

EViews tutorial:

Cointegration and error correction

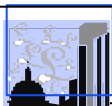
Professor Roy Batchelor

City University Business School, London

& ESCP, Paris

EViews Tutorial 1

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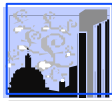


EViews

- ☐ On the City University system, EViews 3.1 is in Start/ Programs/ Departmental Software/CUBS
- ☐ Analysing stationarity in a single variable using VIEW
- ☐ Analysing cointegration among a group of variables
- ☐ Estimating an ECM model
- ☐ Estimating a VAR-ECM model

EViews Tutorial 2

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The FT500M workfile

EViews
File Edit Objects View Procs Quick Options Window Help

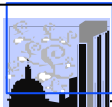
Workfile: UNTITLED
View Procs Objects Save Label+/- Show Fetch Store Delete Genr Sample
Range: 1975:01 2000:12 Filter: * Default Eq: None
Sample: 1975:01 2000:12

☒ c
☒ conf
☒ div
☒ dy
☒ earn
☒ ft500
☒ growth
☒ infl
☒ pe
☒ prod
☒ resid
☒ return
☒ rpi
☒ tb3

Group: UNTITLED Workfile: UNTITLED
View Procs Objects Print Name Freeze Edit+/- Smpl+/- InsDel Transpose Title Sample

obs	obs	FT500	EARN	DIV	RPI
1999:08	1999:08	14709.42	495.4300	326.5500	166.20
1999:09	1999:09	14178.95	505.1300	327.5300	166.50
1999:10	1999:10	14572.28	501.9700	327.8800	166.70
1999:11	1999:11	15725.26	520.3600	333.3800	167.30
1999:12	1999:12	16694.16	515.4100	330.5400	166.60
2000:01	2000:01	15612.37	518.5100	329.4200	167.50
2000:02	2000:02	15826.98	491.8300	313.3700	168.40
2000:03	2000:03	16355.85	521.3900	310.7600	170.10
2000:04	2000:04	15784.34	528.4300	310.9500	170.70
2000:05	2000:05	15658.66	564.4800	311.6100	171.10
2000:06	2000:06	15769.05	544.1400	309.0700	170.50
2000:07	2000:07	15907.72	531.5000	305.4300	170.50
2000:08	2000:08	16525.57	556.6000	309.0300	171.70
2000:09	2000:09	NA	NA	NA	NA
2000:10	2000:10	NA	NA	NA	NA

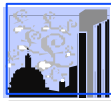
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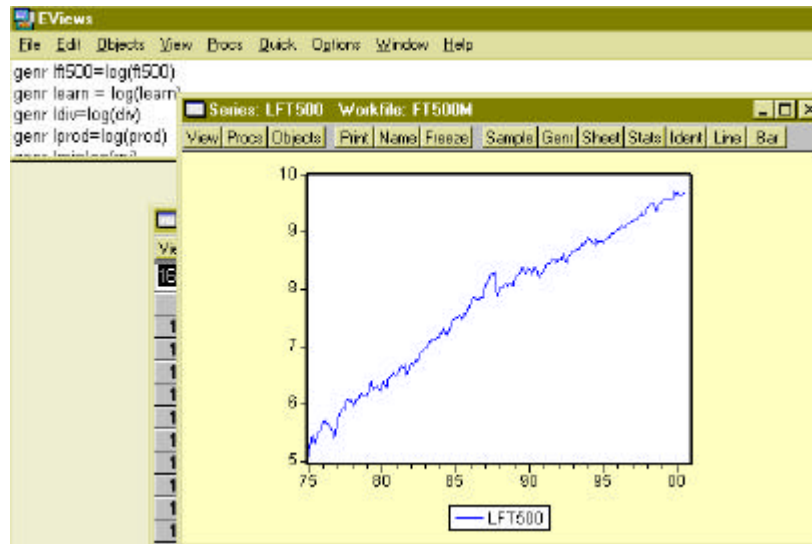
Data transformation

- ☐ Generate a series for the natural log of the FT500 index (lft500)
- ☐ Test for stationarity in
 - the level of this series
 - the first difference of this series (dlft500)
- ☐ Results show that lft500 is an I(1) variable



