationary in levels
22   //I(1) stationary in 1st differences
23   *Im:
24   //not stationary in levels
25   //I(1) stationary in 1st differences
26
27
28   **Income_level (intercept): => result: I(1) stationary in 1st difference
29   *Breitung:
30   //not stationary in levels
31   //I(1) stationary in 1st differences
32   *Im:
33   //not stationary in levels
34   //I(1) stationary in 1st differences
35
36   **CPI (intercept & trend): => result: I(0) stationary in levels
37   *Breitung:
38   //I(0) stationary in levels
39   //not stationary in 1st differences
40   *Im:
41   // not stationary in levels
42   //not stationary in 1st difference
43
44
45   **gdppc_growth (intercept): => result: I(0) stationary in levels
46   *Breitung:
47   // I(0) stationary in levels
48   // not stationary in 1st differences
49   *Im:
50   //I(0) stationary in levels
51   //I(1) stationary in 1st differences
52
53   ***STEP 1: COINTERGRATION TEST (lnrencons, iq, income_level)
54   **KAO:
55   xtcointtest kao lnrencons iq income_level
56
57   Kao test for cointegration
58   --------------------------
59   H0: No cointegration                       Number of panels      =      48
60   Ha: All panels are cointegrated            Avg. number of periods = 10.854
61
62   Cointegrating vector: Same
63   Panel means:          Included             Kernel:          Bartlett
```

```
64   Time trend:            Not included        Lags:              1.42 (Newey-West)
65   AR parameter:          Same                Augmented lags:    1
66   --------------------------------------------------------------------------------
67                                              Statistic         p-value
68   --------------------------------------------------------------------------------
69    Modified Dickey-Fuller t                   1.6519           0.0493
70    Dickey-Fuller t                           -1.2413           0.1072
71    Augmented Dickey-Fuller t                  1.3817           0.0835
72    Unadjusted modified Dickey-Fuller t       -2.3416           0.0096
73    Unadjusted Dickey-Fuller t                -4.3476           0.0000
74   --------------------------------------------------------------------------------
75   //result: cointergrated
76
77   **Pedroni
78    xtcointtest pedroni lnrencons iq income_level
79
80   Pedroni test for cointegration
81   ------------------------------
82   H0: No cointegration                        Number of panels       =      48
83   Ha: All panels are cointegrated             Avg. number of periods = 11.896
84
85   Cointegrating vector: Panel specific
86   Panel means:           Included            Kernel:            Bartlett
87   Time trend:            Not included        Lags:              2.00 (Newey-West)
88   AR parameter:          Panel specific      Augmented lags:    1
89   --------------------------------------------------------------------------------
90                                              Statistic         p-value
91   --------------------------------------------------------------------------------
92    Modified Phillips-Perron t                 5.2419           0.0000
93    Phillips-Perron t                         -2.0536           0.0200
94    Augmented Dickey-Fuller t                 -1.3332           0.0912
95   --------------------------------------------------------------------------------
96   //result: cointergrated
97
98   **Westerlund:
99   xtcointtest westerlund lnrencons iq income_level
100
101  Westerlund test for cointegration
102  ---------------------------------
103  H0: No cointegration                        Number of panels       =      48
104  Ha: Some panels are cointegrated            Avg. number of periods = 12.938
105
