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INVESTIGATING THE FEATURES OF GREEK BUSINESS CYCLES

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Abstract

This paper tests against several greek macroeconomic time series some of the recent development on business cycles theory. Results suggest that monetary policy could play a significant role in explaining output movements, especially when the target is clarified and the policy instruments optimally chosen. (JEL C22, E52).

1. Introduction

Business cycle theory was a major branch of economics until the Keynesian revolution. Early business cycle theorists considered the cycle as largelry self-sustained, where each boom contains the seeds of recovery and boom. The keynesian revolution shifted the focus of macroeconomics from the inevitability of the cycle to methods of improving macroeconomic performance. During the long expansion of the sixties, it was even possible to think that business cycle has been cured. In the decade followed, poor economic performance (reflected in the increased frequency and depth of recessions) and the forceful advocacy of Lucas (1977) renewed interest in the business cycle as a specific field of research. Nevertheless, eighties experienced a new challenge in business cycles theory. This affected all conventional views (keynesian and new-classical) since the definition of business cycle itself and the alleged size of the effects of macroeconomic policy (in particular monetary policy) on economic activity, is questioned. The distiguishing characteristic of the so-called real business cycle (RBC) models is a denial that monetary policy actions have any significant impact on aggregate output and employment magnitudes (see McCallum, 1986) and attribute all business cycle phenomena to changes in taste patterns and productivity (real) shocks[1].

The influence of this new point of view has been substantial for that it offers a theory based on strict neoclassical principles at a time when the attractiveness of the leading alternative (the Barro/Lucas theory of monetary business cycles) seems to weaken. This induced a tremendous amount of research on a better specification of the role of monetary policy in a neoclassical model. Despite the fact that theoretical work have not managed to proceed significantly since then (see the discussion in Lucas, 1987), there is a growing number of empirical papers which try to identify the significance of monetary shocks on real variables. First, there is a line of argument developed primarily by Nelson and Plosser (1982) that relies entirely on the univariate time-series properties of aggregate output, employment and other real variables. The main emphasis of their argument is that most of the fluctuations in these variables should attributed to the trend component, in a secular versus cyclical decomposition, which would presumably be unaffected by monetary shocks. On the other hand, there are the studies of Sims (1980, 1982), Litterman and Weiss (1985) which show that money stock innovations' explanatory power for output variations diminishes, when some interest rate variables are included in the Vector Autoregression (VAR) system.

The purpose of this paper is to discuss the relevance and some of the propositions of the real business cycle theory in the context of the greek economy, for the period 1956 to 1990. This could be of special interest since monetary and financial sectors have the characteristics of a developing country (see e.g. Arestis, 1988; Demopoulos, 1981). The banking system is in fact underdeveloped. There is no money market while the capital market is in its infancy. The financial assets available are very limited. Interest rates are administered rates, although the responsibility for fixing them has passed to the relatively independent Central Bank since 1982. Nevertheless, nominal rates have been kept lower than inflation for all the examined period. On the other hand during this period, real disturbances of great magnitude (like the oil price in increases, changes in nominal and real exchange rates, large swings in fiscal policies) occured internationally and domestically. These phenomena had an impact on output and employment. Section 2 investigates the existence of unit roots for twenty five annual macroeconomic series in Greece. In the econometric specification of the hypotheses tested, it was avoided the use of any complex method of detrending and separating the secular from the cyclical component. Section 3 examines VAR models and tests for causality among output and several real and nominal variables. Here, the problem of lag structure specification was taken under consideration and the existence of error correction terms among cointegrated series thoroughly investigated. Nevertheless, I decided to expose the methods used in some details but on the other hand, keep the exhibition of 'numbers' to a minimum. Finally, section 4 sums up the conclusions.

2. Trend and Cyclical Components - Unit Roots in Macroeconomic Series

It is a common practice in theoretical and empirical work on business cycles, to correct the time-series under investigation for the growth component, in order to isolate the cyclical part. The unobserved components model is of the form

$$y_t = \bar{y} + y_t$$

where c_t is the 'cyclical' componen
t supposed generated by a process that has the property of stationarity, and y_t is the 'secular' component to which any non-stationarity in y_t must be attributed.

