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EVIDENCE OF COINTEGRATION BETWEEN INTRA-TRADE OF EACH MEMBER WITH OTHER MEMBERS OF THE GCC CUSTOMS UNION

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This paper tries to test if there is a long-term relationship between the intra-trade of each member of the GCC Customs Union and its total trade with non-GCC countries. If such a relationship exists, this would suggest that the two variables do not drift too far apart from each other over time, which implies that the relative magnitude of intra-trade between GCC partners did not change much over the past few years. However, if there is no evidence of cointegration between intra-trade of each member with other members of the GCC and its total trade with non-GCC countries, this suggests that the two variables can drift apart from each other more and more as time goes on.

The paper uses unit root test of stationery, Engle-Granger test for cointegration and the Johansen-Juselius Cointegration Method. These tests were conducted using quarterly data over the period 1982-2007.

The results of the calculated ADF statistic and the PP statistic are greater than the critical value only for the first differenced variables. This indicates that the variables are non-stationary at levels and have achieved stationery after being differenced once.

According to the Engle-Granger test, we cannot reject the null hypothesis of no cointegration between intra-trade of each GCC member and its total trade with non-GCC countries. However, according to the Johansen-Juselius method, the null hypothesis of no cointegration is rejected for all members of the GCC except Oman. Thus, for Bahrain, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates, intra-trade with GCC members seems to converge with total trade with non-GCC countries.

I. INTRODUCTION

The study of the long-run relationship between intra-trade and total trade of members of the GCC customs union is very important in order to evaluate the effectiveness of the commercial policy of discriminatively reducing or eliminating trade barriers among the GCC countries (Osama, 1987, Al-Badri and Cain, 1989, Modfid, 1990, Gorti, 1990, Patibandla, 1993, Metwally, 1993, Al-Ashal, 1995 and Hoque and Nutairi, 1996). The main question to be answered is whether intra-trade of each GCC member with other GCC members and total trade of each GCC member with non-GCC countries converge towards a long-run equilibrium.

This paper applies the Engle-Granger method and the Johansen-Juselius approach to cointegration in examining the long-run relationship between intra-trade and total trade of each member of the GCC customs union, using quarterly data over the period 1982, when the GCC Trade Union was created, to 2007, where most recent data are available. The importance of use of co-integration analysis in the theory of foreign trade has been applied by many researchers (Bahmani-Oskooee, 1994 and 1995, Krueger, 1997 and Metwally, 2004).

The paper is divided into five sections. Section two examines graphically the relation between intra-trade and total trade variables of the six GCC members. Section three analyzes the results of Engle-Granger method of cointegration. Section four examines the results of the Johansen-Juselius method of cointegration. Finally, section five summarizes the main conclusions.

II. RELATION BETWEEN INTRA-TRADE AND TOTAL TRADE VARIABLES OF THE SIX GCC MEMBERS

Table 1 displays the ADF and the PP unit root tests results for the intra-trade of each member with all other members and its total trade with non GCC countries. The data were collected from various sources, including IMF, Direction of Trade Statistics Quarterly and GCC Economic Bulletin. It is clear from table 6.1 that in all cases the calculated ADF statistic and the PP statistic are greater than the critical value only for the first differenced variables. The results indicate that the variables are non-stationary at levels and have achieved stationery after being differenced once. Thus, both intra-trade and total trade (to non-GCC countries) in all members are integrated of order one, I (1). Because both variables in each GCC member are integrated to the same order, the cointegration analysis will be very practical. Therefore, the Engle-Granger method and Johansen-Juselius approach to cointegration between intra-trade and total trade will be applied to the six GCC members.

Table 1
Estimation Results of Unit Root Tests for GCC Members

(Bahrain)

	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-0.347	-3.473	3	-.369	-3.444	3
Δ Intra-trade	-9.012	-3.473	1	-8.674	-3.444	3
Total Trade	-1.498	-3.473	2	-1.566	-3.444	3
Δ Total Trade	-10.335	-3.473	1	-10.792	-3.444	3

(Kuwait)

	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-1.789	-3.551	3	-1.901	-3.501	3
Δ Intra-trade	-9.295	-3.551	1	-9.732	-3.501	3
Total Trade	-0.798	-3.551	1	-.895	-3.501	3
Δ Total Trade	-6.283	-3.551	1	-6.582	-3.501	3

(Oman)

	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-2.278	-3.440	4	-2.322	-3.433	3
Δ Intra-trade	-7.774	-3.440	1	-7.783	-3.433	3
Total Trade	-1.162	-3.440	4	-1.1925	-3.433	3
Δ Total Trade	-6.679	-3.440	1	-6.746	-3.433	3

