Économétrie Appliquée : Estimation d'un VEC sur EViews et Stata

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Kinshasa, Février 2018

(Inspiré de Bourbonnais R., 2007)

Économétrie Appliquée :
Estimation d'un VEC sur EViews et Stata

Par

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*« Rien n'est trop tôt, ni trop tard, tout est à sa place ».*

▶ Evolution Graphique des séries

```
create u 1 30
data Y1 Y2 Y3
plot Y1 Y2 Y3
```
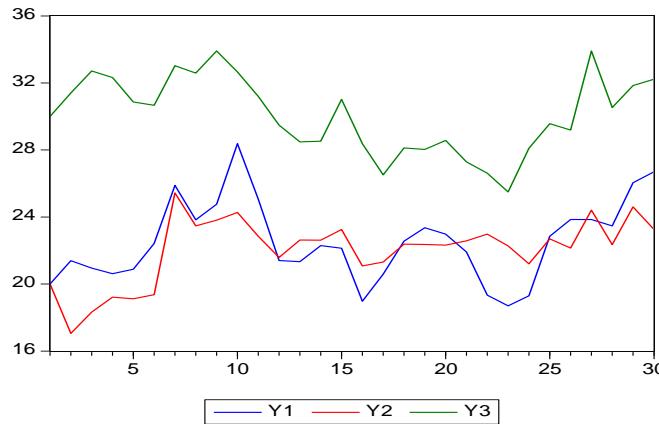

▶ Test de stationnarité (corrélogramme : lag = 1) sur « Y1 » : NS du type DS

Null Hypothesis: Y1 has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.105144	0.5216
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y1)
Method: Least Squares
Date: 06/05/14   Time: 15:04
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y1(-1)	-0.322906	0.153389	-2.105144	0.0451
C	7.199071	3.469646	2.074872	0.0480
@TREND(1)	0.017286	0.041309	0.418456	0.6790

R-squared	0.148053	Mean dependent var	0.230893
Adjusted R-squared	0.082519	S.D. dependent var	1.939676
S.E. of regression	1.857923	Akaike info criterion	4.174493
Sum squared resid	89.74885	Schwarz criterion	4.315937
Log likelihood	-57.53015	Hannan-Quinn criter.	4.218792
F-statistic	2.259165	Durbin-Watson stat	1.557553
Prob(F-statistic)	0.124556		

Null Hypothesis: Y1 has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.116625	0.2399
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y1)
Method: Least Squares
Date: 06/05/14   Time: 15:07
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y1(-1)	-0.319109	0.150763	-2.116625	0.0437
C	7.373378	3.391524	2.174060	0.0386

R-squared	0.142315	Mean dependent var	0.230893
Adjusted R-squared	0.110549	S.D. dependent var	1.939676
S.E. of regression	1.829322	Akaike info criterion	4.112240
Sum squared resid	90.35330	Schwarz criterion	4.206536
Log likelihood	-57.62748	Hannan-Quinn criter.	4.141772
F-statistic	4.480099	Durbin-Watson stat	1.552714
Prob(F-statistic)	0.043653		

▶ Test de stationnarité (corrélogramme : lag = 1) sur « Y2 » : NS du type DS

Null Hypothesis: Y2 has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)			

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.054294	0.1357
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y2)
Method: Least Squares
Date: 06/05/14 Time: 15:12
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y2(-1)	-0.528677	0.173093	-3.054294	0.0052
C	10.88493	3.546381	3.069307	0.0050
@TREND(1)	0.056838	0.039826	1.427174	0.1654

R-squared	0.264697	Mean dependent var	0.112162
Adjusted R-squared	0.208135	S.D. dependent var	1.726653
S.E. of regression	1.536493	Akaike info criterion	3.794580
Sum squared resid	61.38110	Schwarz criterion	3.936024
Log likelihood	-52.02141	Hannan-Quinn criter.	3.838878
F-statistic	4.679778	Durbin-Watson stat	1.990298
Prob(F-statistic)	0.018368		

Null Hypothesis: Y2 has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)			

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.655547	0.0940
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y2)
Method: Least Squares
Date: 06/05/14 Time: 15:14
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y2(-1)	-0.401083	0.151036	-2.655547	0.0131
C	8.931775	3.333906	2.679072	0.0124

|			
R-squared	0.207093	Mean dependent var	0.112162
Adjusted R-squared	0.177726	S.D. dependent var	1.726653
S.E. of regression	1.565717	Akaike info criterion	3.801037
Sum squared resid	66.18966	Schwarz criterion	3.895333
Log likelihood	-53.11503	Hannan-Quinn criter.	3.830569
F-statistic	7.051929	Durbin-Watson stat	2.139687
Prob(F-statistic)	0.013122		

