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How Stable is the Demand for Money in Greece?

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ABSTRACT The cointegration technique is now a common method of estimating any money demand function. Numerous studies that applied this technique to estimate the money demand function in Greece, interpreted their finding of cointegration as a sign of stable money demand. In this paper, after incorporating CUSUM and CUSUMSQ tests into cointegration analysis, we show that even though M1 and M2 monetary aggregates are cointegrated with income and interest rate, the M2 money demand function is unstable while M1 is stable.

KEY WORDS: Money demand, cointegration, stability test, Greece
JEL CLASSIFICATION: E41

Introduction

During the post-war period and until the mid 1980s, the Greek monetary system was characterized by the presence of direct controls on credit and interest rates, which led to inefficiencies and resource misallocation. However, this picture altered during the late 1980s and 1990s through a process of financial liberalization that aimed to restore market conditions throughout the system; hence, improving the efficiency of the monetary system and the competitiveness in the banking system.[1] The transition period from regulation to liberalization raises concerns and questions about the stability of the money demand, mostly because an effective

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[1]For more see Karfakis (2000) and Apergis (1999).

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monetary policy requires a stable relation between money, income and interest rate or a stable money demand function.

Numerous empirical studies in the macroeconomics literature have focused on determinants of the demand for money and its stability in Greece over the last decades. First, there are the earlier studies that relied upon the Ordinary Least Squares (OLS) method of estimation and estimated income and interest rate elasticities of the demand for money. They either did not test for stability or, even if they did, they provided mixed results. The list includes Brissimis & Leventakis (1981), Himarios (1983, 1986, 1987), Panayiotopoulos (1984), Prodromidis (1984), Paleologos (1986) and Tavlas (1987). The main shortcoming associated with these studies is that due to non-stationary data employed, they all suffer from 'spurious regression problem'. Therefore, neither the estimates nor the stability test results could be relied upon.

To correct the problem associated with the first group, a second set of studies employed the more recent advances in time-series analysis, such as cointegration and error-correction modelling. The list includes Arestis (1988), Karfakis (1991), Psaradakis (1993), Papadopoulos & Zis (1997), Ericsson & Sharma (1998), Apergis (1999), and Karfakis & Sidiropoulos (2000).[2] The main problem associated with this second group is that they have interpreted their finding of cointegration as a sign of stable demand for money in Greece. However, as demonstrated by Bahmani-Oskooee & Bohl (2000) for Germany, the variables in the money demand function could be cointegrated but the estimated cointegrating vector could be unstable. Bahmani-Oskooee & Bohl argue that cointegration does not imply stability. Once cointegration is established, formal tests for stability of the parameters must be applied. Specially, following Laidler (1993), they incorporate the short-run dynamics into the testing procedure for stability. Therefore, it is the purpose of this paper to examine the stability of M1 and M2 money demand function in Greece.[3] To this end, in the next section we outline the models and explain the testing procedure. The section after reports the empirical results showing that even though both M1 and M2 monetary aggregates are cointegrated with income and interest rate, M1 money demand function is stable but M2 is not. The final section concludes.

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[2]The exception is Karfakis & Sidiropoulos (2000) who applied Hansen & Johansen (1993) test for stability of the long-run parameters. The Hansen–Johansen test is used to determine whether the number of cointegrating vectors and their associated eigenvalues are different for different sub-sample periods. As argued by Bahmani-Oskooee & Chomisisengphet (2002), the test is a long-run test and it does not incorporate the short-run dynamics.

[3]Other studies that have looked at cointegrating properties of money demand in other countries are Hafer & Jansen (1991), Hoffman & Rasche (1991), McNown & Wallace (1992) for the US; Karfakis & Parikh (1993) for Australia; Adams (1991), Johansen (1992) for the UK; Muscatelli & Papi (1990) for Italy; Frenkel & Taylor (1993) for Yugoslavia; Hafer & Kutan (1994) for China; and Bahmani-Oskooee (1996) for Iran.