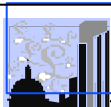


Generate $\ln(FT500)$

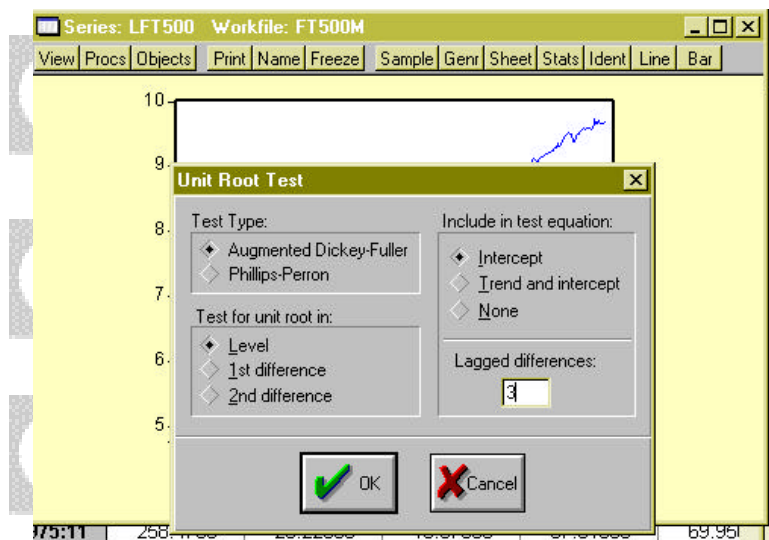


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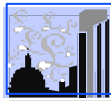


Augmented Dickey-Fuller (ADF) Test

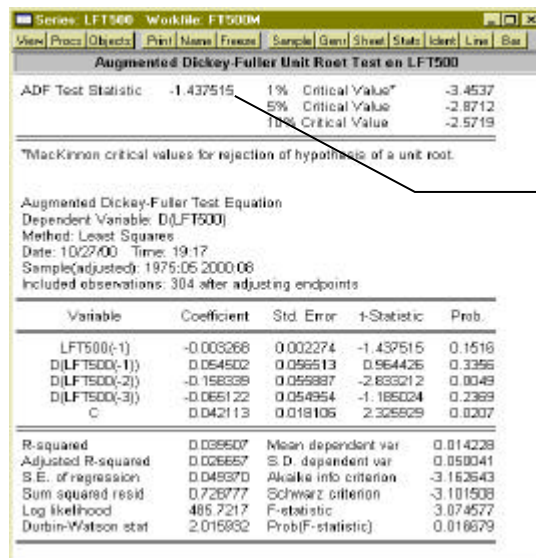


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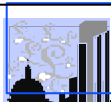
ADF results: level



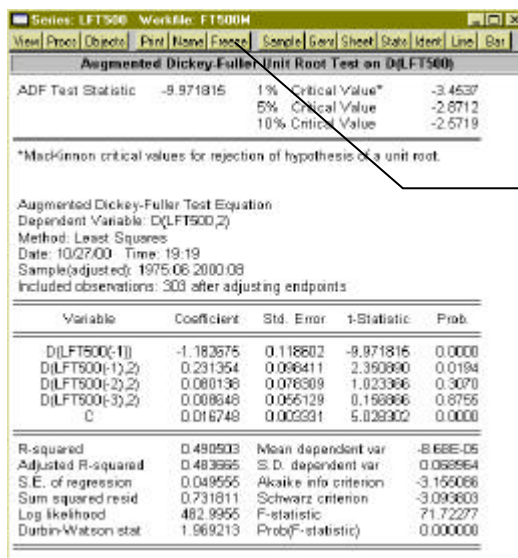
The hypothesis that lft500 has a unit root cannot be rejected

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ADF test results: first difference

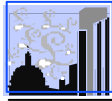


The hypothesis that the first difference of lft500 has a unit root **can** be rejected.

So lft500 is I(1)

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Cointegration: two variables

- ❑ The variables lft500 (log of stock index) and ldiv (log of dividends per share) are both I(1)
- ❑ We can test whether they are cointegrated
 - that is, whether a linear function of these is I(0)
 - An example of a linear function is

$$\text{lft500}_t = a_0 + a_1 \text{ldiv}_t + u_t$$
 when $u_t = [\text{lft500}_t - a_0 - a_1 \text{ldiv}]$ might be I(0)
- ❑ The expression in brackets [] is called the **cointegrating vector**, which has normalised coefficients [1, -a₀, -a₁]

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Form new group ...