106  Cointegrating vector: Panel specific
107  Panel means:           Included
108  Time trend:            Not included
109  AR parameter:          Panel specific
110  --------------------------------------------------------------------------------
111                                             Statistic         p-value
112  --------------------------------------------------------------------------------
113   Variance ratio                             5.4792           0.0000
114  --------------------------------------------------------------------------------
115  //result: cointergrated
116
117  ***INTERPRETATION OF UNIT ROOT TEST AND COINTERGRATION TEST
118  **Unit Root Test:
119  //(I0) fdi, gdppc_growth, cpi
120  //(I1) lnrencons, iq, income_level
121  *result: mix of I(0) and I(1) => Panel ARDL
122  **Cointergration test for I(1) variables
123  // All three tests of Kao, Pedroni, Westerlund show p-value/majority of p-value <0.05 => reject H0:
     no cointergration
124  *result: I(1) and cointergrated => short-run and long-run relationship between variables
125
```

```stata
126   ***STEP2: PREPARING DATA
127   **encoding
128   xtset c_id yr
129   **Filling missing data
130   misstable sum
131   bysort c_id: ipolate lnrencons yr, gen(lnrencon) epolate
132   replace lnrencons=lnrencon if missing(lnrencons)
133   drop lnrencon
134
135   ***STEP 3:UPPER BOUND AND LOWER BOUND
136   ** Upper Bound: POOLED OLS
137   reg L(0/1).lnrencons fdi iq income_level cpi gdppc_growth c.fdi#c.iq c.fdi#i.income_level i.yr
138   est sto ols
139   //result: alpha = 0.9537942
```

Source	SS	df	MS
Model	89.283297	21	4.25158557
Residual	2.42490736	554	.004377089
Total	91.7082044	575	.159492529

Number of obs	= 576
$F(21, 554)$	= 971.33
Prob > F	= 0.0000
R-squared	= 0.9736
Adj R-squared	= 0.9726
Root MSE	= .06616

lnrencons	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
lnrencons						
L1.	.9537942	.0072072	132.34	0.000	.9396374	.967951
fdi	-.0159353	.0135477	-1.18	0.240	-.0425465	.0106759
iq	.0117933	.0070757	1.67	0.096	-.0021051	.0256917
income_level	-.0235055	.0093791	-2.51	0.012	-.0419284	-.0050826
cpi	-.0000574	.0001045	-0.55	0.583	-.0002627	.0001479
gdppc_growth	-.000071	.0010626	-0.07	0.947	-.0021583	.0020162
c.fdi#c.iq	-.0003469	.0004119	-0.84	0.400	-.0011558	.0004621
income_level#c.fdi						
2	.001017	.0122917	0.08	0.934	-.0231271	.0251611
3	.0158147	.0131741	1.20	0.230	-.0100626	.041692
4	.0163479	.0136131	1.20	0.230	-.0103918	.0430875
yr						
2012	-.0146424	.0135813	-1.08	0.281	-.0413196	.0120348
2013	.0039475	.0135933	0.29	0.772	-.0227531	.0306482
2014	-.0163585	.0136125	-1.20	0.230	-.0430969	.01038
2015	-.0138799	.0136333	-1.02	0.309	-.0406592	.0128995
2016	-.0226818	.013673	-1.66	0.098	-.0495391	.0041756
2017	-.0016921	.0137368	-0.12	0.902	-.0286747	.0252904
2018	.0031729	.0138212	0.23	0.819	-.0239754	.0303212
2019	.0013009	.0138783	0.09	0.925	-.0259596	.0285614
2020	.0126136	.0155437	0.81	0.417	-.0179183	.0431454
2021	-.0273133	.0147031	-1.86	0.064	-.0561938	.0015673
2022	-.011985	.0147	-0.82	0.415	-.0408595	.0168895
_cons	.1372661	.0381514	3.60	0.000	.062327	.2122052

```stata
182   ** Lower Bound: Fixed Effect
183   xtreg L(0/1).lnrencons fdi iq income_level cpi gdppc_growth c.fdi#c.iq c.fdi#i.income_level i.yr, fe
      robust
184   est sto fe
185   //result: alpha = 0.6802753
186   Fixed-effects (within) regression          Number of obs    =        576
187   Group variable: c_id                       Number of groups =         48
```

```
188
189   R-squared:                                      Obs per group:
190        Within  = 0.6427                                        min =          12
191        Between = 0.9852                                        avg =        12.0