The Models and Methods

In formulating the money demand function, we follow previous research and assume that the demand for money depends on a measure of income and interest rate. Thus, the following formulation is adopted:

$$\ln M_t = a + b \ln Y_t + ci_t + \varepsilon_t \tag{1}$$

where M is the real monetary aggregate (nominal M1 or M2 deflated by CPI), Y is the real income with expected positive elasticity, i is a measure of opportunity cost of holding money, i.e. interest rate with expected negative elasticity.[4]

In estimating equation (1), we employ the Johansen & Juselius (1990) cointegration analysis that allows feedback effects among the variables. Johansen & Juselius (1990) basically introduce two test statistics known as λ-max and trace to identify a number of cointegrating vectors. Once cointegration is established, we borrow the stationary residuals from the cointegrating vector and include its lagged value (EC_{t-1}) in an error-correction model of the following type:

$$\Delta \ln M_t = a' + \sum_{j=1}^{n} b'_j \Delta \ln M_{t-j} + \sum_{j=0}^{n} c'_j \Delta \ln Y_{t-j} + \sum_{j=0}^{n} d'_j \Delta i_{t-j} + \gamma EC_{t-1} + \mu_t \tag{2}$$

where γ is the speed of convergence toward equilibrium. Following Bahmani-Oskooee & Bohl (2000) and Pesaran & Pesaran (1997) we employ the CUSUM or CUSUMSQ tests proposed by Brown *et al.* (1975) to test for the stability of not only the long-run coefficients (proxied by EC_{t-1} as their linear combination) but also the short-run coefficients (coefficient estimates of the first differenced variables) in equation (2). The sample period is broken and the CUSUM and CUSUMSQ statistics are updated recursively and are plotted against the break points. If the plot of CUSUM or CUSUMSQ stays within the 5% significance level, then the coefficient estimates are said to be stable.[5] We will rely upon a graphical presentation of these tests in the next section.

Empirical Results and Stability Tests

Using quarterly data over the 1975I–2002IV period, we try to apply the methodology explained in the previous section to M1 and M2 money

[4]We also deflated nominal M1 and M2 by the GDP deflator and carried out the empirical results. There was no change at all in the conclusions.

[5]The significance level is portrayed by two straight lines whose equations are given in Brown *et al.* (1975: section 2.3).

Table 1. Autocorrelation test results and the order of VAR

	M1 Demand for Money				M2 Demand for Money			
	Constant		Trend		Constant		Trend	
	LM(1)	Lag Order	LM(1)	Lag Order	LM(1)	Lag Order	LM(1)	Lag Order
i_1	14.31	3	13.18	3	14.36	3	13.39	3
i_2	13.79	3	9.04	3	16.65	3	13.49	3
i_3	15.65	3	11.21	3	9.77	5	10.35	5
i_4	12.61	3	8.66	3	6.01	3	12.21	3
i_5	12.28	3	6.69	3	16.08	5	11.09	5

Note: The LM test for autocorrelation is distributed as a χ^2 with nine degrees of freedom. At the usual 5% level, the critical value of $\chi^2_{(9)}$ is 16.92.

demand functions in Greece in order to determine which monetary aggregate has a stable relation with the income and interest rates. In order to complete our search for a stable money demand function, we will use five different interest rates denoted by i_1, i_2, i_3, i_4, i_5. The definition of each rate is provided in the appendix. Before we apply the tests, we must make sure that all variables are non-stationary and integrated of order one, I(1). Indeed, application of the Augmented Dickey–Fuller (ADF) test revealed that all variables are I(1). This was further supported when we tested for the stationarity of variables using Johansen's multivariate framework.

The second step is to apply the Johansen–Juselius maximum-likelihood procedure to estimate the λ-max and trace statistics in order to determine whether variables are cointegrated. In doing so we must first decide the order of VAR. Following Juselius (1996) we began with one lag, but made sure that the residuals did not suffer from at least first-order autocorrelation. The autocorrelation-free residuals were achieved when the order of VAR was increased to three in most cases and to five in some cases, depending upon whether a constant or a trend was included in the procedure and depending upon type of the interest rate employed. Table 1 provides the LM test for first-order autocorrelation and the optimum number of lags.

Once the order of VAR has been determined, we carry out the cointegration analysis by imposing the optimum lags reported in Table 1 for each case. For example, in estimating the M1 money demand function with a constant term in the cointegrating space and i_1 as the interest rate, we impose three lags on the VAR. However, when we shift to M2 money demand function and include i_3, we impose five lags on the VAR.