Two approaches are used to account for secular movements in empirical studies of the business cycle: **(i)** In the first approach, the observable variables which are considered for economic growth are explicitly included in the respective regressions. E.g. the model could contain a deterministic linear time trend plus a stationary stochastic component with an unconditional mean of zero however of unspecified autocorrelation structure. The former variable approximates the secular component while the latter is taken as an adequate measure of c_t. This class of models is the so-called Trend Stationary (TS) models. It is important to note here that the secular part is of a deterministic nature and only the cyclical component is stochastic. Proponents of RBC theory state that the assumption of a deterministic trend is ad hoc. Nelson and Plosser (1982) argue that using observable variables to account for growth components seems unsatisfactory since neither factor inputs nor population seem to suffice and direct measures of technology are no readily available.**(ii)** Nelson and Plosser (1982) assume that y_t is generated by a 'difference stationary' (DS) model. Thus, y_t is a variable whose ARMA representation includes a unit root in the AR polynomial and no deterministic trend. Assuming that c_t is stationary it then follows that the secular component must have a unit root. Analysing the variances of the components, they conclude that the variance in actual output changes for the USA is dominated by changes in the secular component $\bar{y}_t$ rather than the cyclical on c_t. The weak point in their study is the crucial role of conclusions regarding DS versus TS processes. The cyclical component is measured by whatever is left over after an estimate of the (DS) secular component (practically random walk) is removed. However, if the process is of a TS type with an AR root close to one, then the secular component removal step, can easily take out many times as much of the signal as is properly attributable to the secular component, thereby yielding a many-fold underestimate of cyclical variability.

A proper way to avoid the detrending problems that Nelson and Plosser (1982) faced to is to consider a model that encompasses the TS and DS process as special cases:

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + u_t \quad (1)$$

where $\Delta y_t = y_t - y_{t-1}$, t the time trend and u_t the error term.

(a) $\beta \neq 0$ and $\rho = -1$ implies a TS model discussed previously.

(b) $\beta = 0$ and $-1 < \rho < 0$ is an ARMA Box/Jeckins class of models.

(c) $\beta = 0$ and $\rho = 0$ is a DS model where y_t variable is integrated of order one: I(1). Assuming that the cyclical component is stationary, the secular component has a unit root and Y_t follows a random walk process. In this case future values of y_t cannot be predicted since the disturbance term is not autocorrelated. Furthermore if $\alpha \neq 0$ (random walk with drift process) the forecast variance increases 'without bound' as the series is an accummulation of stationary changes, and this sum is not stationary.

Dickey and Fuller (1979) provide tabulations of the distributions of the t-ratio for ρ. When residuals are not white noise, a lag dependent variable polynomial can be inserted in order to 'soak up' the seriar correlation of error term, which consists the so-called Augmented Dickey Fuller (ADF) test:

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + \sum_{i}^{m} \gamma_i \Delta y_{t-1} + u_t \quad (2)$$

In a later paper (see Dickey and Fuller, 1981) they construct likelihood ratio tests for the joint null hypothesis Φ_2: $(\alpha, \beta, \rho) = (0, 0, 0)$ and the Φ_3: $(\alpha, \beta, \rho) = (\alpha, 0, 0)^2$. Their estimated values are compared with the values of Φ^*_i (i= 2, 3) provided in the same paper: if $\Phi_i < \Phi^*_i$ the null hypothesis is accepted.

There are twenty five macroeconomic series tested for unit roots during the priod 1956-1990 (for variables' notation see the data appendix). All variables except the unemployment rate and the interest rate are in logarithms. Experiments with TS models showed that the cyclical component, measured as the deviation from a deterministic trend is highly and positively autocorrelated. The DS model and Box/Jeckins analysis showed that in sixteen cases the cyclical part is approximated by low order MA processes, which coincide with the Nelson and Plosser (1982) type of results. This hypothesis is rejected for real GDP, real domestic demand, nominal and real money supply, total domestic credit, velocity, M2 money supply and the real interest rate[3].

