CCR: A User Guide

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University of Rochester
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This is a user guide for the CCR package written in GAUSS by the author. Financial support by NSF SES-9213930 is gratefully acknowledged.
1. Introduction

This is a user guide for the CCR package written in GAUSS. This package contains programs to implement Park’s (1992) Canonical Cointegrating Regression (CCR) and CCR related tests described in the companion paper, Ogaki (1993a). This paper uses Ogaki’s (1993a) notation. See Ogaki (1992) and Ogaki and Park (1993) for examples of applications.

The minimum knowledge of GAUSS that is necessary to run these programs can be obtained in Ogaki (1993b, Section 2).

2. Programs

Each file with *.SET extension defines a GAUSS procedure. Each of these files come with an example file with a *.EXP extension that contains instructions about how to use the program.

2.A. CCR.SET

This program defines a procedure to implement Park’s (1992) CCR. Park’s (1990) H(p,q) tests for the null of stochastic cointegration and deterministic cointegration restriction. The example file for this program, CCR.EXP, is printed as Appendix A and the output file COINT.OUT is printed as Appendix B.

As explained in Ogaki (1993b), it is recommended that the third stage CCR estimates and H(p,q) test results from the fourth stage CCR are reported.

Suppose that $y(t)$ and $X_2(t)$ are first difference stationary random variable and random variables with unknown drift.

First, let us consider the case where $y(t)$ and $X_2(t)$ are stochastically cointegrated with the deterministic cointegration restriction, then a
cointegrating regression

\( y(t) = \theta + X_2(t)'\eta + u(t) \)

is used to estimate a normalized cointegrating vector \( \eta \).

For (1), the global variable \( x1p \) in the CCR.EXP file should be defined by a statement

\[ x1p=\text{ones(tend,1)}; \]

as in the example file. In this case, the deterministic cointegration restriction can be tested by setting

\[ \text{dctflag}=111; \]

which will produce Park's H(0,1) test for the null of the deterministic cointegration restriction. For H(1,q) tests of stochastic cointegration,

\[ \text{sctflag}=212151110; \]

will produce H(1,2),...,H(1,5) tests.

Second, let us consider the case where \( y(t) \) and \( X_2(t) \) are stochastically cointegrated without the deterministic cointegration restriction, then a cointegrating regression

\( y(t) = \theta + \mu t + X_2(t)'\gamma + u(t) \)

is used. In this case,

\[ x1p=\text{ones(tend,1)}-\text{seqa(1,1,tend)}; \]

should be used to define \( x1p \). Because the deterministic cointegration restriction is not satisfied,

\[ \text{dctflag}=010; \]

is used, but \( \text{sctflag} \) is same as in the first case to construct H(1,q) tests for stochastic cointegration.

In some applications, it is appropriate to assume that drift terms of
\( y(t) \) and \( X_2(t) \) are known to be zero if these variables do not exhibit a tendency to drift upward. In this case, there is no deterministic cointegration restriction, so set dctflag=00. For tests of stochastic cointegration, \( H(0,q) \) tests should be used. So set scfflag=11141110, for example.

In the CCR.EXP file, variables \( rm \) and \( rv \) are set up to construct a Wald test. When you do not have restrictions to test, set \( rm=0 \). When an error message such as "matrices not conformable" is encountered, make sure that the \( rm \) variable is defined conformably with the particular application.

2.B. JPQTSSTUR.SET

This program defines a procedure for for Park’s (1990) \( J(p,q) \) test for the null of a unit root that was originally developed by Park and Choi (1988). Critical values for \( J(p,q) \) tests are reported in Park and Choi (1988) and Ogaki (1993). Note that the null hypothesis is rejected when the \( J(p,q) \) statistic is smaller than the critical value.

2.C. GPQTSST.SET

This program defines a procedure for Park’s (1990) \( G(p,q) \) test for the null of trend stationarity that was originally developed by Park and Choi (1988). The \( G(p,q) \) test statistics have asymptotic chi square distributions, and this program prints p-values in the output file.