The cointegration test results for both M1 and M2 money demand function using all five measures of interest rates (one at a time) are reported in Table 2. Note that Reinsel & Ahn (1992) show that the λ-max and trace statistics should be adjusted for the number of observations, the order of VAR as well as for the number of variables in cointegration space. They suggest multiplying the statistics by $(T\text{-}nk)/T$ to obtain the adjusted statistics where T is the total number of effective observations, n is the number of variables and k

Table 2. Johansen's maximum likelihood results (r = number of cointegrating vectors)

	λ-Max			Trace		
Null	$r = 0$	$r <= 1$	$r <= 2$	$r = 0$	$r <= 1$	$r <= 2$
Alternative	$r = 1$	$r = 2$	$r = 3$	$r = 1$	$r = 2$	$r = 3$
Panel A1. M1 money demand including a constant						
i_1	18.37	5.51	0.69	24.58	6.20	0.69
i_2	19.02	5.69	0.87	25.59	6.57	0.87
i_3	14.84	6.20	0.97	22.00	7.17	0.97
i_4	19.32	4.39	0.83	24.53	5.21	0.83
i_5	17.76	5.87	0.76	24.38	6.62	0.76
Panel A2. M1 money demand including a trend						
i_1	28.27	16.58	5.48	50.32	22.06	5.48
i_2	26.65	18.27	5.29	50.13	23.58	5.29
i_3	26.55	13.48	6.01	46.04	19.50	6.01
i_4	27.57	17.88	4.28	49.73	22.16	4.28
i_5	27.39	17.59	5.63	50.62	23.22	5.63
Panel B1. M2 money demand including a constant						
i_1	16.58	11.30	5.77	33.64	17.06	5.77
i_2	21.72	9.94	3.60	35.25	13.54	3.60
i_3	20.38	7.90	1.08	29.35	8.98	1.08
i_4	20.78	9.58	4.06	34.44	13.66	4.06
i_5	26.39	9.09	0.61	36.09	9.70	0.61
Panel B2. M2 money demand including a trend						
i_1	19.56	15.46	8.52	43.54	23.98	8.52
i_2	23.02	16.22	9.90	49.14	26.12	9.90
i_3	21.34	13.47	5.05	39.86	18.51	5.05
i_4	22.55	15.89	9.50	47.94	25.39	9.50
i_5	30.68	14.69	5.49	50.85	20.17	5.49
95% Critical Value	25.42	19.22	12.39	42.34	25.77	12.39

is the order of VAR.[6] Thus, throughout the paper we report adjusted statistics.

Panels A1 and A2 report the results for M1 money demand function depending upon whether a constant or trend is included in the analysis. Panels B1 and B2 report the same results for M2 monetary aggregate. Beginning with Panel A1, it appears that when a constant term is included in the analysis, no matter which interest rate is included, the null of no cointegration (i.e. $r = 0$) cannot be rejected. This is because our calculated λ-max and trace statistics are both less than the critical values reported at the bottom of Table 2. However, when we move to Panel A2 and replace the

[6]Cheung & Lai (1993) show that an equivalent way to make finite-sample corrections is to adjust the critical values (and not the test statistics) by multiplying the critical values by $T/(T\text{-}nk)$.

constant with the trend term, there the null of no cointegration is rejected in favour of one cointegrating vector. This is regardless of which interest rate is used. Note that the null of $r \leq 1$ cannot be rejected in favour of two cointegrating vectors. Thus, we conclude that when the trend term is included, there is at most one vector in each case. The story is slightly different when we shift to Panels B1 and B2 and M2 monetary aggregate. In Panel B1 there is evidence of one cointegrating vector by the λ-max test, when i_5 is included as the opportunity cost of holding money. However, in Panel B2, where the trend term is included in the procedure, there is evidence of one cointegrating vector using the trace test in all cases except when i_3 is used as an interest rate. In the case of i_2, there are actually two cointegrating vectors.[7] Estimates of these vectors normalized on the monetary aggregate by setting its coefficient at -1, are reported in Table 3. Reported in Table 3, next to each coefficient, is the likelihood ratio test for exclusion of the corresponding variable. This test has a χ^2 distribution with degrees of freedom equal to the number of cointegrating vectors in each case.[8]