(Qatar)						
	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-1.901	-3.469	3	-1.791	-3.508	3
Δ Intra-trade	-7.912	-3.469	1	-7.533	-3.508	3
Total Trade	-2.589	-3.469	1	-2.754	-3.508	3
Δ Total Trade	-5.100	-3.469	1	-5.228	-3.508	3

(Saudi Arabia)						
	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-0.548	-3.428	1	-0.587	-3.477	3
Δ Intra-trade	-8.619	-3.428	1	-8.738	-3.477	3
Total Trade	-0.118	-3.428	4	-0.153	-3.477	3
Δ Total Trade	-7.422	-3.428	1	-7.562	-3.477	3

(United Arab Emirates)						
	ADF Test Statistic			*PP Test Statistic*		
Variable	*ADF Test*	*5% C.V.*	*No of Lags*	*PP Test*	*5% C.V.*	*No of Lags*
Intra-trade	-0.301	-3.467	3	-0.253	-3.514	3
Δ Intra-trade	-8.697	-3.467	1	-8.708	-3.514	3
Total Trade	—1.801	-3.467	3	-1.888	-3.514	3
Δ Total Trade	-4.677	-3.467	1	-4.833	-3.514	3

Note: The null hypothesis in each variable is integrated of order I (1), the 95% critical values are given in parenthesis and derived from E-views econometric package. D denotes the first difference of the variable.

III. ENGLE-GRANGER TEST FOR COINTEGRATION

The most widely used method of applying cointegration analysis is based on Engle and Granger (1987) approach. This approach suggests if a set of time series are I(1) and the linear combination of these variables are I(0), then these time series are said to be cointegrated. In order to determine if a cointegrating relationship exists, a cointegration regression is estimated by regressing the log of intra-trade on the log of total trade (and vice versa) by OLSQ method and testing for the stationarity of the residuals using the ADF test.

Table 2 presents the results of the Engle-Granger method. Two forms of regression were estimated in the case of Kuwait, one has no dummy, whereas the other one includes a dummy variable to capture the structural change after 1990. The inclusion of a dummy variable did not improve the results. Furthermore, a trend variable was also included in all the regression, no improvement in the results was achieved either.

It can be seen from Table 2 that the ADF of the residuals are greater than their critical values in all the regressions for all GCC members. Therefore, we cannot reject the null hypothesis of no cointegration between intra-trade of each GCC member and its total trade with non-GCC counties.

Table 2
The Engle-Granger Cointegration Results

(Bahrain)

Equation	*Constant*	*Slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	4.722	0.200	0.148	-1.258	-3.501
	(13.0)[b]	(4.103)		[1][a]	
log(TT) = f(log(IT))	2.758	0.773	0.150	-3.059	-3.522
	(2.399)	(4.069)		[1]	

(Kuwait)

Equation	*Constant*	*slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	-6.901	1.400	0.557	-3.395	-3.459
	(-6.375)[b]	(10.4)		[1][a]	
log(TT) = f(log(IT))	6.433	0.392	0.557	-2.755	-3.459
	(32.5)	(10.4)		[1]	

(Oman)

Equation	*Constant*	*Slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	3.810	0.322	0.070	-2.715	-3.459
	(4.326)[b]	(2.651)		[1][a]	
log(TT) = f(log(IT))	6.198	0.234	0.070	-1.385	-3.459
	(11.7)	(2.652)		[4]	

(Qatar)

Equation	*Constant*	*Slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	-3.410	1.091	0.710	-2.092 [1][a]	-3.459
	(-6.277)[b]	(15.2)			
log(TT) = f(log(IT))	4.434	0.650	0.710	-1.852	-3.459
	(20.0)	(14.0)		[1]	

(Saudi Arabia)

Equation	*Constant*	*Slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	-1.689	0.848	0.638	-3.111	-3.459
	(-2.584)[b]	(12.9)		[1][a]	
log(TT) = f(log(IT))	4.793	0.739	0.638	-3.059	-3.459
	(12.3)	(12.9)		[1][a]	

(United Arab Emirates)

Equation	*Constant*	*slope*	*R^2*	*ADF*	*95% C.V*
log(IT) = f(log(TT))	-2.798	0.971	0.957	-2.828	-3.459
	(-11.6)[b]	(37.4)		[1][a]	
log(TT) = f(log(IT))	3.211	0.920	0.937	-2.707	-3.459
	(20.4)	(37.4)		[1]	

Notes: (a) Number inside the brackets is the number of lags in the ADF test of residuals.
(b) Number inside the parenthesis is the value of *t*-statistic.

