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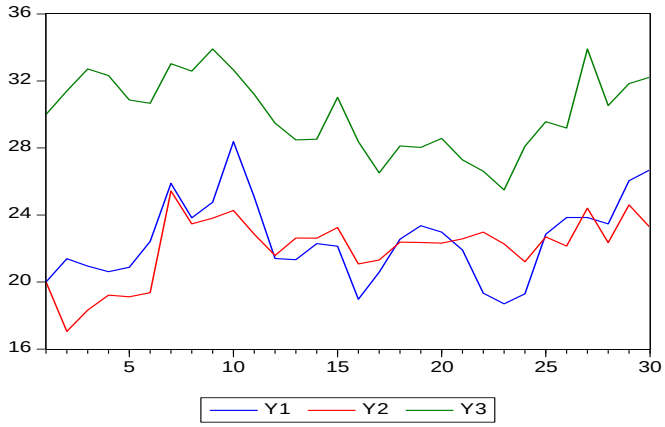
« Rien n'est trop tôt, ni trop tard, tout est à sa place ».

Février 2018

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	

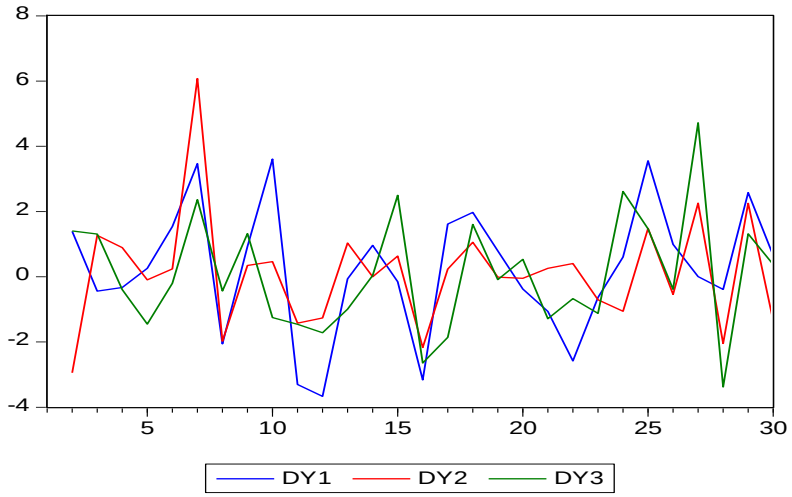
*MacKinnon (1996) one-sided p-values.

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

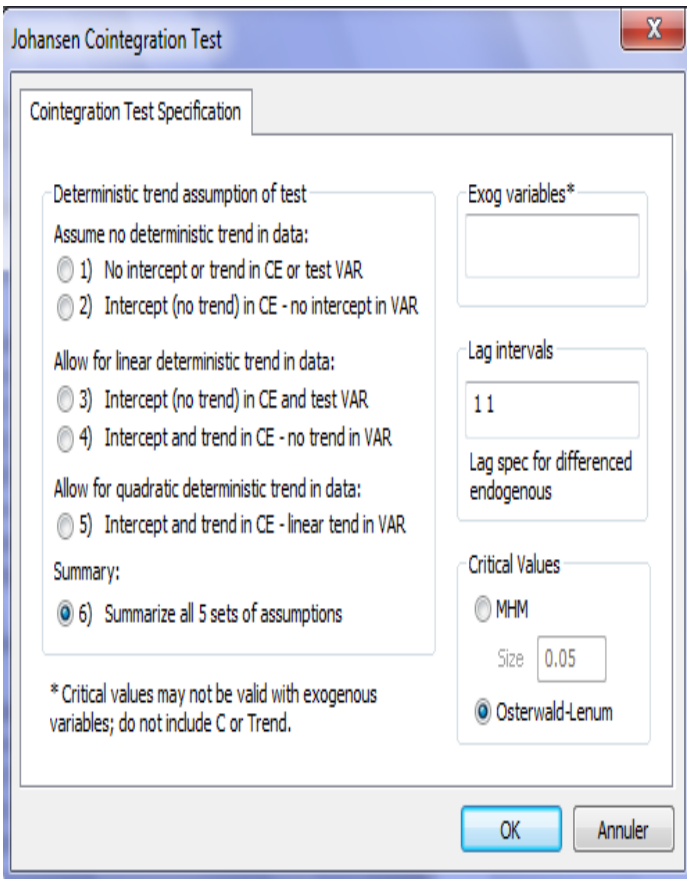
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y3(-1)	-0.283744	0.138527	-2.048292	0.0504
C	8.598835	4.172405	2.060883	0.0491