Workfile: FT500M - [c:\eviews3\example files\ft500m.wfl]

View Proc Objects Save Label+/- Show Fetch Store Delete Gen+ Sample

Range: 1975:01 2000:12 Filter: * Default Eq. eq01

Sample: 1975:01 2000:12

☒ c
☒ conf
☒ div
☒ ddiv
☒ dleam
☒ dft500
☒ dft500f
☒ dprod
☒ dlrpi
☒ dltb3
☒ dy
☒ leam
☒ eq01
☒ ft500

☒ ft500m
☒ growth
☒ infl
☒ ldiv
☒ leam
☒ ft500f
☒ lprod
☒ lrp
☒ pe
☒ prod
☒ res
☒ resid
☒ return

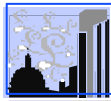
☒ rpi
☒ tb3

Group: UNTITLED Workfile: FT500M

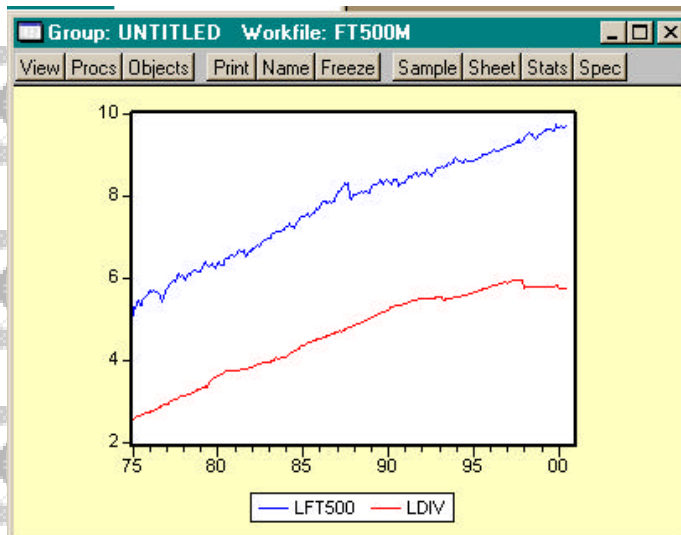
obs	LFT500	LDIV
1975:01	5.077982	2.651006
1975:02	5.291997	2.561868
1975:03	5.231429	2.578422
1975:04	5.387268	2.623944
1975:05	5.451862	2.629728
1975:06	5.338883	2.644755
1975:07	5.311579	2.666757
1975:08	5.448374	2.665838
1975:09	5.482055	2.688528
1975:10	5.630421	2.700018
1975:11	5.654780	2.712706
1975:12	5.600790	2.723924
1976:01	5.685347	2.732418
1976:02	5.668053	2.740840
1976:03		

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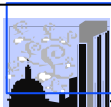


Common trends?



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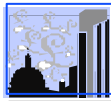
Engle-Granger: first stage regression

Equation: UNTITLED Workfile: FT500M				
View Procs Objects Print Name Freeze Estimate Forecast Stats Resids				
Dependent Variable: LFT500				
Method: Least Squares				
Date: 11/02/00 Time: 11:01				
Sample: 1975:01 1995:12				
Included observations: 252				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.388322	0.040888	58.41105	0.0000
LDIV	1.149353	0.009165	125.4075	0.0000
R-squared	0.984353	Mean dependent var	7.395240	
Adjusted R-squared	0.984290	S.D. dependent var	1.117301	
S.E. of regression	0.140042	Akaike info criterion	-1.085842	
Sum squared resid	4.902952	Schwarz criterion	-1.057830	
Log likelihood	138.8160	F-statistic	15727.05	
Durbin-Watson stat	0.167088	Prob(F-statistic)	0.000000	

Don't worry
about this...