IV. THE JOHANSEN-JUSELIUS COINTEGRATION METHOD

Tests of the long-run relationship between economic variables using the Engle-Granger approach suffer from a major deficiency, in which the estimated cointegrating relationship may not be invariant depending on which variable is used on the left hand side. In this respect, the multivariate cointegration technique proposed by Johansen (1988) or Johansen and Juselius (1990) is superior to the Engle-Granger approach as it fully captures the underlying time series properties of the data. The Johansen and Juselius method depends on the calculation of Maxiaml eigen-value (λ-*max*) and *trace* statistics using maximum likelihood estimation procedure to identify the number of cointegrating vectors. To carry out the test we proceed sequentially by first testing for H_0: $r <= 0$, where r is the number of cointegrating vectors. If H_0 was rejected, we then test for $r<=1$ and so on, until the null hypothesis could not be rejected. The *trace* test provides a test of the null hypothesis $H_0 : r = r_0$ against the alternative $H_a : r > r_0$, where r refers to the number of cointegrating vectors. The maximal eigen value test concerns a test of $H_0 : r = r_0$ against $H_a : r = r_0 + 1$. Johansen and Juselius (1990) suggest that the maximal eigen-value test has greater power than the trace test, but both tests will be reported for consistency.

Prior to the application of the Johansen method, the order of the VAR (Vector-Auto-Regressive) error correction model must be determined. According to the test statistics and choice criteria for selecting the order of the VAR model, the Schwarz Bayesian Criterion (SBC) suggests a VAR of order 1, the Akaike Information Criterion (AIC) of order 2. Due to the limited number of observations it is appropriate to choose an order of 2 or less. To determine the sensitivity of the results to the choice of lag order, lag of orders 1 and 2 will be reported in each case. The statistical package (MFIT 4.0) offers five options in applying the Johansen's method. The options correspond to different specification of intercept and trend variable in the underlying VAR model. The options are as follows:

1. No intercept or trends included in the VAR model
2. Restricted intercept, and no trends in the VAR model
3. Unrestricted intercept, and no trends in the VAR model
4. Unrestricted intercept, and restricted trends in the VAR Model
5. Unrestricted intercept, and unrestricted trends in the VAR model

Option 1 assumes that there are no deterministic trends in the variables and the underlying data generating process (DGP) does not contain a trend term either. Option 2 is appropriate when the jointly determined variables do not contain a deterministic trend. Option 4 is appropriate when the jointly determined variables in the VAR have a linear deterministic trend. Option 3 and 5 can lead to error correction models with different trend properties depending on the number of cointegrating relations. In the case of the cointegrating VAR option, the choice of intercepts and trends is very important in testing for cointegration. In regard to the GCC Intra-trade and total trade, although the underlying variables are trended, they move together, and it seems unlikely that there will be a trend in the cointegrating relations. The Johansen method will be applied to the variables using option 4. Table 3 report the results of λ-*max* and *trace* statistics for all three cases.

As can be seen the null hypothesis of no cointegration can be rejected in all cases except the case of Oman. In those cases where the null hypothesis is rejected, the maximal eigen-value and trace statistics are larger than their 95 per cent and 90 per cent critical values. The results are very sensitive to the choice of lags in the VAR. In some cases, the null of r=0 is rejected by both tests when one and two lags are used. As was mentioned previously, The maximal eigen-value statistic is more reliable than the trace statistic and the choice of one lag is more appropriate for the limited observation in this study. According to the Engle-Granger approach and Johansen-Juselius method of cointegration, there is no evidence of long-run relation between Oman intra-trade with members of the GCC and its total trade with non-GCC countries. In the case of Oman, the results in Table 3 suggest that the null hypothesis of no cointegration cannot be rejected by both the maximal eigen-value and trace tests in all cases.

To summarize, applying the Johansen-Juselius cointegration method between the intra-trade of each GCC member with other members and its total trade with non-GCC countries, a strong evidence of cointegration between the two variables was found in the cases of Bahrain, Kuwait, Qatar, Saudi Arabia and United Arab Emirates. No unique cointegrating seems to exist in the case of Oman.

V. CONCLUSIONS

This paper examined the long run relationship between intra-trade of each member of the GCC customs union and its total trade with non-GCC countries.

The Engle-Granger approach and Johansen-Juselius method of cointegration analysis were implemented. The Engle-Granger cointegration approach revealed no evidence of cointegration between intra-trade and total trade of any member of the GCC.