Table 1 presents the estimated coefficients for $\hat{\alpha}$, $\hat{\beta}$, $\hat{\rho}$, their computed t-statistics and the Box-Pierce Q-statistic for eigth lags (asymptotically distributed by χ^2 (8)) for the simple DF test of equation (1), and also the Φ_2, Φ_3 and Q-statistic for the relevant ADF test of equation (2) with m= 1. Regressions have been also tested for parameters stability across time (with break point the 1974), and in case the hypothesis is rejected, tests for unit root have been applied to the two sub-samples.

In the simple DF test the hypothesis for white noise residuals is accepted in all, but three cases, at 5% s.1. the only series that clearly rejects the hypothesis for unit root is the real imports, where additionally the trending factor is highly significant. In the case of real interest rate the unit root hypothesis is only weakly accepted. Results for the ADF test (where in all cases white noise residuals hypothesis is highly accepted) show that the unit root hypothesis is rejected at 5% s.l. in four cases: real GDP, real M1 supply, velocity and total domestic credit. In other twelve cases the unit root with drift process is accepted, while in the rest of them the hypothesis of zero drift term can not be rejected.

Briefly, there are aggregate macroeconomic series for the Greek economy that reject the hypothesis for unit root. This outcome is either due to significant trending factors or because of considerably sluggish adjustment processes. Concequently, we can argue tht it could be room for economic policy, even if this could have only short-run effects on real variables. Finally, an other interesting issue coming out from the results is that unemployment rate series appears to follow, a random walk. This result differs from that of Nelson and Plosser's (1982) for the United States, where the unemployment rate is the only series which does not seem to follow a random walk, but is coming along with other findings refered to european countries (see Scheide, 1989; Kaskarelis, 1992). This characteristic undermines that unemployment does not follow a pronounced cyclical pattern but instead shows shifts which are persistent. This is particularly true for the eighties when uneployment increased to a new level and stayed there. In economic literature we have seen a number of possible explanations for this phenomenon (e.g. the hysteresis hypothesis, see Blanchard and Summers (1986).

3. Vector Autoregression Systems and Granger-Causality Tests

The test procedures and used above have virtually no power in discriminating between a first order unit root and an autocorrelation coefficient slightly below zero. However the economic interpretation is completely different in the two cases. If a unit root is present the series is non-stationary, whereas in the other case it would return to a constant long-run mean (see e.g. McCallum, 1986). Thus, it is worth analyzing further the aspect of real business cycle theory by looking at the effects of monetary and real variables on the development of output. For this purpose Vector Autoregression models are going to be examined. VAR proved to be a convenient way of summarizing empirical regularities and perhaps suggesting predominant channels through which relations work (see Sims, 1982).

Of the various VAR studies, the first to appear was that of Sims (1980) which was followed by Sims (1982). In these papers Sims estimates VAR systems that include among their variables measures of aggregate production and money stock. He solves for the implied moving-average representations and uses the latter to decompose the variance of each variable into portions attributable to the innovations of each of the systems' variables. He finds for the USA that when a system includes only money output and the price level, the money stock innovations contribute a substantial fraction of the total explanatory power for output. However when some nominal interest rate is added to such system, the fraction of output variability attributable to money stock innovations declines sharply. He concludes that monetary policy surprises are not important in explaining the real component of postwar business cycles. Thus, the imposition of a monetarist rule to make the quantity of money more predictable would have had little real effect towards reducing these fluctuations. Ahmed et al. (1989) confirm Sims's conclusion for the European Community. Litterman and Weiss (1985) also find that the portion of output variance attributable to money stock innovations declines sharply when a nominal interest rate is added to a small VAR system. However one of their prominent finding is that the real rate is not significantly Granger-caused in the quarterly US data by any of money, output, price and the nominal interest rate. They argue that the theories of Lucas/Barro and sticky-price types are contradicted by the data, as both transmit monetary impulses to real variables by way of the real rate. Other results reported in Litterman and Weiss (1985) provide evidences which are inconsistent with the RBC hypothesis. Figures in their paper indicate that log of output is in fact Granger-caused by nominal variables.