Test de stationnarité (corrélogramme : lag = 1) sur « Y3 » : NS du type DS

Null Hypothesis: Y3 has a unit root			
Exogenous: Constant, Linear Trend			
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)			

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.037994	0.5570
Test critical values:	1% level	-4.309824	
	5% level	-3.574244	
	10% level	-3.221728	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y3)
Method: Least Squares
Date: 06/05/14 Time: 15:26
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y3(-1)	-0.314064	0.154105	-2.037994	0.0518
C	9.808902	4.927826	1.990513	0.0571
@TREND(1)	-0.019961	0.041612	-0.479690	0.6355

R-squared	0.142083	Mean dependent var	0.076606
Adjusted R-squared	0.076090	S.D. dependent var	1.778900
S.E. of regression	1.709883	Akaike info criterion	4.008425
Sum squared resid	76.01624	Schwarz criterion	4.149869
Log likelihood	-55.12216	Hannan-Quinn criter.	4.052723
F-statistic	2.152985	Durbin-Watson stat	2.065368
Prob(F-statistic)	0.136391		

Null Hypothesis: Y3 has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)			

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.048292	0.2659
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(Y3)
Method: Least Squares
Date: 06/05/14 Time: 15:27
Sample (adjusted): 2 30
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y3(-1)	-0.283744	0.138527	-2.048292	0.0504
C	8.598835	4.172405	2.060883	0.0491

R-squared	0.134491	Mean dependent var	0.076606
Adjusted R-squared	0.102435	S.D. dependent var	1.778900
S.E. of regression	1.685329	Akaike info criterion	3.948270
Sum squared resid	76.68899	Schwarz criterion	4.042567
Log likelihood	-55.24992	Hannan-Quinn criter.	3.977803
F-statistic	4.195502	Durbin-Watson stat	2.112902
Prob(F-statistic)	0.050369		

▶ Différenciation 1ère (stationnarisation) et plot des séries stationnarisées
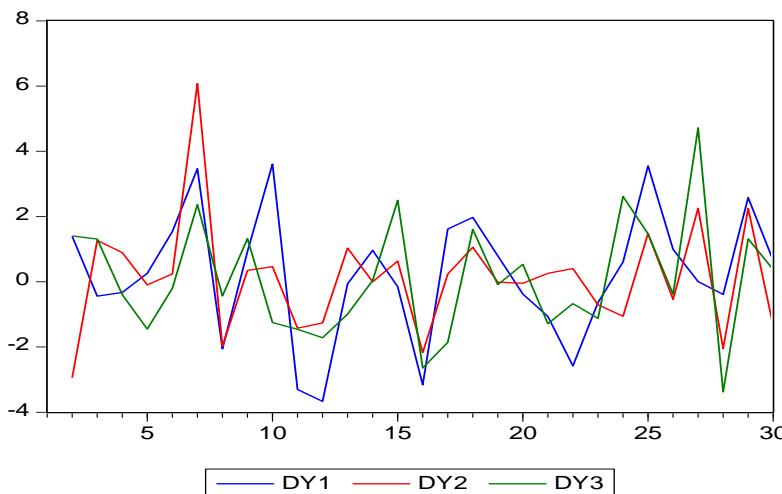
▶ Test de cointégration de Johansen : Quick/Groupe Statistics/Cointegration Test→La boîte de dialogue à gauche complète la procédure et, à droite, les résultats :

Date: 06/08/14 Time: 16:09
Sample: 1 30
Included observations: 28
Series: Y1 Y2 Y3
Lags interval: 1 to 1

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	0	1
Max-Eig	0	1	1	1	1

*Critical values based on Osterwald-Lenum (1992)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	-147.4174	-147.4174	-146.8584	-146.8584	-144.6346
1	-138.7542	-134.4182	-133.8985	-133.3263	-132.2039
2	-134.6256	-130.2603	-130.2519	-129.2354	-128.7165
3	-134.6095	-128.1640	-128.1640	-127.0783	-127.0783
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	11.17267	11.17267	11.34703	11.34703	11.40247
1	10.98244	10.74416*	10.84989	10.88045	10.94313
2	11.11611	10.94716	11.01799	11.08825	11.12261
3	11.54354	11.29743	11.29743	11.43416	11.43416
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	11.60088	11.60088	11.91798	11.91798	12.11616
1	11.69612	11.50542*	11.70631	11.78445	11.94229
2	12.11527	12.04147	12.15988	12.32529	12.40723
3	12.82816	12.72479	12.72479	13.00426	13.00426