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

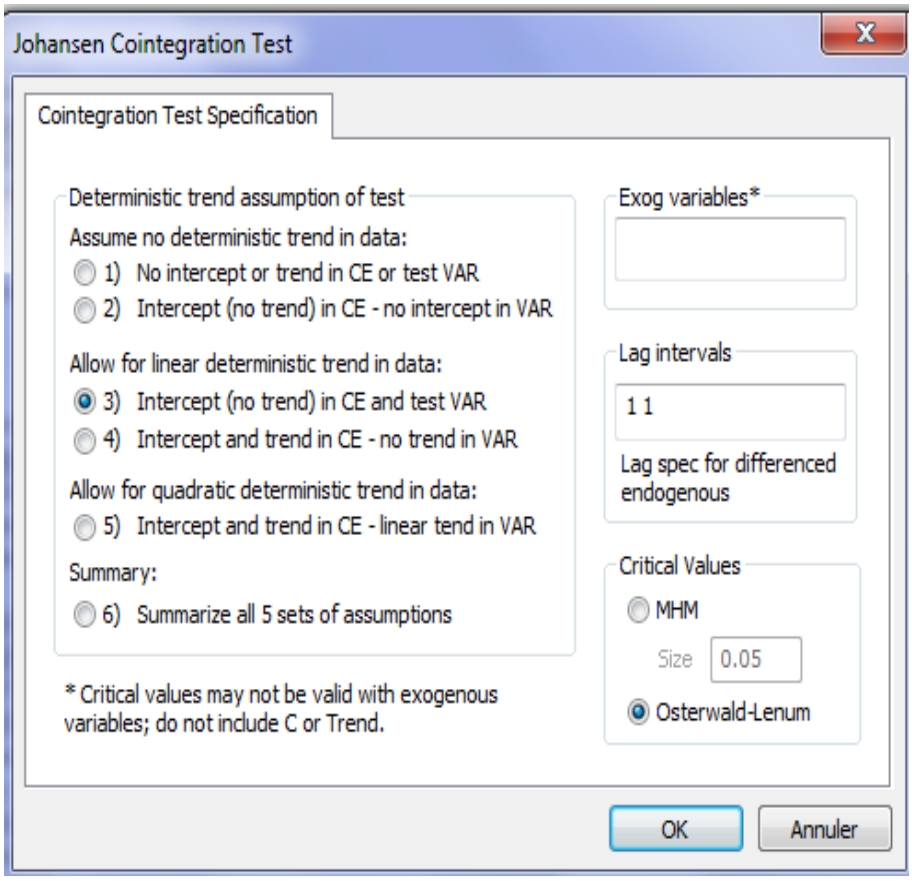
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	1	1	1	0	1
Max-Eig	0	1	1	1	1

*Critical values based on Osterwald-Lenum (1992)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept 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