Note that since there was no evidence of cointegration in Panel A1 of Table 2, no cointegrating vector is reported for this case in Table 3. Panel A2 in Table 3 reports the cointegrating vectors associated with Panel A2 of Table 2, i.e. M1 money demand function with the trend term. It appears that the income variable not only carries its positive coefficient in all five cases, but – reflected by the exclusion test – it is highly significant in all cases. However, the exclusion test for the interest rate indicates that no matter which interest rate we consider, it carries an insignificant coefficient. Thus, it appears that in Greece, money is held mainly for transaction purposes. When we shift to Panel B1 and M2 money demand with a constant term, although all three variables belong to the cointegrating space (reflected by significant exclusion tests), the income term takes an unexpected negative sign. Results do not change when a constant term is replaced with the trend, as in Panel B2. In Panel B2, when i_1 or i_2 is used as the interest rate, M2 does not actually belong to cointegrating space. As reflected by the significant LR test, in these cases cointegration is due to the relation between income and interest rate. When i_4 or i_5 is used, although all three variables do belong to the cointegrating space, the income term, again, carries a negative coefficient. Because of the significant positive relation between M1 and income but not between M2 and income, we may conclude that, in Greece, monetary policy should target the control of M1 monetary aggregate. However, we need to back this statement up further by showing that M1 money demand is stable but M2 is not.

As explained in the previous section, using coefficient estimates from each case we form the lagged error-correction term and include it in equation (2). After estimating equation (2) by OLS, we then apply the CUSUM and

[7]In the case of M2 that included i_5, since the results were identical whether a constant or trend was included, we only report the cointegrating vectors when the trend is included.

[8]For the test formula based on the eigenvalues of restricted versus unrestricted models, see Bahmani-Oskooee (1996).

Table 3. Estimate of each cointegrating vector

	ln *M1*	ln *Y*	*i*
Panel A. Estimate of M1 money demand function (with trend)			
i_1	−1.00 [11.69]	0.75 [10.49]	−0.003 [0.77]
i_2	−1.00 [08.96]	0.80 [07.88]	0.002 [0.10]
i_3	−1.00 [13.68]	0.77 [12.13]	−0.0004 [0.02]
i_4	−1.00 [10.02]	0.77 [08.47]	−0.0007 [0.02]
i_5	−1.00 [10.72]	0.84 [10.34]	0.004 [0.65]
	ln *M2*	ln *Y*	*i*
Panel B: Estimate of M2 money demand function (with trend)			
i_1	−1.00 [01.04]	1.45 [03.82]	0.113 [4.25]
i_2	−1.00 [04.21]	−1.34 [09.80]	−0.082 [10.8]
	−1.00	3.28	0.157
i_3	−1.00 [04.68]	−1.22 [04.14]	−0.075 [5.48]
i_4	−1.00 [18.61]	−0.80 [12.89]	−0.042 [15.65]

Note: At the 5% level of significance, the critical value of χ^2 statistic with one degree of freedom is 3.84 and with two degrees of freedom it is 5.99.

CUSUMSQ tests to the residuals of equation (2). For brevity of presentation, for each monetary aggregate we report the results of one case. Figure 1 reports the stability results for M1 and M2 money demand function when i_4 is used as a measure of interest rate.

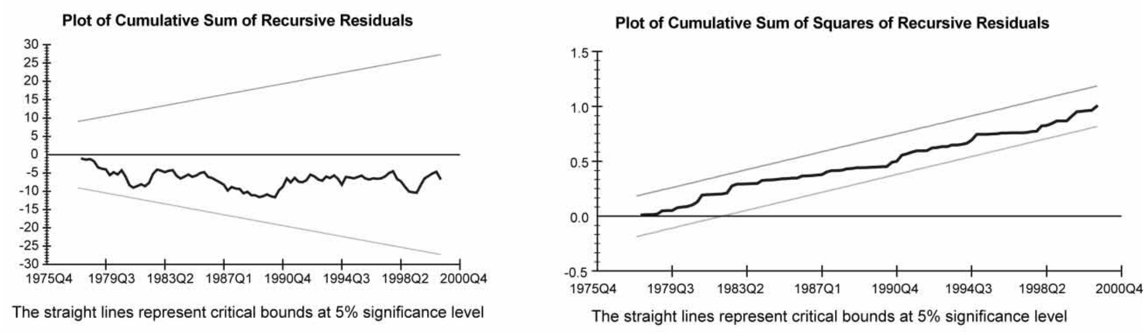
From Figure 1, it is clear that since the plot of CUSUM and CUSUMSQ statistics stay within the critical band in the case of M1 but not M2, we conclude that M1 money demand is stable but M2 is not. Furthermore, inspection of the full-information estimates of the error-correction models revealed that the error-correction term carried an unexpectedly significant positive coefficient in the case of M2 but not in the results for M1. This indicates that while M2 money market is in disequilibrium, M1 market is not. As a sensitivity analysis, we carried out the stability test results for all the cases (five interest rates) and there was no change in the conclusion that M1 is stable but M2 is not.