▶ Test de cointégration de Johansen (précis) : Quick/Groupe Statistics/Cointegration Test→ La boîte de dialogue ci-dessous complète la procédure et, juste après (en bas), les résultats :
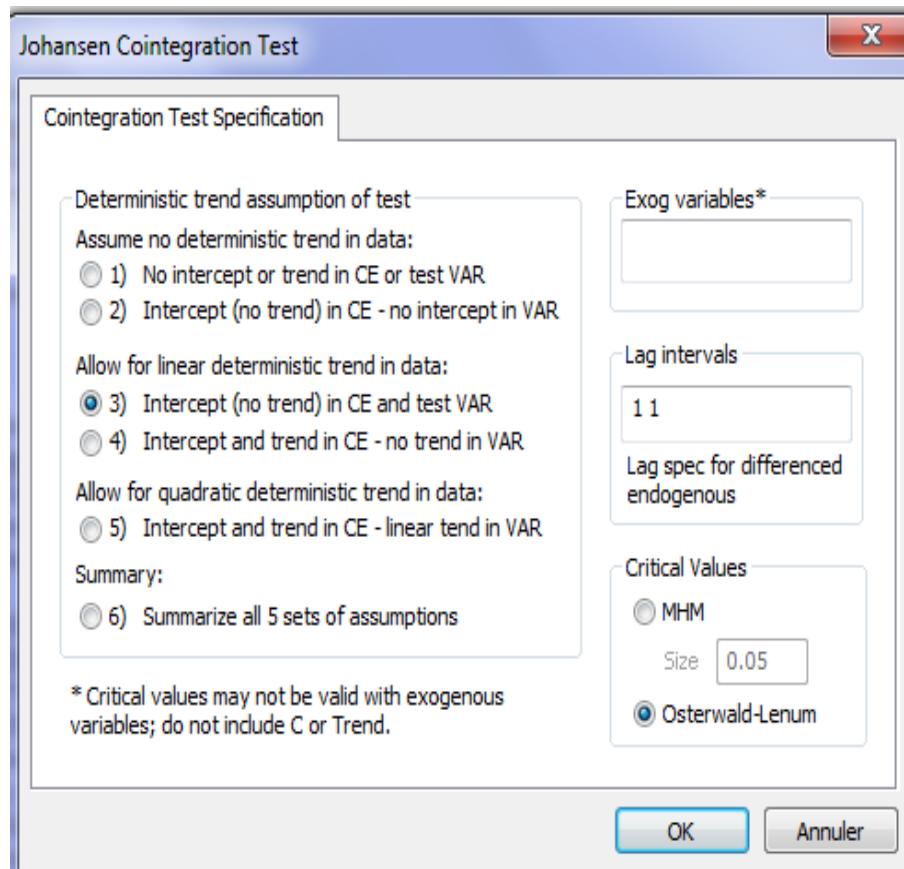

```
Date: 06/08/14   Time: 16:13
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Trend assumption: Linear deterministic trend
Series: Y1 Y2 Y3
Lags interval (in first differences): 1 to 1
```

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.603749	37.38888	29.68	35.65
At most 1	0.229311	11.46904	15.41	20.04
At most 2 *	0.138550	4.175870	3.76	6.65

Trace test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.603749	25.91984	20.97	25.52
At most 1	0.229311	7.293174	14.07	18.63
At most 2 *	0.138550	4.175870	3.76	6.65

Max-eigenvalue test indicates 1 cointegrating equation(s) at both 5% and 1% levels
*(**) denotes rejection of the hypothesis at the 5%(1%) level

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

Y1	Y2	Y3
-0.976817	0.841951	0.527038
-0.330329	-0.274757	0.391754
0.002613	-0.263299	-0.433646

Unrestricted Adjustment Coefficients (alpha):

D(Y1)	0.890676	0.580357	0.272732
D(Y2)	-0.313913	0.507934	0.307021
D(Y3)	-0.009081	-0.088499	0.536754

1 Cointegrating Equation(s):	Log likelihood	-133.8985

Normalized cointegrating coefficients (standard error in parentheses)

Y1	Y2	Y3
1.000000	-0.861933	-0.539547
	(0.10220)	(0.08250)

Adjustment coefficients (standard error in parentheses)

D(Y1)	-0.870028
	(0.32374)
D(Y2)	0.306635
	(0.27854)
D(Y3)	0.008871
	(0.29612)

2 Cointegrating Equation(s):	Log likelihood	-130.2519

Normalized cointegrating coefficients (standard error in parentheses)

Y1	Y2	Y3
1.000000	0.000000	-0.868505
		(0.28380)
0.000000	1.000000	-0.381652
		(0.32951)

Adjustment coefficients (standard error in parentheses)