192        Overall = 0.9605                                        max =          12
193
194                                                   F(21,47)          =      149.14
195   corr(u_i, Xb) = 0.8782                          Prob > F          =      0.0000
196
197                                      (Std. err. adjusted for 48 clusters in c_id)
198   --------------------------------------------------------------------------------
199                    |             Robust
200        lnrencons   | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
201   ------------------+-------------------------------------------------------------
202        lnrencons   |
203             L1.    |   .6802753   .0550739    12.35   0.000     .5694809     .7910697
204                    |
205             fdi    |  -.001007    .025383     -0.04   0.969    -.0520711     .050057
206              iq    |   .0331997   .0433712     0.77   0.448    -.0540519    .1204513
207    income_level    |   .0074317   .0280911     0.26   0.793    -.0490802    .0639436
208             cpi    |   .0000403   .0001234     0.33   0.746     -.000208    .0002886
209    gdppc_growth    |  -.0010019   .0010396    -0.96   0.340    -.0030932    .0010895
210                    |
211      c.fdi#c.iq    |  -.0003373   .0000763    -4.42   0.000    -.0004909   -.0001837
212                    |
213  income_level#c.fdi |
214               2    |  -.010917    .0231326    -0.47   0.639    -.0574538    .0356198
215               3    |   .0069082   .0253857     0.27   0.787    -.0441612    .0579776
216               4    |   .0013449   .0253971     0.05   0.958    -.0497474    .0524373
217                    |
218              yr    |
219            2012    |  -.0085684   .0170867    -0.50   0.618    -.0429423    .0258055
220            2013    |   .0137812   .0106412     1.30   0.202    -.0076261    .0351886
221            2014    |   .001011    .0164398     0.06   0.951    -.0320615    .0340836
222            2015    |   .0061631   .0117635     0.52   0.603    -.0175021    .0298283
223            2016    |  -.0008469   .0162455    -0.05   0.959    -.0335286    .0318349
224            2017    |   .0201638   .0109223     1.85   0.071    -.0018092    .0421367
225            2018    |   .0292105   .0132524     2.20   0.032     .0025501     .055871
226            2019    |   .0326672   .0112653     2.90   0.006     .0100044      .05533
227            2020    |   .0446614   .0137375     3.25   0.002     .0170251    .0722978
228            2021    |   .0199987   .0150993     1.32   0.192    -.0103772    .0503746
229            2022    |   .0266949   .0150409     1.77   0.082    -.0035635    .0569534
230                    |
231           _cons    |   .1549849   .0893953     1.73   0.090    -.0248552     .334825
232   ------------------+-------------------------------------------------------------
233         sigma_u    |   .11544725
234         sigma_e    |    .061328
235            rho     |   .77991215   (fraction of variance due to u_i)
236   --------------------------------------------------------------------------------
237
238
239   ***STEP 4: DIFFERENCE V.S SYSTEM GMM
240   **Twostep Difference GMM
241   xtabond2 L(0/1).lnrencons fdi iq income_level cpi gdppc_growth c.fdi#c.iq c.fdi#i.income_level i.yr,
         gmm(L6.lnrencons L5.fdi L6.iq L6.income_level L6.cpi L.gdppc_growth L2.c.fdi#c.iq L2.c.fdi#i.
         income_level, lag (6 6)) iv(i.yr)noleveleq nodiffsargan twostep robust orthogonal small
242   est sto diffgmm
243   //result:
244
245   Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, perm.
246   1b.income_level#co.fdi dropped due to collinearity
247   2010b.yr dropped due to collinearity
248   2020.yr dropped due to collinearity
```