2.D. IPQTSST.SET

This program defines a procedure for Park’s (1990) \( I(p,q) \) test for the null of no cointegration that was originally developed by Park, Ouliaris, and Choi (1988). Asymptotic distributions of \( I(p,q) \) tests are based on a
OLS cointegrating regression rather than CCR. Hence this program uses OLS. Critical values for I(p,q) tests are reported in Park and Choi (1988) and Ogaki (1993). Note that the null hypothesis of no cointegration is rejected when the I(p,q) statistic is smaller than the critical value and that the distributions of I(p,q) depend on the number of regressors.

References


APPENDIX A  CCR.EXP FILE

@ CCR.EXP @

Written by Masao Ogaki

Last Revision: 11/03/92

/*
This is an example file for CCR.SET written in Version 2 of GAUSS

This program has been used and seem to be free of errors. However, I do not assume responsibility for any remaining errors.

@@ To run this example file, type
RUN CCR.SET [F4][F2]
RUN CCR.EXP [F4][F2]
The program CCR.SET defines a procedure for CCR.

@@ The user is supposed to go through Step 1-3 to modify this file for the user's problem. All the parameters for the procedures in CCR.SET controlled by parameters defined in this file, so that the user does not have to modify the CCR.SET file.

Model: x2(t) (k by 1 vector) is difference stationary:
x2(t)=d+x2(t-1)+v(t)
y(t)=x(t)'b+u(t)

where x(t)'=[x1(t)' x2(t)']
x1(t) is a vector of deterministic terms: typically, a constant or a constant and a linear time trend.
Let w(t)=[u(t),v(t)']'. We assume w(t) is stationary with zero mean and the long run covariance matrix omega.

*/
@------------------------------------------------ User Definition Area ------------------------------------------------- @
@************************************************************************************************************************************************ @
@ ------------------------------------------------ Step 1: Prepare the Output File ------------------------------------------------ @
@************************************************************************************************************************************************ @
output file=count.out reset; @ Specify the name of the output file. @

@ Prepare the following message which will be printed at the top of the output file @

? "CCR.OUT    Ogaki and Park, Durables & Nondurable+Services, Total Pop";
datestr(0);
timestr(0);

@************************************************************************************************************************************************ @
@ ------------------------------------------------ Step 2: Prepare the Data ------------------------------------------------ @
@************************************************************************************************************************************************ @
@ 1. Reading in data @
load qn[176,2]=qnrnd91.dat; @nondurables (nominal-real)@
load qd[176,2]=qnr91.dat; @durables (nominal-real)@
load mpop1[529,2]=mpop91.dat; @population (total-16+)@

@ 2. Specify the sample period @
nob=169; @the number of observation in the data@
taubeg=2; @ The beginning of the sample period @
tauend-nob; @ The end of the sample period @
tend=tauend-taubeg+1; @ The sample size @

@ 3. Transform the data if necessary @

mpop1=mpop1/1000000;
mpop1=mpop1[1,1]-0.5*(mpop1[1,1]-mpop1[2,2]); @mpop1[.,2]; 16+@
popul=reshape(mpop1[1:nob,3],nob,3);
popul=meanc(popul'); @ave. over each quarter@

c1v=qn;
c2v=qd;

c1=c1v[1:nob,2]./popul[1:nob,1]; @real per capita consumption@
c2=c2v[1:nob,2]./popul[1:nob,1];

q2=(c2v[1:nob,1]./c2v[1:nob,2])./(c1v[1:nob,1]./c1v[1:nob,2]);

@ 4. Define global variables xlp, x2p, yv, vp used by CCR.SET @
@ xlp=[x1(1)'
  | ... | tend by m1 matrix
  |x1(tend)']

x2p=[x2(1)'
  | ... | tend by m2 matrix
  |x2(tend)']

yv=[y(1)
  | ... | tend by 1 vector
  |y(tend)]

vp=[v(1)'
  | ... | tend by m2 matrix
  |v(tend)']

yv=ln(c1);
x2p=ln(q2)-ln(c2);
xlp=ones(tend,1);

yv-yv[taubeg:tauend,.];
deltx=x2p[taubeg:tauend,.]-x2p[taubeg-1:tauend-1,.];
x2p=x2p[taubeg:tauend,.];
vp=deltx-meanc(deltx)';

clear q2,c1,c2,deltx;