As argued by Bahmani-Oskooee & Shin (2002), who applied a similar procedure for the demand for money in Korea, the results could be sensitive to treating all variables as endogenous so far. To determine which variable is exogenous, we carried out likelihood ratio tests for weak exogeneity of each variable. The results are reported in Panel A of Table 4.[9]

As can be seen from Table 4, in the M1 money demand function, the null of weak exogeneity is rejected for ln M1 but not for ln *Y* and *i*. However, in the case of M2 money demand function, ln M2 seems to be weakly exogenous. We carried out the CUSUM and CUSUMSQ tests by treating the income

[9]Note that the test of weak exogeneity of each variable amounts to testing whether each element of α matrix is zero. For more on this see Johansen (1992).

Panel A. Stability test results for M1 (with trend and i_4)



Panel B. Stability test results for M2 (with trend and i_4)

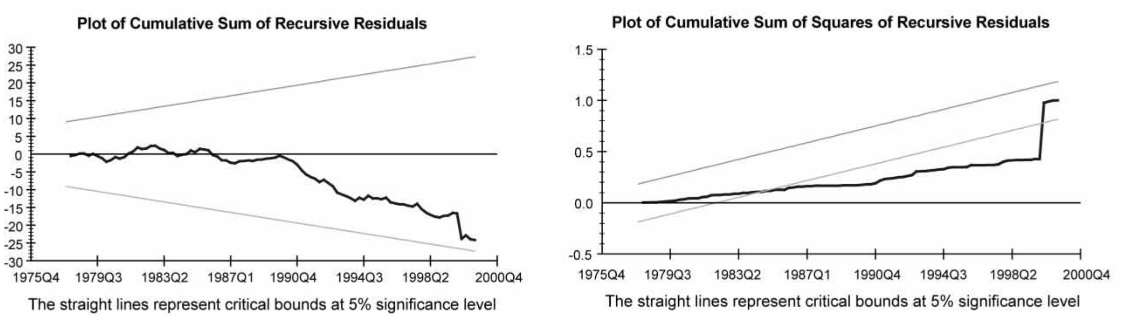


Figure 1. Stability test results using CUSUM ad CUSUMSQ tests

Table 4. The results of weak exogeniety and stationarity tests

	ln *M1*	ln *Y*	*i*	ln *M2*	ln *Y*	*i*
Panel A. Weak exogeniety test results						
i_1	12.83	3.84	0.06	0.51	3.21	2.95
i_2	8.28	0.73	0.31	3.77	12.04	6.22
i_3	13.34	1.44	0.04	–	–	–
i_4	10.38	1.91	2.01	0.54	6.35	1.73
i_5	9.20	0.29	0.44	2.49	15.34	6.91
Panel B. Stationarity test results						
i_1	26.82	24.27	20.07	11.99	10.40	9.87
i_2	25.05	20.36	24.77	9.60	8.24	13.12
i_3	25.15	21.84	23.35	–	–	–
i_4	26.20	22.37	26.67	15.84	14.18	20.03
i_5	26.45	21.23	25.15	29.72	29.58	34.78

Note: At the 5% level of significance, the critical value of χ^2 statistic with one degree of freedom is 3.84 and with two degrees of freedom it is 5.99.

and interest rate as exogenous in the case of the M1 money demand function. The results were no different than those reported in Figure 1, that M1 money demand is stable. As for the M2 money demand function, the weak exogeneity for ln M2 cannot be rejected in any of the five cases, whereas it could be rejected for ln *Y* in four cases and for the interest rate in three cases. Thus, since ln M2 is exogenous, we may conclude that we are not really estimating an M2 money demand function; rather, we are estimating an output equation or an interest rate equation. The striking point is that when the income and interest rates were treated as endogenous and M2 as exogenous, both the CUSUM and CUSUMSQ tests showed a stable relation, although, as mentioned above, this may not be the money demand function.