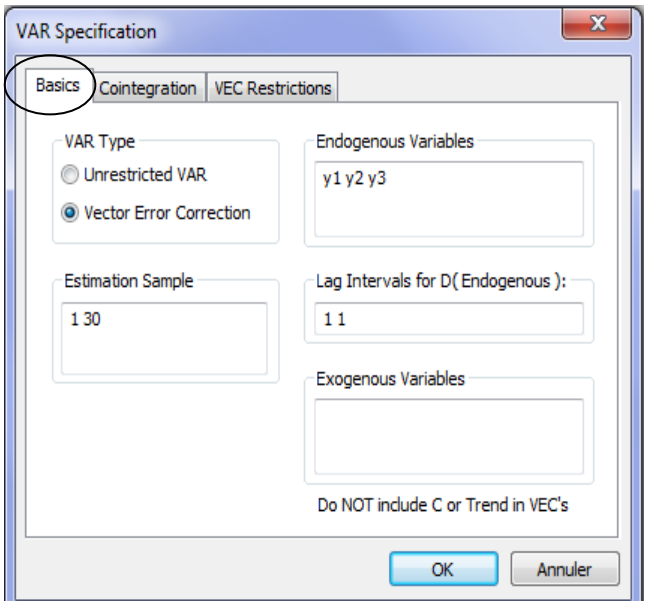
Normalized cointegrating coefficients (standard error in parentheses)

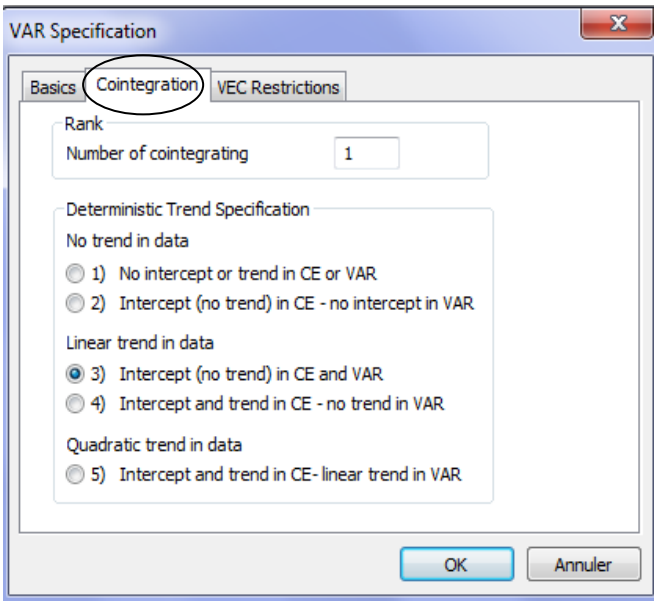
Y1	Y2	Y3
1.000000	0.000000	-0.868505
		(0.28380)
0.000000	1.000000	-0.381652
		(0.32951)

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 :





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

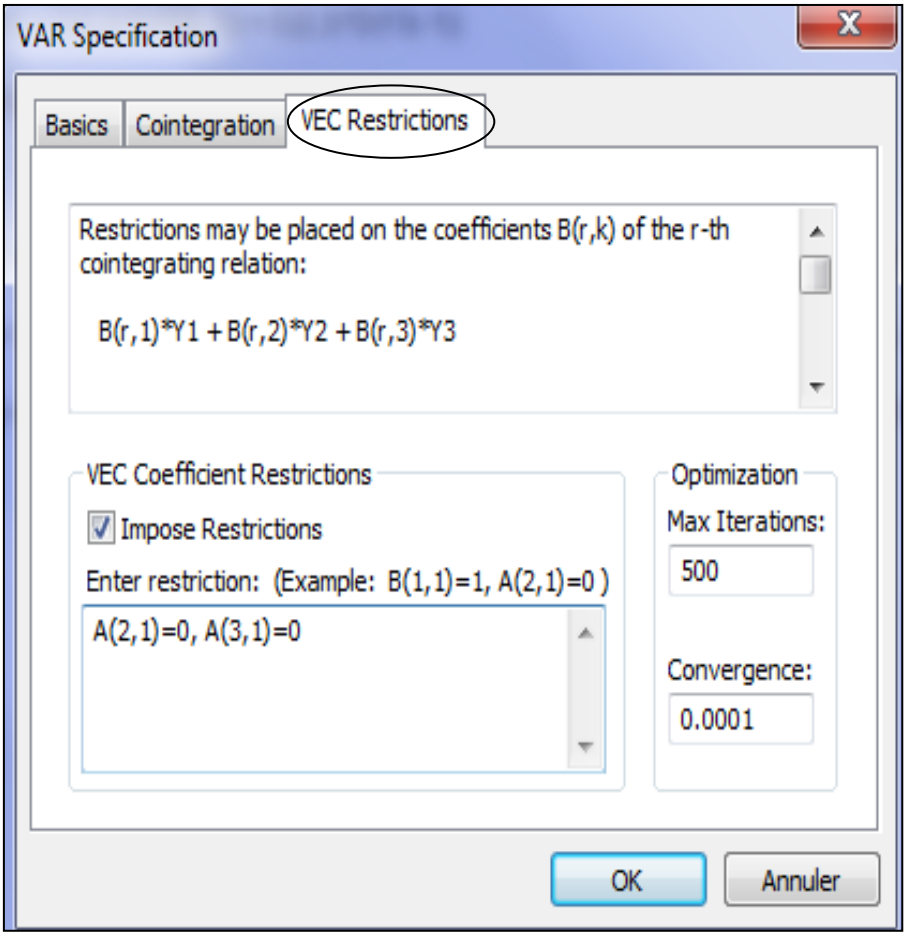
(i) Suivre : View/representations :