@ ***************************************** @
@------- Step 3: Specify Variable to Control the CCR procedure ------- @
@ ***************************************** @

st=0; @
This scalar controls the bandwidth parameter for the QS kernel. if st=0, then an automatic bandwidth estimator is used. if st/=0, then st is used as the bandwidth parameter.
st=0 is recommended.@
wav=ones(cols(x2p)+1,1); @
This (m2+1) by 1 vector sets weights given to the a-th element of w(t) for the automatic bandwidth estimator (if st=0).@

bst=sqrt(tend); @ This scalar bounds the bandwidth parameter @
maxd=0.99;  @
    if maxd=0, then nonprewhitened HAC with the QS kernel is used.
    if 0<maxd, then the elements of DeltaLS with the absolute
    value greater than maxd is replaced by maxd. See Andrews
    and Monahan's (1990) footnote 4.@
lpn=le+10; @ The bounding by bst and maxd are necessary for H(p,q) tests
    but not recommended for cointegrating vector parameter estimates.
    This scalar lpn is used for lst and 2nd stage CCR for which
    the bounding by bst and maxd is not necessary.@

dctflag=1|1;
    @ 2 by 1 vector to control the K test for deterministic
    cointegrating restriction using sdc(t);

    dctflag[1,1]: the smallest order of time polynomial to test
    for deterministic cointegrating restriction.
    dctflag[2,1]: the largest order of time polynomial to test
    for deterministic cointegrating restriction.
    No test for sdc(t) will be given if dctflag[2,1]=0. @

sctflag=2|2|5|1|0;
    @ 5 by 1 vector to control H(p,q) tests for stochastic cointegrating
    restriction using deterministic trends, sl(t):

    sctlflag[1,1]: the smallest order of time polynomial in sl(t)

    *** p=sctlflag[1,1]-1 ***

    sctlflag[2;4,1] controls the largest order of time polynomial
    in sl(t); The largest order of polynomial in sl(t)
    will be increased from sctlflag[2,1] to
    sctlflag[3,1] with an increment of sctlflag[4,1].

    *** q=sctlflag[2,1] for the first result ***
    *** q=sctlflag[2,1]+sctlflag[4,1] for the second
    *** q=sctlflag[3,1] for the last result.

    sctlflag[5,1] controls joint tests for coefficients of sdc(t)
    and sl(t): If sctlflag[5,1]=1, then the joint test
    will be given; if sctlflag[5,1]=0, then no joint test
    will be given.
    No test for sl(t) will be given if sctlflag[3,1]=0. @

pflag=0;
    @ scalar; Trend coefficients and their standard errors are
    not printed if pflag=1 not if pflag=0. @

@ ** The following two arguments are
    for testing a linear restriction Rb=r. ** @

rm=zeros(2,1)-eye(2);
    @rm=R q by cols(b) matrix for the test. If rm=0, no test for Rb=r. @

rv=1|(-1);
    @ rv=r q by 1 vector for the test. @

@ ** **********************************************************************
@ THE PROGRAM STARTS @
@ You need not change the following @

@ ** Initial OLS to get w(t) and bini ** @
x=x1p-x2p;
biniols=invpd(x'x)*(x'yv);
? "unmodified OLS=" biniols';
clear x;
? "***** 2nd stage CCR *****";
bini=biniols;
bc=ccr(bini,st,wav,lpn,lpn,zeros(2,1),zeros(5,1),pflag,0,0);
? "
***** 3rd stage CCR *****";
bc3=ccr(bc,st,wav,lpn,lpn,zeros(2,1),zeros(5,1),pflag,rm,rv);
load covbc3=covbc;
  @ It is recommended that estimates (bc3) from this stage be reported.@
? "
***** 4th stage CCR *****";
bc4=ccr(bc3,st,wav,maxd,bst,dctflag,sctflag,pflag,rm,rv);
@ It is recommended that H(p,q) tests from this stage be reported.@
output off;
@ --------------------------- END OF PROGRAM --------------------------- @
APPENDIX B  CCR.EXP OUTPUT

CCR.OUT  Ogaki and Park, Durables & Nondurable+Services, Total Pop
4/15/93
10:06:13

unmodified OLS= 5.4442809 0.19171496 0.38986091

****** 2nd stage CCR *****

******* Canonical Cointegrating Regression Results (CCR.SET) *******
Prewhitened HAC with the QS kernel is used for calculation of omega
ALS and DELTALS for prewhitening=