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Save first-stage residuals ($u_t = RES$)

Equation: UNTITLED Workfile: FT500M

View: Specify/Estimate... Estimate Forecast Stats Resids

Dependent Variable: DLFT500
Method: Least Squares
Date: 11/02/00 Time: 11:06
Sample(adjusted): 1975:03 1995:12
Included observations: 250 after adjusting endpoints

Make Residual Series

Make Residuals

Residual type:

- ☒ Ordinary
- ☐ Standardized
- ☐ Generalized

Name for residual series:

RES

OK

Cancel

RES Workfile: FT500M

Objects Print Name Freeze Edit/View Simple Labels Wide

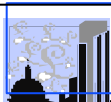
RES

Last updated: 11/02/00 - 11:03
Modified: 1975:01 2000:12 // makeresid
Modified: 1975:01 2000:12 // makeresid
Modified: 1975:01 1995:12 // makeresid

1975:05	0.242345		
1975:06	-0.040614		
1975:07	-0.118110		
1975:08	-0.016669		
1975:09	0.040675		
1975:10	-0.068195		
1975:11	-0.130293		
1975:12	-0.003906		
1975:13	0.003667		
1975:14	0.036826		
1975:15	0.045553		

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Engle-Granger: stage two (ECM) regression

Equation: UNTITLED Workfile: FT500M

View: Procs Objects Print Name Freeze Estimate Forecast Stats Resids

Dependent Variable: DLFT500
Method: Least Squares
Date: 11/02/00 Time: 11:06
Sample(adjusted): 1975:03 1995:12
Included observations: 250 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010568	0.005777	1.829286	0.0686
DLFT500(-1)	0.059286	0.062509	0.948434	0.3438
DLDIV	0.148933	0.257720	0.577887	0.5639
DLDIV(-1)	0.125376	0.255328	0.491037	0.6238
RES(-1)	-0.073868	0.025017	-2.952702	0.0035

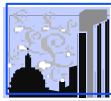
R-squared: 0.035776
Adjusted R-squared: 0.020034
S.E. of regression: 0.053443
Sum squared resid: 0.699762
Log likelihood: 380.0748
Durbin-Watson stat: 1.929673

Mean dependent var: 0.014948
S.D. dependent var: 0.053987
Akaike info criterion: -3.000598
Schwarz criterion: -2.930169
F-statistic: 2.272610
Prob(F-statistic): 0.062054

About 7% of disequilibrium "corrected" each month

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General model: stage one (I(1) variables)

Equation: UNTITLED Workfile: FT500M

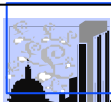
View | Proc | Objects | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LFT500
Method: Least Squares
Date: 11/02/00 Time: 11:09
Sample: 1975:01 1995:12
Included observations: 252

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.438814	1.006762	4.408999	0.0000
LDIV	0.824636	0.070706	11.66295	0.0000
LEARN	0.400457	0.065511	6.112645	0.0000
LPROD	-0.603047	0.210528	-2.864443	0.0045
LRPI	0.041873	0.105460	0.397051	0.6917
CONF	0.005704	0.000478	11.93730	0.0000
TB3	-1.857279	0.271673	-6.836465	0.0000
R-squared	0.993328	Mean dependent var	7.395240	
Adjusted R-squared	0.993164	S.D. dependent var	1.117301	
S.E. of regression	0.092376	Akaike info criterion	-1.899520	
Sum squared resid	2.090654	Schwarz criterion	-1.800480	
Log likelihood	246.2135	F-statistic	6079.104	
Durbin-Watson stat	0.451859	Prob(F-statistic)	0.000000	

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General model: stage two

Equation: UNTITLED Workfile: FT500M

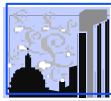
View | Proc | Objects | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: DLFT500
Method: Least Squares
Date: 11/02/00 Time: 11:13
Sample (adjusted): 1975:03 1995:12
Included observations: 250 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008040	0.005069	1.589178	0.1133
DLFT500(-1)	0.075496	0.060525	1.247361	0.2135
DLDIV	0.296524	0.262421	1.126143	0.2612
DLEARN	0.068621	0.127303	0.539040	0.5904
DLPROD	0.269909	0.224798	1.209640	0.1984
DLRPI	0.044388	0.454281	0.097708	0.9222
DCONF	0.001385	0.000500	2.768013	0.0061
DTB3	-2.542017	0.409831	-6.202503	0.0000
RES(-1)	-0.162015	0.037486	-4.065259	0.0001
R-squared	0.195254	Mean dependent var	0.014948	
Adjusted R-squared	0.168540	S.D. dependent var	0.053987	
S.E. of regression	0.049227	Akaike info criterion	-3.149394	
Sum squared resid	0.584026	Schwarz criterion	-3.022622	
Log likelihood	402.6743	F-statistic	7.309158	
Durbin-Watson stat	1.959520	Prob(F-statistic)	0.000000	