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

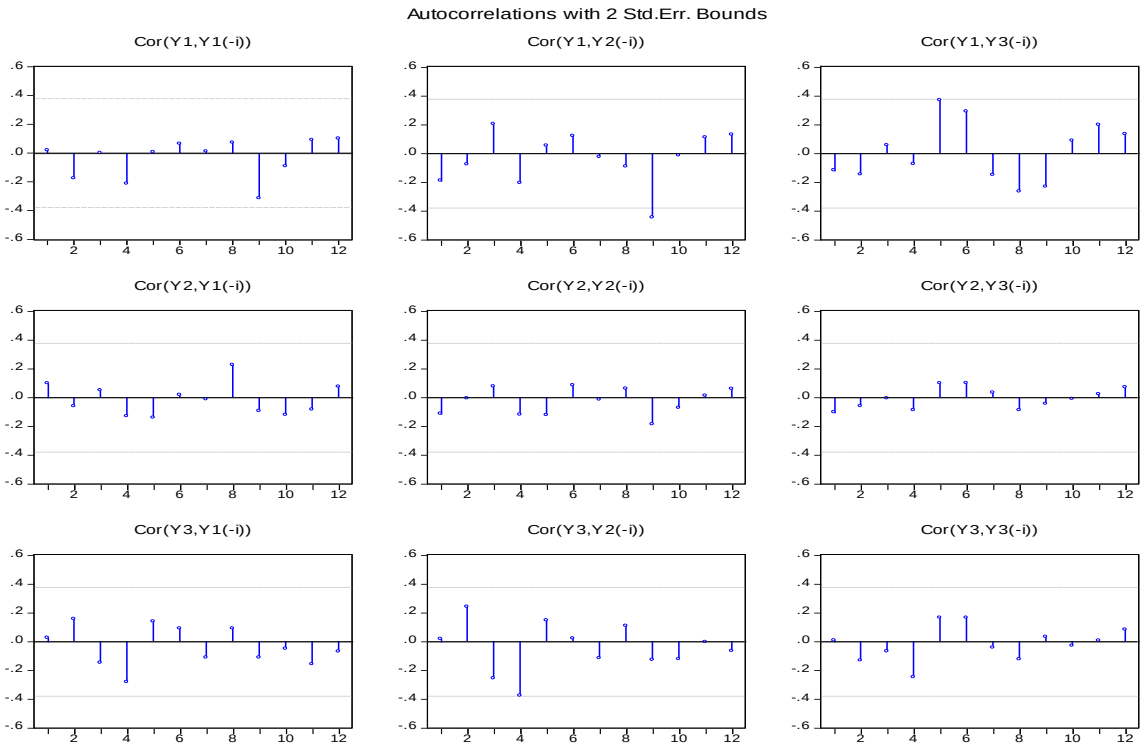
Cointegrating Eq:	CointEq1
Y1(-1)	0.997283
Y2(-1)	-0.797187
Y3(-1)	-0.555922
C	11.94414

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 :



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

b) Autocorélation 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
```