Using quarterly data for Denmark over the sample period 1974:1 to 1987:3, Johansen and Juselius (1990) let the x_t vector be represented by

$$x_t = (m2_t, y_t, i_t^d, i_t^b)'$$

where: $m2$ = log of the real money supply as measured by $M2$ deflated by a price index
y = log of real income
i^d = deposit rate on money representing a direct return on money holding
i^b = bond rate representing the opportunity cost of holding money

Including a constant in the cointegrating relationship (i.e., augmenting x_{t-1} with a constant), they report that the residuals from (6.54) appear to be serially uncorrelated. The four characteristic roots of the estimated π matrix are given in the first column of the following table:[14]

	λ_{max} $-T \ln(1 - \hat{\lambda}_{r+1})$	λ_{trace} $-T \sum \ln(1 - \hat{\lambda}_i)$
$\hat{\lambda}_1 = 0.4332$	30.09	49.14
$\hat{\lambda}_2 = 0.1776$	10.36	19.05
$\hat{\lambda}_3 = 0.1128$	6.34	8.69
$\hat{\lambda}_4 = 0.0434$	2.35	2.35

1. $H_0: r=0$, $H_A: r=1,2,3$ or 4, $\lambda_{trace}(0) = -T \sum_{i=1}^{4} \ln(1-\hat{\lambda}_i) = 49.1$
not cointegrated

2. $H_0: r \leq 1$, $H_A: r=2,3$ or 4, $\lambda(1) = -T \sum_{i=2}^{4} \ln(1-\hat{\lambda}_i) = 19.05$
not cointegrated

3. $H_0: r \leq 2$, $H_A: r=3,4$, $\lambda(2) = -T \sum_{i=3}^{4} \ln(1-\hat{\lambda}_i) = 8.69$

1. H_0 $r=0$, $H_A: r=1$, $\lambda(0,1) = -T \ln(1-\hat{\lambda}_1) = 30.09$
reject H_0 at 5%, conclude 1 coint. vector.

2. $H_0: r=1$, $H_A: r=2$ $\lambda(1,2) = -T \ln(1-\hat{\lambda}_2) = 10.36$
accep H_0

ith $I(1)$ and $I(2)$ Variables

Linear Trend			
$m_2 = 1$		$m_2 = 2$	
prob-value		*prob*-value	
0.01	0.05	0.01	0.05
–4.66	–4.01	–5.14	–4.45
–4.55	–3.90	–4.93	–4.31
–4.41	–3.83	–4.81	–4.20
–5.11	–4.42	–5.62	–4.89
–4.85	–4.26	–5.23	–4.62
–4.73	–4.19	–5.11	–4.50
–5.47	–4.74	–5.98	–5.17
–5.21	–4.58	–5.59	–4.93
–5.07	–4.51	–5.35	–4.80
–5.89	–5.13	–6.23	–5.48
–5.52	–4.91	–5.97	–5.25
–5.38	–4.78	–5.69	–5.07
–6.35	–5.47	–6.64	–5.82
–5.86	–5.20	–6.09	–5.50
–5.66	–5.08	–5.95	–5.34

of $I(2)$ variables on the right-hand side of

ı Haldrup (1994) and critical values for the

Table E **Empirical Distributions of the λ_{max} and λ_{trace} Statistics**

Significance level								
	10%	5%	2.5%	1%	10%	5%	2.5%	1%
λ_{max} and λ_{trace} statistics without any deterministic regressors								
$n{-}r$	λ_{max}				λ_{trace}			
1	2.86	3.84	4.93	6.51	2.86	3.84	4.93	6.51
2	9.52	11.44	13.27	15.69	10.47	12.53	14.43	16.31
3	15.59	17.89	20.02	22.99	21.63	24.31	26.64	29.75
4	21.56	23.80	26.14	28.82	36.58	39.89	42.30	45.58
5	27.62	30.04	32.51	35.17	54.44	59.46	62.91	66.52
λ_{max} and λ_{trace} statistics with drift								
$n{-}r$	λ_{max}				λ_{trace}			
1	2.69	3.76	4.95	6.65	2.69	3.76	4.95	6.65
2	12.07	14.07	16.05	18.63	13.33	15.41	17.52	20.04
3	18.60	20.97	23.09	25.52	26.79	29.68	32.56	35.65
4	24.73	27.07	28.98	32.24	43.95	47.21	50.35	54.46
5	30.90	33.46	35.71	38.77	64.84	68.52	71.80	76.07
λ_{max} and λ_{trace} statistics with a constant in the cointegrating vector								
	λ_{max}				λ_{trace}			
1	7.52	9.24	10.80	12.97	7.52	9.24	10.80	12.95
2	13.75	15.67	17.63	20.20	17.85	19.96	22.05	24.60
3	19.77	22.00	24.07	26.81	32.00	34.91	37.61	41.07
4	25.56	28.14	30.32	33.24	49.65	53.12	56.06	60.16
5	31.66	34.40	36.90	39.79	71.86	76.07	80.06	84.45

Source: Osterwald-Lenum (1992). The tables reported here are reproduced with permission from Blackwell Publishers.