```
249   Warning: Two-step estimated covariance matrix of moments is singular.
250     Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
251     DFm
252     20
253
254   Dynamic panel-data estimation, two-step difference GMM
255   -------------------------------------------------------------------------------
256   Group variable: c_id                        Number of obs      =        528
257   Time variable : yr                          Number of groups   =         48
258   Number of instruments = 46                  Obs per group: min =         11
259   F(20, 48)      =    108.30                                 avg =      11.00
260   Prob > F       =     0.000                                 max =         11
261   -------------------------------------------------------------------------------
262                      |                 Corrected
263       lnrencons |  Coefficient  std. err.      t    P>|t|    [95% conf. interval]
264   -------------------+---------------------------------------------------------------
265       lnrencons |
266             L1. |    .7389838    .1591267    4.64   0.000    .4190381    1.058929
267                  |
268             fdi |   -.1849776    .0668427   -2.77   0.008   -.3193738   -.0505815
269              iq |    .1179377    .1628867    0.72   0.473    -.209568    .4454434
270    income_level |   -.1097661    .1442937   -0.76   0.451    -.399888    .1803559
271             cpi |    .0002051    .0005104    0.40   0.690   -.0008211    .0012313
272    gdppc_growth |    .0083554    .0046649    1.79   0.080   -.0010241    .0177349
273                  |
274      c.fdi#c.iq |     .000065    .0007125    0.09   0.928   -.0013676    .0014977
275                  |
276 income_level#c.fdi |
277               2 |    .1308336     .067319    1.94   0.058   -.0045202    .2661875
278               3 |    .2020388    .0708335    2.85   0.006    .0596185     .344459
279               4 |    .1847425    .0668771    2.76   0.008    .0502771    .3192079
280                  |
281             yr |
282            2011 |   -.1192176    .0344896   -3.46   0.001   -.1885636   -.0498716
283            2012 |   -.1105263    .0360465   -3.07   0.004   -.1830026   -.0380499
284            2013 |   -.0970898      .02724   -3.56   0.001   -.1518595   -.0423202
285            2014 |    -.101113    .0359252   -2.81   0.007   -.1733455   -.0288806
286            2015 |   -.1015527    .0343922   -2.95   0.005   -.1707029   -.0324024
287            2016 |   -.1017399    .0348944   -2.92   0.005   -.1718998     -.03158
288            2017 |   -.0912808    .0330301   -2.76   0.008   -.1576922   -.0248694
289            2018 |   -.0759234    .0354187   -2.14   0.037   -.1471375   -.0047094
290            2019 |   -.0723535     .031424   -2.30   0.026   -.1355358   -.0091713
291            2021 |   -.1239018    .0529719   -2.34   0.024    -.230409   -.0173947
292            2022 |   -.0915959    .0480418   -1.91   0.063   -.1881904    .0049986
293   -------------------------------------------------------------------------------
294   Instruments for orthogonal deviations equation
295     Standard
296       FOD.(2010b.yr 2011.yr 2012.yr 2013.yr 2014.yr 2015.yr 2016.yr 2017.yr
297       2018.yr 2019.yr 2020.yr 2021.yr 2022.yr)
298     GMM-type (missing=0, separate instruments for each period unless collapsed)
299       L6.(L6.lnrencons L5.fdi L6.iq L6.income_level L6.cpi L.gdppc_growth
300       cL2.fdi#c.iq 1b.income_level#cL2.fdi 2.income_level#cL2.fdi
301       3.income_level#cL2.fdi 4.income_level#cL2.fdi)
302   -------------------------------------------------------------------------------
303   Arellano-Bond test for AR(1) in first differences: z =  -2.34  Pr > z =  0.019
304   Arellano-Bond test for AR(2) in first differences: z =   0.99  Pr > z =  0.324
305   -------------------------------------------------------------------------------
306   Sargan test of overid. restrictions: chi2(25)   =  18.69  Prob > chi2 =  0.812
307     (Not robust, but not weakened by many instruments.)
308   Hansen test of overid. restrictions: chi2(25)   =  21.81  Prob > chi2 =  0.647
309     (Robust, but weakened by many instruments.)
310
311   // alpha = 0.738 (> fe & <ols) => Difference GMM is the way to go
```

```
312
313    ***INTERPRETATION OF MODEL RESULT (5% significant):
314    //FDI has a significant negative relationship on industrial renewable energy consumption
315    //The income level of upper-middle and high-income countries has a significant positive impact on
       the relationship between FDI and Industrial Renewable Energy Consumption
316    //However, Institutional Quality does not have an significant impact on the relationship between FDI
       and Industrial Renewable Energy Consumption
317
```