Applying the superior Johansen-Juselius cointegration method between the intra-trade of each GCC member with other members and its total trade with non-GCC countries, a strong evidence of cointegration between the two variables was found in the cases of Bahrain, Kuwait, Qatar, Saudi Arabia and United Arab Emirates. No unique cointegrating seems to exist in the case of Oman.

The results of the analysis of this chapter suggests that the intra-trade between most members of the GCC customs union and their total trade with non-GCC countries do not drift too far apart from each other over time.

Only in the case of Oman, the results suggest that its intra-trade with members of the GCC customs union and its total trade with non-GCC countries drift apart from each other more and more as time goes on.

Table 3
Results of Cointegration Analysis for GCC Countries Intra-trade and Total Trade
Cointegration with unrestricted intercepts and restricted trends in the VAR

1. Bahrain

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

92 observations from 1983Q1 to 2005Q4. Order of VAR = 4.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigenvalues in descending order:
0.00 048659. 20816.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	21.4723	19.2200	17.1800
r<= 1	r = 2	4.5892	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

92 observations from 1983Q1 to 2005Q4. Order of VAR = 4.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0.00 048659. 20816 .

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	26.0615	25.7700	23.0800
r<= 1	r = 2	4.5892	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

92 observations from 1983Q1 to 2005Q4. Order of VAR = 4.
List of variables included in the cointegrating vector:
IT X1 Trend
List of eigen values in descending order:
0.00 048659. 20816 .

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1138.2	-1152.2	-1169.8	-1159.3
r = 1	-1127.5	-1145.5	-1168.2	-1154.6
r = 2	-1125.2	-1145.2	-1170.4	-1155.3

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

2. Kuwait

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

87 observations from 1982 to 2005. Order of VAR = 1
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 089897. 19298.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	19.6530	19.2200	17.1800
r<= 1	r = 2	8.1952	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

87 observations from 2 to 88. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 089897. 19298.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	26.8482	25.7700	23.0800
r<= 1	r = 2	8.1952	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trendsin the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

87 observations from 2 to 88. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 089897. 19298.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1106.5	-1108.5	-1111.0	-1109.5
r = 1	-1097.2	-1103.2	-1110.6	-1106.2
r = 2	-1093.1	-1101.1	-1110.9	-1105.1

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

3. Oman

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

93 observations from 1982Q4 to 2005Q4. Order of VAR = 3.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 060663. 093918.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	9.1722	19.2200	17.1800
r<= 1	r = 2	5.8201	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trendsin the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

93 observations from 1982Q4 to 2005Q4. Order of VAR = 3.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 060663. 093918.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	14.9923	25.7700	23.0800
r<= 1	r = 2	5.8201	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

93 observations from 1982Q4 to 2005Q4. Order of VAR = 3.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 060663. 093918.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1191.2	-1201.2	-1213.9	-1206.3
r = 1	-1186.6	-1200.6	-1218.4	-1207.8
r = 2	-1183.7	-1199.7	-1220.0	-1207.9

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

4. Qatar

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigen value of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 12049. 38288.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	45.8551	19.2200	17.1800
r<= 1	r = 2	12.1974	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 12049. 38288.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	58.0525	25.7700	23.0800
r<= 1	r = 2	12.1974	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 12049. 38288.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1124.9	-1126.9	-1129.4	-1127.9
r = 1	-1101.9	-1107.9	-1115.6	-1111.0
r = 2	-1095.8	-1103.8	-1114.1	-1108.0

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

5. Saudi Arabia

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 11180. 21791.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	23.3500	19.2200	17.1800
r<= 1	r = 2	11.2631	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 11180. 21791.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	34.6131	25.7700	23.0800
r<= 1	r = 2	11.2631	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0000. 11180. 21791.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1449.6	-1451.6	-1454.2	-1452.7
r = 1	-1438.0	-1444.0	-1451.6	-1447.1
r = 2	-1432.3	-1440.3	-1450.5	-1444.5

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

6. UAE

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Maximal Eigen value of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0.00 23349. 32468.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r = 1	37.2947	19.2200	17.1800
r<= 1	r = 2	25.2613	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0.00 23349. 32468.

Null	Alternative	Statistic	95% Critical Value	90%Critical Value
r = 0	r>= 1	62.5559	25.7700	23.0800
r<= 1	r = 2	25.2613	12.3900	10.5500

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria

95 observations from 1982Q2 to 2005Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
IT TT Trend
List of eigen values in descending order:
0.00 23349. 32468.

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-1367.6	-1369.6	-1372.1	-1370.6
r = 1	-1348.9	-1354.9	-1362.6	-1358.0
r = 2	-1336.3	-1344.3	-1354.5	-1348.4

AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

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