Finally, to test for the stationarity of each variable within Johansen's cointegration framework, we applied a relatively stronger and a multivariate version of the ADF test proposed by Hansen & Juselius (1995) where the null is the stationarity of a variable in connection with the cointegration rank. This likelihood-based procedure to test for the stationarity of each variable has χ^2 distribution with $(p\text{-}r)$ degrees of freedom, where p is the number of variables in cointegrating space and r is the number of cointegrating vectors. The results are reported in Panel B of Table 4. As can be seen, the null of stationarity is rejected for all variables. Further investigation revealed that all variables are indeed first differenced stationary or I(1), as assumed throughout our analysis of cointegration and stability tests.

Concluding Remarks

Demand for money in Greece has been studied by numerous researchers. The early studies employed non-stationary data in estimating income and interest elasticities. Given the recent advances in time-series econometrics, their results suffer from the 'spurious regression problem'. More recent studies, however, have employed the cointegration technique and interpreted their finding of cointegration as a sign of a stable money demand function.

In this paper, we show that cointegration does not imply stability. More precisely, we show that in Greece both real M1 and M2 monetary aggregates are cointegrated with income and interest rate. However, when we incorporate the CUSUM and CUSUMSQ tests into cointegration analysis, it is revealed that while M1 money demand is stable, M2 is not.

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References

Adams, Christopher S. (1991) Financial innovation and the demand for M3 in the U.K. 1975-86, *Oxford Bulletin of Economics and Statistics*, 53, November, pp. 401–423.

Apergis, Nicholas (1999) Inflation uncertainty and money demand: evidence from a monetary regime change and the case of Greece, *International Economic Journal*, 13, Summer, pp. 21–30.

Arestis, Philip (1988) The demand for money in Greece: an application of the error correction mechanism, *Greek Economic Review*, 10, pp. 419–439.

Bahmani-Oskooee, Mohsen (1996) The black market exchange rate and demand for money in Iran, *Journal of Macroeconomics*, 18, Winter, pp. 171–176.

Bahmani-Oskooee, Mohsen & Bohl, Martin (2000) German monetary unification and the stability of long-run German money demand function, *Economics Letters*, 66, February, pp. 203–208.

Bahmani-Oskooee, Mohsen & Chomsisengphet, Souphala (2002) Stability of M2 money demand function in industrial countries, *Applied Economics*, 34, November, pp. 2075–2083.

Bahmani-Oskooee, Mohsen & Shin, Sungwon (2002) Stability of the money demand for money in Korea, *International Economic Journal*, 16, Summer, pp. 85–95.

Brissimis, Sophocles N. & Leventakis, John A. (1981) Inflationary expectations and the demand for money: the Greek experience, 14, *Kredit und Kapital*, pp. 482–489.

Brown, R. L., Durbin, J. & Evans, J. M. (1975) Techniques for testing the constancy of regression relations over time, *Journal of the Royal Statistical Society*, 37, Series B, pp. 149–163.

Cheung, Yin-Wong & Lai, Kon S. (1993) Finite-sample sizes of Johansen's likelihood ratio tests for cointegration, *Oxford Bulletin of Economics and Statistics*, 55, pp. 313–328.

Ericsson, Neil. R. & Sharma, Sunil (1998) Broad money demand and financial liberalization in Greece, *Empirical Economics*, 23, pp. 417–436.

Frenkel, Jacob A. & Taylor, Mark P. (1993) Money demand and inflation in Yugoslavia, 1980–1989, *Journal of Macroeconomics*, Summer, 15, pp. 455–481.

Hafer, Rik W. & Jansen, David W. (1991) The demand for money in the United States: evidence from cointegration tests, *Journal of Money, Credit, and Banking*, 23, May, pp. 155–168.

Hafer, Rik W. & Kutan, Ali (1994) Economic reforms and long-run money demand in China: implications for monetary policy, *Southern Economic Journal*, 60, April, pp. 936–945.

Hansen, Hendrik & Johansen, Soren (1993) Recursive estimation in cointegrated models, Institute of Mathematical Statistics preprint no. 1, January, University of Copenhagen.

Hansen, Hendrik & Juselius, Katarina (1995) *CATS in RATS: Cointegration Analysis of Time Series* (distributed by Estima, Illinois, US).

Himarios, Daniel (1986) Administered interest rates and the demand for money in Greece under rational expectations, *Weltwirtschaftliches Archiv*, 122, pp. 173–188.

Himarios, Daniel (1987) Has there been a shift in the Greek money demand function?, *Kredit und Kapital*, 20, pp. 106–115.

Himarios, Daniel (1993) Inflationary expectations and the demand for money: the Greek experience. a commend and some different results, *Kredit und Kapital*, 2, pp. 253–263.