D(Y1)	-1.061737	0.590448
	(0.31815)	(0.27326)
D(Y2)	0.138850	-0.403858
	(0.27300)	(0.23447)
D(Y3)	0.038104	0.016670
	(0.31201)	(0.26798)

► Estimation du VEC : Quick/Estimate VAR : les boîtes de dialogue suivantes complètent la procédure :
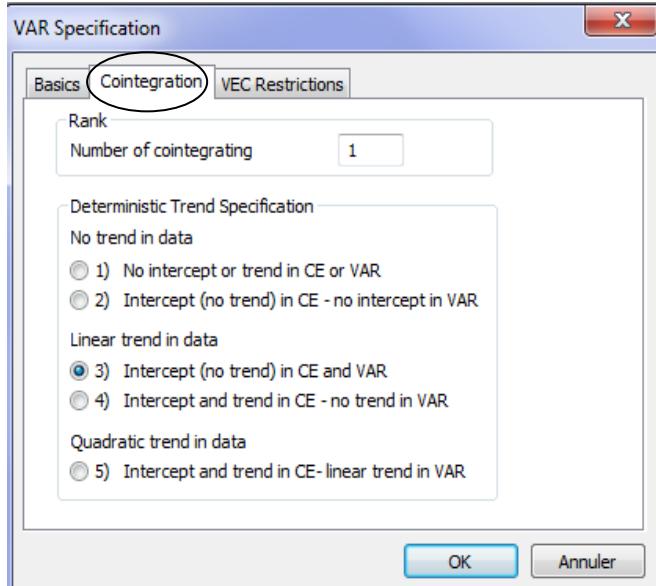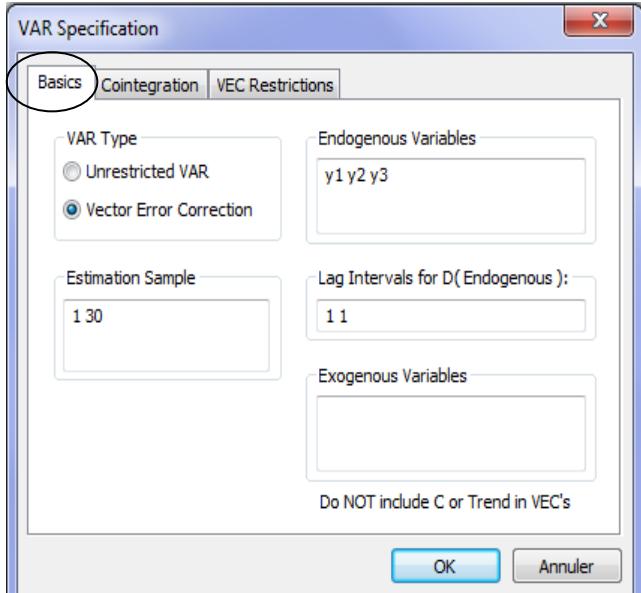