In the paragraphs that follow, some of the aforementioned popositions are going to be tested for the Greek economy. The variable representing the measure of output is domestic demand (real GDP minus net exports). As far as monetary factors are concerned, they are examined in nominal and real terms[4] the effectiveness of Ml money supply, domestic credit total and that directed to the private sector of the economy, and finally the role of short-term interest rate. The real variables, which reflect influences from the real side of the economy, are the terms of trade (imports over exports deflator), real exports, real government expenditures, and the real production wage. All variables except the interest rates are first differences of natural logs. Interest rates are simply in differences[5].

VAR estimation pays particular attention to determining the appropriate lag structure. In Sims (1980, 1982) and Litterman and Weiss (1985) all variables appear in all equations with the same number of lags. In this paper it will be followed the procedure proposed by several authors (see Hsiao, 1981; Fackler, 1985 among others), which implies that the lag length in the vector autoregressions should be chosen according to Akaike's FPE creterion (Final Prediction Error). This is more preferable than the usual practice of ad-hoc lags since in the later results could be biased either because existing causalities are not detected or of spurious causalities[6]. Table 2 reports the optimum lag length and the corresponding FPE for each univariate case. In all equations the tests for autocorrelation in the residuals (calculated from the Q-statistic) are favourable to the hypothesis of white noise processes. Before proceeding to the construction of the bi -or multivariate VAR models it should be examined whether important error correction terms are erroneously excluded from the regressions. This detects the importance of long run components in regressions among difference stationary variables, and it is connected with the rapidly expanding literature on cointegration[7]. Results showed that the null non-cointegration hypothesis can not be rejected at 5% s.l. in all cases.

Results from the investigated bivariate and multivariate VAR systems (FPE, Q-statistic and a Chow test for 1974 are applied to all systems) can be summarised as follows[8]. Money supply and total domestic credit cause demand but with opposite (negative) than the expected sign, while nominal rate causes demand negatively. In real terms, signs return to normal. On the other hand, real domestic demand causes only the half of the propable monetary instruments examined. It does not cause money in nominal and real terms. It affects positively the nominal rate but only for the 1975-90 period. Surprisingly, demand is negatively causing the real rate: when real domestic demand rises, monetary authorities reduce domestic credit but they do not compensate nominal interest rate enough to cover inflation.

We now proceed to the relations among the monetary instruments. Money supply causes positively the interest rate in nominal terms but causes it negatively in real ones. Inversely, rates have a positive impact on money supply which could attributed to the underdeveloped financial system (see Alogoskoufis (1982) where a similar result was reported). In the multivariate system, nominal rate dominates over money supply and diminishes its impact on demand, while Ami does not cause the system Ara/Ars. However in real terms, money dominates over the real rate in causing domestic demand. Similarly puzzlying are the relations between money and total credit. In nominal terms causality runs only from credit to money (although in real terms runs in the opposite direction) while money dominates over credit in affecting demand. If we replace total credit with this directed to the private sector of the economy, then cps affects m 1 positively during the first year but the overall effect is negative. Money causes positively credit too, and dominates in the relations to domestic demand. Not far better are the results between rates and credit variables.

Despite the puzzlying relations in respect to economic theory, such results are not new for greek time series. There is a common conclusion among researchers that apart from the financial system underdevelopment, monetary authorities did not have a clear objective throughout the post war period. Demopoulos (1981) concludes that "... the authorities are following the philosophy of the Real Bill Doctrine which is interpreted to mean that stabilization does not depend on the rate of growth of the money supply but on the quality of bank credit. This policy presupposes that interest rates should be fairly constant and this is the policy which the monetary authorities have been following. Controls over the availability of credit and artificially low interest rates produce perverse effects on the desired objectives of economic development and stabilization... On the other hand, if the authorities consider the money supply as one of the aggregates affecting aggregate demand, they should follow a 'true' monetary policy rather than a credit policy."

Turning now to the real factors, we can see that no causal link was found between government expenditure and domestic demand, which is a surprising outcome. Real exports do not cause demand (no export led growth can be manifested upon this outcome). However, exports are positively affected by domestic demand, which is probably due to positive reactions in production caused by changes in consumption, investment and public spending on country's infrastructure. Terms of trade (or real exchange rate) negatively affects demand, which means that a rise in the relative price of imported to exported goods reduce domestic demand for home produced output, probably due to low price elasticity of imports (see e.g, the estimates reported in Alogoskoufis, 1989).