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Specific model:stage two

Equation: UNTITLED Workfile: FT500M

View Procs Objects Print Name Freeze Estimate Forecast Stats Resids

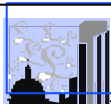
Dependent Variable: DIFT500
 Method: Least Squares
 Date: 11/02/00 Time: 11:14
 Sample(adjusted): 1975:Q2 1996:12
 Included observations: 251 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015636	0.003412	4.582559	0.0000
DCONF	0.001248	0.000529	2.381295	0.0180
RES(-1)	-0.128131	0.038365	-3.338063	0.0010

R-squared	0.053259	Mean dependent var	0.015741
Adjusted R-squared	0.045623	S.D. dependent var	0.055324
S.E. of regression	0.054048	Akaike info criterion	-2.986023
Sum squared resid	0.724444	Schwarz criterion	-2.943886
Log likelihood	377.7459	F-statistic	6.975430
Durbin-Watson stat	1.809954	Prob(F-statistic)	0.001129

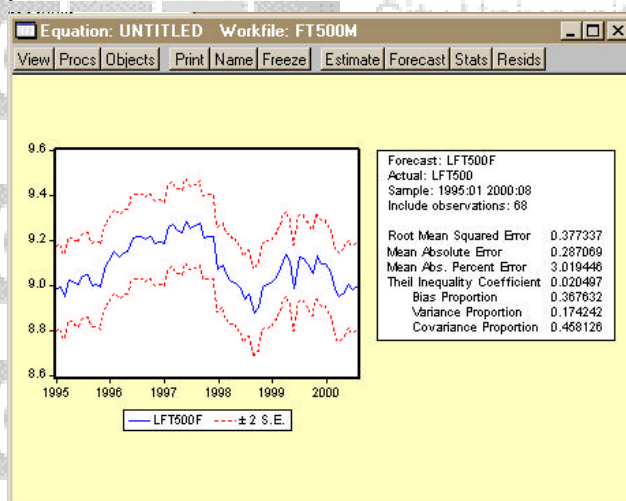
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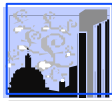
1-month ahead forecasts of lft500 from first stage regression

genr res=lft500-lft500f

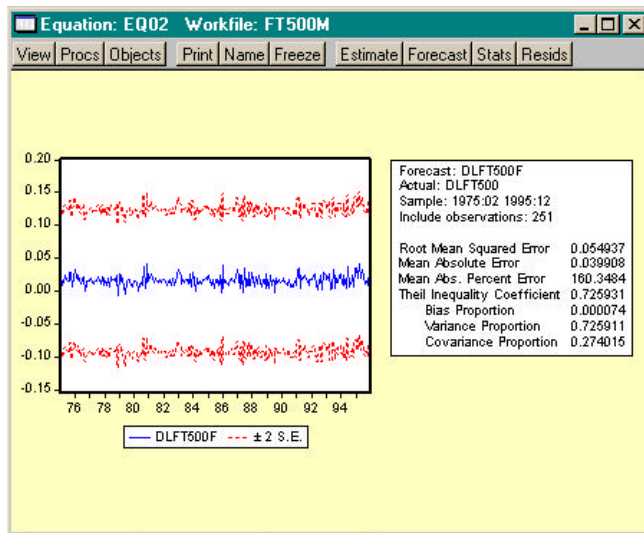


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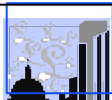