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Vector Error Correction Estimates
Date: 06/07/14   Time: 12:25
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]
```

Cointegrating Eq:	CointEq1		
Y1(-1)	1.000000		
Y2(-1)	-0.865989		
	(0.10029)		
	[-8.63461]		
Y3(-1)	-0.538340		
	(0.08096)		
	[-6.64957]		
C	12.91873		
	(3.31714)		
	[3.89453]		

Error Correction:	D(Y1)	D(Y2)	D(Y3)
CointEq1	-0.846643	0.324797	0.008958
	(0.31995)	(0.27492)	(0.28852)
	[-2.64618]	[1.18144]	[0.03105]
D(Y1(-1))	0.765475	0.101305	0.529527
	(0.27090)	(0.23277)	(0.24429)
	[2.82564]	[0.43521]	[2.16764]
D(Y2(-1))	-0.712854	-0.339983	-0.457668
	(0.27331)	(0.23485)	(0.24646)
	[-2.60819]	[-1.44769]	[-1.85695]
D(Y3(-1))	-0.258211	-0.081117	-0.245870
	(0.24012)	(0.20633)	(0.21653)
	[-1.07533]	[-0.39315]	[-1.13549]
R-squared	0.299843	0.271797	0.318000

▶ Estimation du VEC contraint : Quick/Estimate VAR : la boîte de dialogue ci-dessous complète la procédure :

    (i)   Suivre : View/representations :

VAR Model:
===============================
D(Y1) = A(1,1)*(B(1,1)*Y1(-1) + B(1,2)*Y2(-1) + B(1,3)*Y3(-1) + B(1,4)) + C(1,1)*D(Y1(-1)) + C(1,2)*D(Y2(-1)) + C(1,3)*D(Y3(-1))

D(Y2) = A(2,1)*(B(1,1)*Y1(-1) + B(1,2)*Y2(-1) + B(1,3)*Y3(-1) + B(1,4)) + C(2,1)*D(Y1(-1)) + C(2,2)*D(Y2(-1)) + C(2,3)*D(Y3(-1))

D(Y3) = A(3,1)*(B(1,1)*Y1(-1) + B(1,2)*Y2(-1) + B(1,3)*Y3(-1) + B(1,4)) + C(3,1)*D(Y1(-1)) + C(3,2)*D(Y2(-1)) + C(3,3)*D(Y3(-1))

    (ii)   Estimer le VEC restreint en cochant (Cfr boîte de dialogue ci-dessous) :
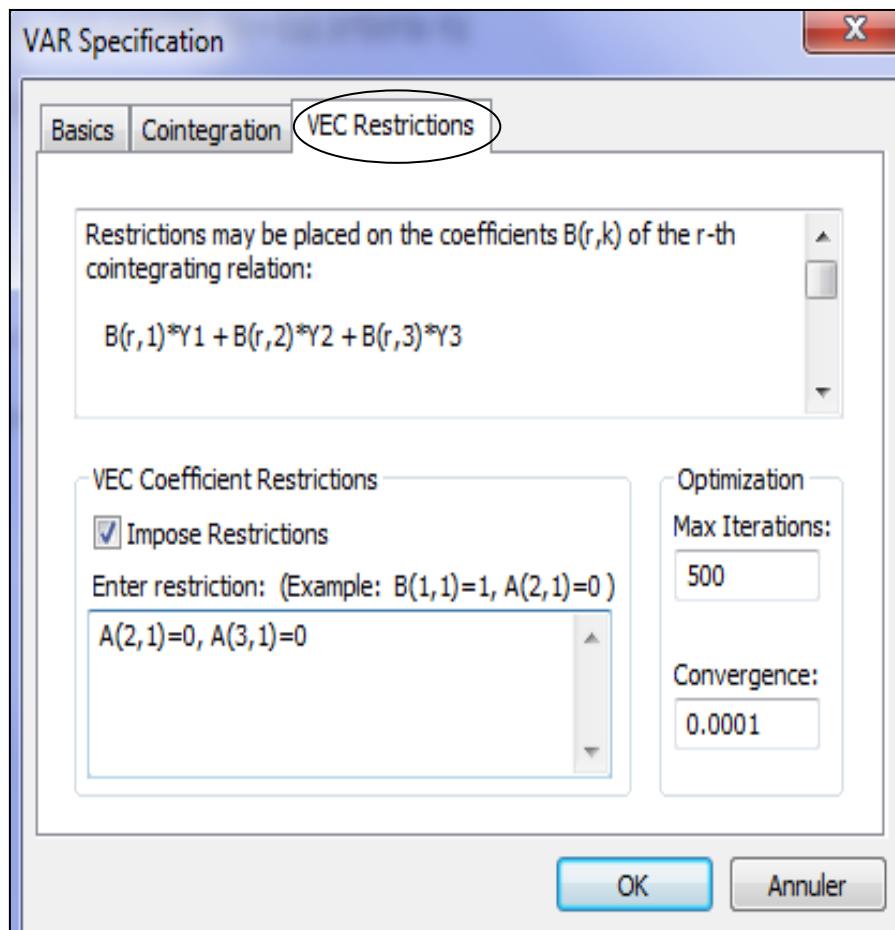
```
Vector Error Correction Estimates
Date: 06/07/14   Time: 12:45
Sample (adjusted): 3 30
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]
```

Cointegration Restrictions:			
A(2,1)=0, A(3,1)=0			
Convergence achieved after 7 iterations.			
Not all cointegrating vectors are identified			
LR test for binding restrictions (rank = 1):			
Chi-square(2)	1.558967		
Probability	0.458643		

Cointegrating Eq:	CointEq1		