0.87074860  -0.17135215  0.008958866
0.0084930075  0.13951200  -0.047680985
0.21577158  0.51462680  -0.071074034
-0.027965812  8.3813910e-19  7.3484873e-18
3.7892866e-17  0.56346646  -1.1186364e-16
1.8490729e-18  8.4236791e-17  0.89868084

maxd= 1.00000000e+10

***** Automatic Bandwidth Estimator is used
The bandwidth parameter used  0.58271933

-------------------------- CCR Results --------------------------
Regression coefficients of x1(t)',x2(t)'

4.9742344  0.39004047  0.45359104

s.e. =

0.28742374  0.12310213  0.039294020

****** 3rd stage CCR *****

******* Canonical Cointegrating Regression Results (CCR.SET) *******
Prewhitened HAC with the QS kernel is used for calculation of omega
ALS and DELTALS for prewhitening=

0.83482377  -0.22911616  0.010042766
0.037592386  0.13744508  -0.039774825
0.21982532  0.51234538  -0.058636890
-0.023468746  -2.8222503e-17  -4.0520372e-17
-1.6967764e-17  -0.57075711  1.5999830e-17
-1.3602820e-17  7.8048263e-17  0.87141090

maxd= 1.00000000e+10

***** Automatic Bandwidth Estimator is used
The bandwidth parameter used  0.72395561

-------------------------- CCR Results --------------------------
Regression coefficients of x1(t)',x2(t)'

4.7866935  0.47001508  0.47899656

s.e. =

0.28829027  0.12195019  0.039335076

*** Testing R*b=r ***
R=

0.0000000  1.0000000  0.0000000
0.0000000  0.0000000  1.0000000

r=

1.0000000
-1.0000000

Chi-squire value and d.f.  9892.0783  2.0000000
p-value=  0.0000000

****** 4th stage CCR *****

******* Canonical Cointegrating Regression Results (CCR.SET) *******
Prewhitened HAC with the QS kernel is used for calculation of omega
ALS and DELTALS for prewhitening=
0.82988980  -0.25297591  0.012064291
0.044665412  0.13685305  -0.037021275
0.20700895  0.51271665  -0.057560714
-0.020990302  -2.5502299e-16  -4.5114814e-17
-6.0884728e-17  -0.57161591  5.3552917e-17
-1.8122693e-17  2.4031182e-16  0.86994985

maxd= 0.99000000

The bandwidth parameter used 0.76348065

Regression coefficients of x1(t)',x2(t)'

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<td>4.7841201</td>
<td>0.47358957</td>
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s.e.=

|        | 0.30908143| 0.13044862| 0.042142671|

*** Testing R*b=r ***

R=

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r=

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</table>

Chi-square value and d.f. 9881.6917 2.00000000

p-value= 0.00000000

Regression with superfluous deterministic trends sdc(t) added smallest order of polynomial in added time trends to be tested= 1.00000000

largest order of polynomial in added time trends to be tested= 1.00000000

Regression results with superfluous deterministic trends ---- Testing if all the coefficients of sdc(t) are 0

Chi-square value and d.f. 4.1137073 1.00000000

p-value= 0.042537020

Testing for Stochastic Cointegrating Restriction with H(p,q) smallest order of polynomial in added time trends to be tested= 2.00000000

largest order of polynomial in added time trends to be tested= 5.00000000

Regression results with superfluous sdc(t) and sl(t) ----- Testing if all the coefficients of sl(t) are 0

H(p,q) chi-square value and d.f. 0.0013616757 1.00000000

p-value= 0.97056403

p,q= 1.00000000 2.00000000

Regression results with superfluous sdc(t) and sl(t) ----- Testing if all the coefficients of sl(t) are 0

H(p,q) chi-square value and d.f. 13.095311 2.00000000

p-value= 0.0014334725

p,q= 1.00000000 3.00000000

Regression results with superfluous sdc(t) and sl(t) ----- Testing if all the coefficients of sl(t) are 0

H(p,q) chi-square value and d.f. 13.359417 3.00000000

p-value= 0.0039204344

p,q= 1.00000000 4.00000000

Regression results with superfluous sdc(t) and sl(t) ----- Testing if all the coefficients of sl(t) are 0

H(p,q) chi-square value and d.f. 15.639593 4.00000000

p-value= 0.0035429422

p,q= 1.00000000 5.00000000