1-month ahead forecasts of dlft500 from the second stage ECM

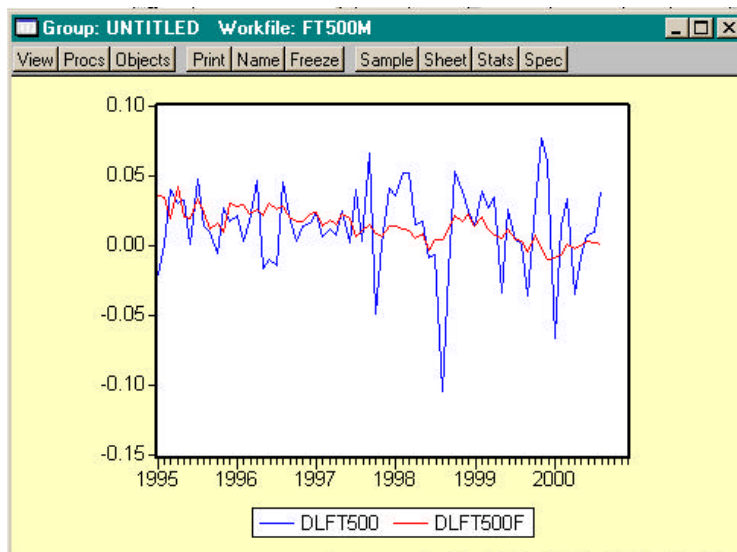


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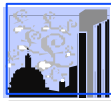


1-month ahead changes in lft500: actual v. forecast

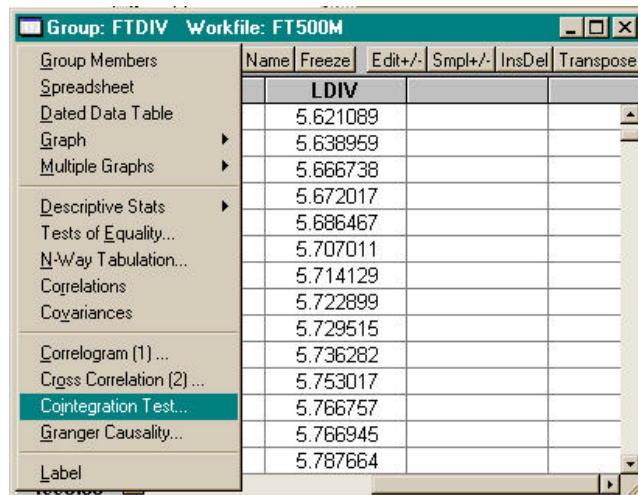


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Johansen method: make group of associated $I(1)$ variables (*lft500*, *ldiv*)



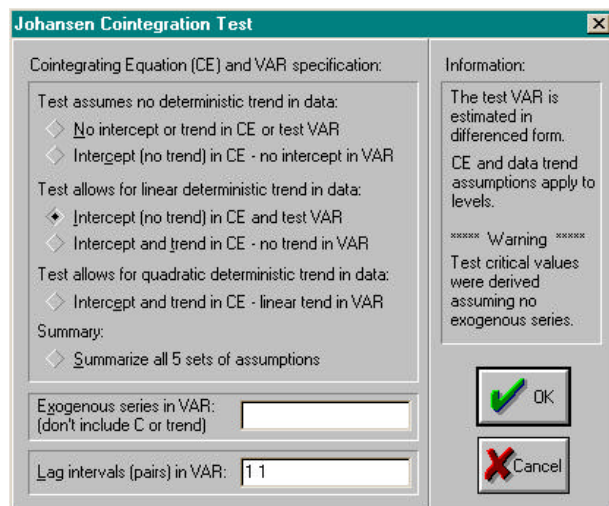
Name	Freeze	Edit+/-	Smpl+/-	InsDel	Transpose
LDIV					
5.621089					
5.638959					
5.666738					
5.672017					
5.686467					
5.707011					
5.714129					
5.722899					
5.729515					
5.736282					
5.753017					
5.766757					
5.766945					
5.787664					

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Set up Johansen procedure



Johansen Cointegration Test

Cointegrating Equation (CE) and VAR specification:

Test assumes no deterministic trend in data:

- ☐ No intercept or trend in CE or test VAR
- ☐ Intercept (no trend) in CE - no intercept in VAR

Test allows for linear deterministic trend in data:

- ☒ Intercept (no trend) in CE and test VAR
- ☐ Intercept and trend in CE - no trend in VAR

Test allows for quadratic deterministic trend in data:

- ☐ Intercept and trend in CE - linear trend in VAR

Summary:

- ☒ Summarize all 5 sets of assumptions

Exogenous series in VAR: (don't include C or trend)

Lag intervals (pairs) in VAR:

Information:

The test VAR is estimated in differenced form. CE and data trend assumptions apply to levels.

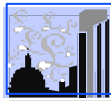
***** Warning *****

Test critical values were derived assuming no exogenous series.