Y1(-1)	0.997283		
Y2(-1)	-0.797187		
Y3(-1)	-0.555922		
C	11.94414		

Error Correction:	D(Y1)	D(Y2)	D(Y3)
CointEq1	-1.187476	0.000000	0.000000
	(0.20103)	(0.00000)	(0.00000)
	[-5.90704]	[NA]	[NA]
D(Y1(-1))	0.813973	0.139232	0.527616
	(0.26543)	(0.23701)	(0.24591)
	[3.06663]	[0.58745]	[2.14553]
D(Y2(-1))	-0.715308	-0.372227	-0.456821
	(0.26279)	(0.23465)	(0.24346)
	[-2.72203]	[-1.58631]	[-1.87634]
D(Y3(-1))	-0.299747	-0.097043	-0.244642
	(0.23644)	(0.21113)	(0.21906)
	[-1.26773]	[-0.45964]	[-1.11679]
R-squared	0.336733	0.255023	0.318024
Adj. R-squared	0.253825	0.161901	0.232777
Sum sq. resids	68.94641	54.97308	59.18074
S.E. equation	1.694924	1.513455	1.570307
F-statistic	4.061515	2.738584	3.730614
Log likelihood	-52.34603	-49.17523	-50.20776
Akaike AIC	4.024716	3.798231	3.871983
Schwarz SC	4.215031	3.988545	4.062298
Mean dependent	0.189433	0.221378	0.029167
S.D. dependent	1.962140	1.653186	1.792766

Determinant resid covariance (dof adj.)	4.775685
Determinant resid covariance	3.007429
Log likelihood	-135.1977
Akaike information criterion	10.79983
Schwarz criterion	11.56109

► Inférence sur le VEC estimé

a) Autocorélation sérielle (lecture sur un corrélogramme) : dans l'output de l'estimation, suivre : View/residual Tests/Correlogram :

Autocorrelations with 2 Std.Err. Bounds
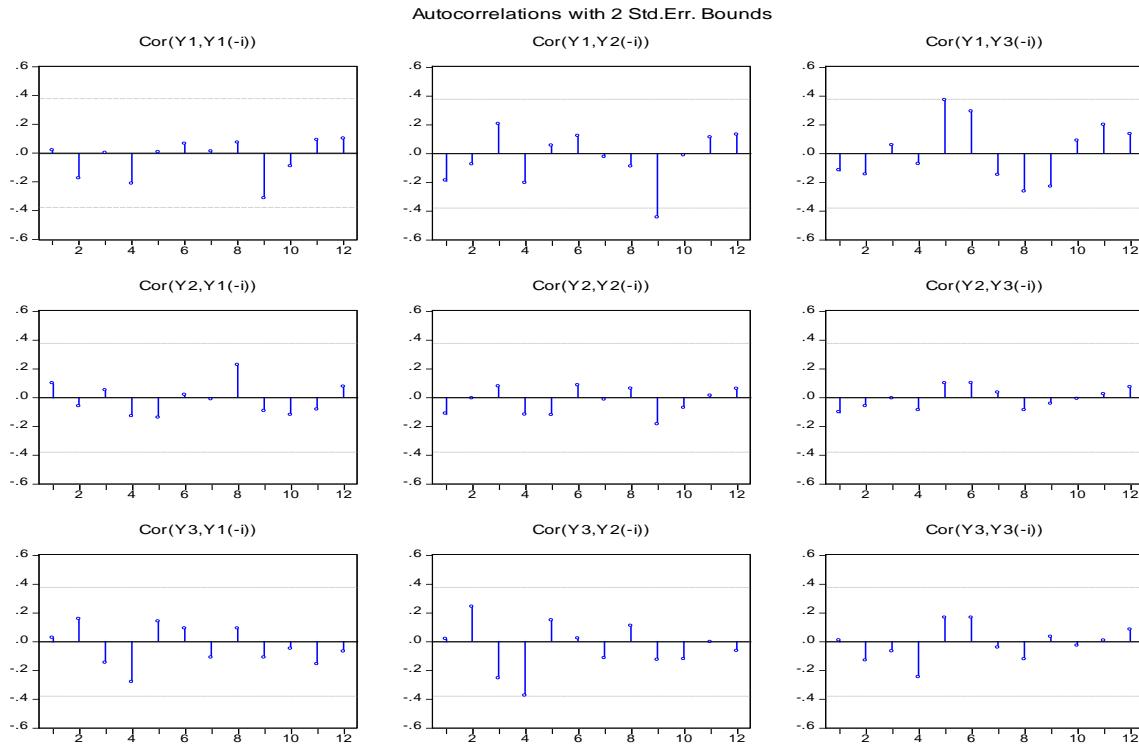
b) Autocorélation sérielle (LM-Test) : dans l'output de l'estimation, suivre : View/residual Tests/Autocorrelation LM Test…:

VEC Residual Serial Correlation LM T...
Null Hypothesis: no serial correlation ...
Date: 06/07/14   Time: 12:52
Sample: 1 30
Included observations: 28

Lags	LM-Stat	Prob
1	6.874585	0.6502
2	10.08456	0.3437
3	19.56868	0.0208
4	10.11509	0.3412
5	16.64337	0.0546
6	11.55136	0.2398
7	7.816972	0.5527
8	11.94662	0.2163
9	12.27529	0.1982
10	5.333437	0.8043
11	9.968504	0.3530
12	4.639211	0.8646

Probs from chi-square with 9 df.

c) Test de bruit blanc/Test portementeau : View/Residual
Tests/Portementeau Autocorrelation Test :