Hoffman, Dennis L. & Rasche, Robert H. (1991) Long-run income and interest elasticities of money demand in the United States, *The Review of Economics and Statistics*, 73, November, pp. 665–674.

Johansen, Soren (1992) Testing weak exogeneity and the order of cointegration in UK money demand data, *Journal of Policy Modeling*, 14, June, pp. 313–334.

Johansen, Soren & Juselius, Katarina (1990) Maximum likelihood estimation and inference on cointegration – with applications to the demand for money, *Oxford Bulletin of Economics and Statistics*, 52, May, pp. 169–210.

Juselius, Katarina (1996) An empirical analysis of the changing role of the German Bundesbank after 1983, *Oxford Bulletin of Economics and Statistics*, 58, pp. 791–819.

Karfakis, Costas I. (1991) Monetary policy and the velocity of money in Greece: a cointegration approach, *Applied Financial Economics*, 1, pp. 123–127.

Karfakis, Costas I. & Parikh, Ashok (1993) A cointegration approach to monetary targeting in Australia, *Australian Economic Papers*, 32, June, pp. 53–70.

Karfakis, Costas I. & Sidiropoulos, Moise (2000) On the stability of the long-run money demand in Greece, *Applied Economics Letters*, 7, pp. 83–86.

Laidler, David E. W. (1993) *The Demand for Money: Theories, Evidence and Problems*, 4th edn (Harper Collins College Publishers).

McNown, Robert & Wallace, Myles S. (1992) Cointegration tests of a long-run relationship between money demand and the effective exchange rate, *Journal of International Money and Finance*, 11, February, pp. 107–114.

Muscatelli, Vito A. & Papi, Luca (1990) Cointegration, financial innovation and modeling the demand for money in Italy, *The Manchester School*, 58, September, pp. 242–259.

Paleologos, John (1986) Unanticipated money, output and inflation in Greece, *Public Finance*, 41, pp. 415–429.

Panayotopoulos, Dimitris (1984) Inflationary expectations and demand for money: the Greek experience. A comment and some different results – a rejoinder, *Kredit und Kapital*, 2, pp. 272–280.

Papadopoulos, Athanasios & Zis, George (1997) The demand for money in Greece: further empirical results and policy implications, *The Manchester School*, 65, January, pp. 71–89.

Pesaran, Hashem M. & Pesaran, Bahram (1997) *Microfit 4.0, Interactive Econometric Analysis* (Cambridge: Camfit Data Limited).

Prodromidis, Kyprianos P. (1984) Determinants of money demand in Greece, 1966I – 1977V, *Kredit und Kapital*, 3, pp. 352–367.

Psaradakis, Zacharias (1993) The demand for money in Greece: an exercise in econometric modeling with cointegrated variables, *Oxford Bulletin of Economics and Statistics*, 55, pp. 215–236.

Reinsel, Gregory C. & Ahn, Sung K. (1992) Vector autoregressive models with unit root and reduced rank structure: estimation, likelihood ratio test and forecasting, *Journal of Time Series Analysis*, 13, pp. 353–375.

Tavlas, George. S. (1987) Inflationary finance and the demand for money in Greece, *Kredit und Kapital*, 20, pp. 245–257.

Appendix

Definitions and Sources of the Variables

All data are quarterly over the period 1975I – 2002IV and collected from the following sources:

M1, money supply consisting of currency in circulation plus demand deposits. Source: *Bank of Greece, Monthly Statistical Bulletin*, various issues.
M2, M1 plus private savings deposits. Source: *Bank of Greece, Monthly Statistical Bulletin, various issues.*
P_t, domestic price level, consumer price index (1995 = 100). Source: *OECD, Main Economic Indicators.*
Y_t, GDP at constant prices (1995 prices). Source: *National Accounts of Greece, various issues.*
i_1, interest rate defined as 12 months treasury bill rate. Source: *IFS CD-ROM.*
i_2, interest rate defined as one year deposit rate. Source: *IFS CD-ROM.*
i_3, interest rate defined as one year lending rate. Source: *IFS CD-ROM.*
i_4, interest rate defined as 36 month rate on deposit. Source: *Bank of Greece/National Statistical Service of Greece*, various issues.
i_5, interest rate defined as 12 month rate on deposit. Source: *Bank of Greece/National Statistical Service of Greece*, various issues.