☒ OK ☐ Cancel

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Johansen test for cointegrating vector(s)

Johansen Cointegration Test				
Date: 11/02/00 Time: 11:38				
Sample: 1975:01 1995:12				
Included observations: 250				
Test assumption: Linear deterministic trend in the data				
Series: LFT500 LDIV				
Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.066904	25.25193	15.41	20.04	None **
0.031261	7.940121	3.76	6.65	At most 1 **
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 2 cointegrating equation(s) at 5% significance level				

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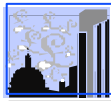


Cointegrating vector (cf. First stage regression)

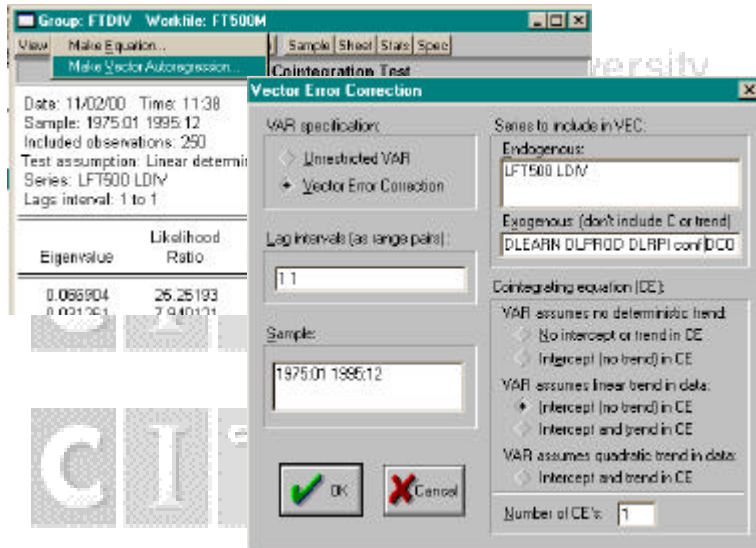
Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)		
LFT500	LDIV	C
1.000000	-1.278575 (0.06102)	-1.826107
Log likelihood	1110.932	

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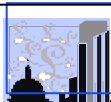


Set up VAR-ECM

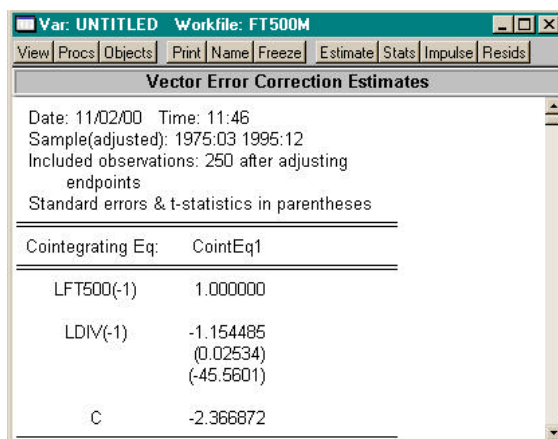


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Cointegrating vector of both endogenous $I(1)$ variables



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VAR-ECM-X models for both endogenous variables

	Error Correction:	D(LFT500)	D(LDIV)
ContEq1	-0.107681 (-3.17746)	0.022982 (2.65634)	
D(LFT500(-1))	0.059589 (0.96838)	-0.017759 (-1.21514)	
D(LDIV(-1))	0.130752 (0.52210)	-0.053182 (-0.39414)	
C	0.007863 (0.54340)	0.001100 (0.32114)	
DLEARN	0.097196 (0.76997)	0.155306 (5.11297)	
DLPROD	0.323052 (1.39494)	-0.092743 (-1.68621)	
DLRPI	-0.013335 (-0.02745)	0.182820 (1.59431)	
CONF	0.000491 (1.69946)	-9.30E-06 (-0.13654)	
DCONF	0.000702 (1.36623)	-0.000130 (-1.06648)	
TB3	-0.022839 (-0.16817)	0.097479 (3.02206)	
DTB3	-2.384705 (-6.52037)	-0.076246 (-0.76267)	
R-squared	0.176485	0.232243	
Adj. R-squared	0.142029	0.200120	
Sum sq. resids	0.597646	0.033711	

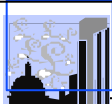
Exogenous I(0) variables affecting stock index and dividends