```
VEC Residual Portmanteau Tests for Autocorrelations
Null Hypothesis: no residual autocorrelations up to lag h
Date: 06/07/14   Time: 12:54
Sample: 1 30
Included observations: 28

 Lags      Q-Stat      Prob.     Adj Q-Stat    Prob.      df

   1      4.635663      NA*       4.807355      NA*       NA*
   2     11.29556     0.2560     11.97955     0.2145       9
   3     20.93803     0.2826     22.77912     0.1992      18
   4     26.78433     0.4755     29.59981     0.3324      27
   5     36.45555     0.4475     41.37346     0.2476      36
   6     42.40236     0.5826     48.94213     0.3178      45
   7     45.91859     0.7749     53.63043     0.4886      54
   8     53.41856     0.7998     64.13040     0.4367      63
   9     61.97595     0.7943     76.74129     0.3292      72
  10     64.15176     0.9155     80.12588     0.5066      81
  11     69.63969     0.9451     89.16481     0.5051      90
  12     71.39085     0.9835     92.22935     0.6718      99

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution
```

d) Normalité des erreurs : View/Residual Tests/Normality Test…→Cocher
"Cholesky of Covariance" :

```
VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 06/07/14   Time: 12:57
Sample: 1 30
Included observations: 28

 Component    Skewness      Chi-sq       df       Prob.

    1        -0.165127     0.127245       1       0.7213
    2         0.581165     1.576178       1       0.2093
    3         0.604200     1.703604       1       0.1918

  Joint                    3.407027       3       0.3330


 Component    Kurtosis      Chi-sq       df       Prob.

    1         3.249950     0.072887       1       0.7872
    2         3.117838     0.016200       1       0.8987
    3         2.516152     0.273127       1       0.6012

  Joint                    0.362214       3       0.9479


 Component   Jarque-Bera      df       Prob.

    1         0.200133        2       0.9048
    2         1.592378        2       0.4510
    3         1.976730        2       0.3722

  Joint       3.769241        6       0.7079
```

e) Test de White sans terme croisé : View/Residual Tests/White heteroskesdasticity (No cross terms)

```
VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 06/07/14   Time: 13:00
Sample: 1 30
Included observations: 28
```

Joint test:

Chi-sq	df	Prob.
40.40015	48	0.7739

Individual components:

Dependent	R-squared	F(8,19)	Prob.	Chi-sq(8)	Prob.
res1*res1	0.234144	0.726106	0.6673	6.556039	0.5852
res2*res2	0.148735	0.414967	0.8978	4.164591	0.8420
res3*res3	0.404892	1.615873	0.1857	11.33698	0.1833
res2*res1	0.181406	0.526315	0.8222	5.079363	0.7491
res3*res1	0.537714	2.762512	0.0329	15.05599	0.0581
res3*res2	0.469077	2.098342	0.0883	13.13416	0.1073

a) Test de White avec terme croisé : View/Residual Tests/White heteroskesdasticity (Whith cross terms)

```
VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Date: 06/07/14   Time: 13:02
Sample: 1 30
Included observations: 28
```

Joint test:

Chi-sq	df	Prob.
70.46094	84	0.8542

Individual components:

Dependent	R-squared	F(14,13)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.323017	0.443060	0.9281	9.044477	0.8282
res2*res2	0.233028	0.282126	0.9873	6.524771	0.9515
res3*res3	0.571157	1.236724	0.3537	15.99240	0.3138
res2*res1	0.251183	0.311480	0.9807	7.033133	0.9334
res3*res1	0.677879	1.954104	0.1180	18.98060	0.1657
res3*res2	0.602713	1.408711	0.2716	16.87597	0.2628

▶ Evolution Graphique des séries (*déjà présentée au début*)

▶ Test de stationnarité (corrélogramme : lag = 1) sur « Y1, Y2 et Y3 » : NS du type DS

▶ Test de cointégration de Johansen : après avoir fait : *tsset annee*

```
Commande: vecrank y1 y2 y3

                      Johansen tests for cointegration
Trend: constant                                         Number of obs =      28
Sample:    1982    2009                                         Lags =       2
--------------------------------------------------------------------------------
                                                         5%
maximum                                         trace   critical
  rank     parms        LL      eigenvalue    statistic   value
   0        12     -146.85843        .         37.3889    29.68
   1        17     -133.89851     0.60375      11.4690*   15.41
   2        20     -130.25192     0.22931       4.1759     3.76
   3        21     -128.16399     0.13855
--------------------------------------------------------------------------------
```

▶ Estimation du VEC :

```
Commande : vec y1 y2 y3, lags(1)