About 2% of disequilibrium "corrected" each month by changes in dividends ldiv

About 10% of disequilibrium "corrected" each month by changes in stock index lft500

EVIEWS Tutorial 27

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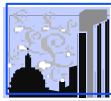
Forecasting: make VAR-ECM model

Var: UNTITLED Workfile: FT500M	
View	Specify/Estimate...
Make Residuals	Estimate Stats Impulse Resids
Make Model	Correction Estimates
Data: Make Endogenous Sample: (auto selected) 1970:1-1999:4 Included observations: endpoints Standard errors & t-statistics	
Cointegrating Eq.	$D(LFT500) = -0.1076813488 * (LFT500(-1) - 1.154485384 * LDIV(-1) - 2.366872291) + 0.05958940158 * D(LFT500(-1)) + 0.1307521497 * D(LDIV(-1)) + 0.007862995094 + 0.09719764941 * DLEARN + 0.3230516954 * DLPROD - 0.01333490676 * DLRPI + 0.000491049478 * CONF + 0.0007023038808 * DCONF - 0.02283939447 * TB3 - 2.384705363 * DTB3$
LFT500(-1)	
LDIV(-1)	
C	$D(LDIV) = 0.02298165152 * (LFT500(-1) - 1.154485384 * LDIV(-1) - 2.366872291) - 0.01775862801 * D(LFT500(-1)) - 0.0531816991 * D(LDIV(-1)) + 0.001100193426 + 0.1553064141 * DLEARN - 0.09274542132 * DLPROD + 0.1828195012 * DLRPI - 9.301065471e-06 * CONF - 0.0001300795635 * DCONF + 0.09747851488 * TB3 - 0.07824606747 * DTB3$
Error Correction:	
ContEq1	

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Updated model (1975-98)

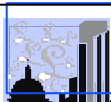
```
Model: UNTITLED Workfile: FT500M
View/Proc/Objects Print Name Freeze Solve/Matrix Spec Endog
ASSIGN @ALL F
D(LFT500) = -0.04408770726*(LFT500(-1) - 1.008512935*LDM(-1) - 3.050155907) +
0.0180103188*D(LFT500(-1)) - 0.1020892276*D(LDM(-1)) + 0.02403719422 +
0.0992203126*DLEARN + 0.330589691*DLPROD - 0.2471833455*DLRPI +
3.471831081e-05*DCONF + 0.000732948396*DCONF - 0.09372771279*TB3 -
2.326070008*DTB3
D(LDM) = -0.008344001406*(LFT500(-1) - 1.008512935*LDM(-1) - 3.050155907) -
0.007354535378*D(LFT500(-1)) - 0.01578736425*D(LDM(-1)) - 0.000732115437 +
0.1688367839*DLEARN - 0.06476336591*DLPROD + 0.03483993433*DLRPI +
0.0001492121049*DCONF - 0.0001980952549*DCONF + 0.09142086334*TB3 -
0.0563297886*DTB3
```



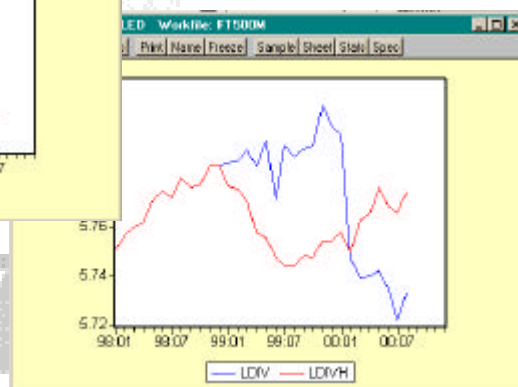
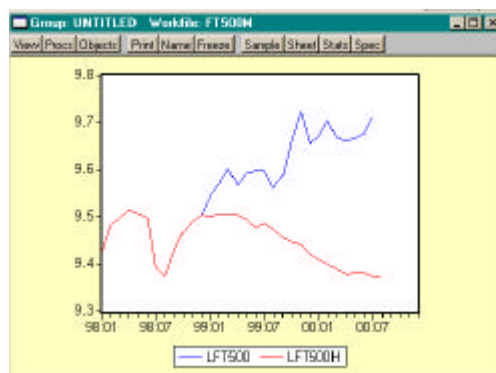
City University
Business School
London

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Forecasts for 1999-2000: a Crash coming?



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