Vector error-correction model

Sample:    1981    2009                        No. of obs      =       29
                                               AIC             =   11.17282
Log likelihood = -154.0058                     HQIC            =   11.29095
Det(Sigma_ml)  =  8.227321                     SBIC            =      11.55

Equation              Parms      RMSE     R-sq     chi2     P>chi2
----------------------------------------------------------------
D_y1                    2       1.9674   0.0223  .6158425   0.7350
D_y2                    2      1.56137   0.2149  7.391579   0.0248
D_y3                    2      1.59306   0.2281  7.980625   0.0185
----------------------------------------------------------------

--------------------------------------------------------------------------------
             |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+------------------------------------------------------------------
D_y1         |
        _ce1 |
         L1. | -.1115329   .2397492    -0.47   0.642    -.5814327    .3583669
       _cons |  .2452062   .3666302     0.67   0.504    -.4733758    .9637882
-------------+------------------------------------------------------------------
D_y2         |
        _ce1 |
         L1. |  .5120313   .1902696     2.69   0.007     .1391098    .8849529
       _cons |   .046454   .2909648     0.16   0.873    -.5238266    .6167346
-------------+------------------------------------------------------------------
D_y3         |
        _ce1 |
         L1. |   .546115   .1941324     2.81   0.005     .1656225    .9266075
       _cons |  .0065236   .2968719     0.02   0.982    -.5753346    .5883818
--------------------------------------------------------------------------------

Cointegrating equations

Equation          Parms    chi2     P>chi2
-------------------------------------------
_ce1                2    76.86291   0.0000
-------------------------------------------

Identification:  beta is exactly identified
```

```
               Johansen normalization restriction imposed
--------------------------------------------------------------------------------
        beta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+------------------------------------------------------------------
_ce1         |
         y1  |          1          .       .       .          .           .
         y2  |  -.9085093   .1532522   -5.93   0.000   -1.208878    -.6081406
         y3  |  -.7679063   .1305841   -5.88   0.000   -1.023846    -.5119661
       _cons |   20.78742          .       .       .          .           .
--------------------------------------------------------------------------------
```

▶ Estimation du VEC contraint : A investiquer (commande : aconstraint)

▶ Inférence sur le VEC estimé

   a) Autocorrélation sérielle (lecture sur un corrélogramme) : dans l'output de
      l'estimation, suivre : View/residual Tests/Correlogram :
   b) Autocorrélation sérielle (LM-Test) :

```
Commande: veclmar
  Lagrange-multiplier test
  +-----------------------------------+
  | lag |    chi2    df   Prob > chi2 |
  |-----+-----------------------------|
  |  1  |  2.4438     9     0.98236   |
  |  2  |  9.2342     9     0.41594   |
  +-----------------------------------+
  H0: no autocorrelation at lag order
```

   c) Test de bruit blanc/Test portementeau : Corrélogram des résidus
   d) Normalité des erreurs :

```
Commande : vecnorm
  Jarque-Bera test
  +-------------------------------------------------------------+
  |         Equation |          chi2   df   Prob > chi2 |
  |------------------+------------------------------------------|
  |             D_y1 |          8.986    2      0.01119  |
  |             D_y2 |          7.543    2      0.02302  |
  |             D_y3 |          5.200    2      0.07428  |
  |              ALL |         21.729    6      0.00136  |
  +-------------------------------------------------------------+
  Skewness test
  +-------------------------------------------------------------+
  |         Equation | Skewness   chi2   df   Prob > chi2 |
  |------------------+------------------------------------------|
  |             D_y1 | -1.0553    5.011    1      0.02518  |
  |             D_y2 |  .82814    3.086    1      0.07896  |
  |             D_y3 |  .99966    4.497    1      0.03395  |
  |              ALL |          12.594    3      0.00560  |
  +-------------------------------------------------------------+
  Kurtosis test
  +-------------------------------------------------------------+
  |         Equation | Kurtosis   chi2   df   Prob > chi2 |
  |------------------+------------------------------------------|
  |             D_y1 | 4.8797    3.975    1      0.04618   |
  |             D_y2 | 4.9904    4.457    1      0.03476   |
  |             D_y3 | 3.7904    0.703    1      0.40182   |
```

```
|                 ALL |         9.135   3    0.02755   |
+----------------------------------------------------+
```

e) Test de stabilité

```
Commande : vecstable

  Eigenvalue stability condition
  +---------------------------------------+
  |        Eigenvalue        |   Modulus  |
  |--------------------------+------------|
  |           1              |        1   |
  |           1              |        1   |
  |   .00391666              |   .003917  |
  +---------------------------------------+
   The VECM specification imposes 2 unit moduli
```