Real product wage has a positive effect on demand and it is also positively caused by the later, which could undermine a procyclical wage behaviour. In the relationships among rw and the monetary variables we see that although there are very few causal links, it seems that real wage dominates over them on affecting demand. As it refers to the terms of trade, causality runs in both directions between tr and ml, tr and rml, tr and cto but runs in no direction between terms of trade and the rest of them. Terms of trade affect positively nominal money but negatively that in real terms, possibly due to the effect of inflation. Money causes terms of trade through an interesting lag structure: positively at first while the total effect is negative. Finally, terms of trade rather dominate over money in affecting domestic demand.

4. Conclusions

This paper aimed at empirically investigating the argument of the real business cycle theory for the Greek economy. For this purpose random walk tests and vector autoregressions have been used, in order to account for the evidence usually put forward by those who stress the dominance of real factors for fluctuations of economic activity. Results are not conclusive. The hypothesis that macroeconomic time series follow a random walk have found some support but VAR models showed that money plays a major role in output movements. Thus, since the view that monetary policy is ineffective could not be validated, the idea of monetary prescriptions can not be dismissed. In particular a rule for monetary policy would help to stabilize the development of output and could be more effective than the actual monetary policy that were followed in Greece during the examined period.

Data Appendix

yc, yq: Gross Domestic Product in current and constant prices respectively *(OECD National Accounts*)

cq, iq, gq, mq: Real Private Consumption, Investment, Government Expenditure, Real Exports, Real Imports respectively *(OECD Nat. Ace.*)

an, ra: Nominal and Real Domestic Demand (GDP minus net exports)

py, pc, tr: GDP deflator, Domestic demand deflator, and Terms of trade (imports over exports deflator)

et, ut: Total employment and Unemployment Rate (Total Employment over Labour Force) *(OECD Labour Force Statistics*)

rw: Real product wage (hourly earnings in manufacturing over GDP deflator) *(OECD Main Economic Indicators*)

rs: Short-term lending rate *(IMFInternational Financial Statistics*)

m1, m2: M1, M2 money supply respectively (*IMF IFS*)
cto, cps: Domestic Credit Total and to the private sector (*IMF IFS*)
tmi=m1-pc (Real Money), vell=m1-an (velocity), crto=cto-pc, crps= cps-pc
rir= ρσ-Δpc.

TABLE 1
Integration Tests

	DF test				ADF test (m=1)		
Series	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	Q-stat	Φ_2	Φ_3	Q-stat
yc	0.08(0.3)	0.21(0.5)	0.00(0.0)	9.6	6.5	1.9	2.5
yq	-0.20(0.4)	-0.27(1.2)	0.02(0.5)	4.2	11.3*	6.5*	2.9
an	0.13(0.4)	0.32(0.7)	-0.00(0.1)	4.3	8.2*	3.5	2.9
ra	0.26(0.4)	-0.02(0.1)	-0.01(0.3)	2.9	5.8*	0.6	2.3
cq	-0.43(0.8)	-0.26(1.4)	0.04(1.0)	10.3	5.3*	2.7	6.9
iq	0.49(0.7)	0.00(0.0)	-0.03(0.6)	3.0	2.8	1.6	3.8
gq	0.82(0.8)	0.26(0.5)	-0.06(0.7)	4.2	7.7*	0.6	6.4
xq	2.00(2.2)	1.45(1.7)	-0.18(2.0)	2.1	8.6*	4.6	2.0
mq	3.03(2.9)	2.11(3.0)	-0.26(2.8)*	7.6	6.2*	2.3	5.3
py	0.09(1.1)	0.19(1.0)	0.02(1.0)	28.4*	2.3	1.7	2.1
pc	0.07(0.8)	0.23(1.1)	0.01(0.6)	27.9*	1.9	2.3	2.7
tr	1.34(1.5)	2.59(1.2)	-0.07(1.1)	7.1	5.0*	1.4	3.8
et	0.68(1.2)	0.03(0.8)	-0.08(1.2)	12.8	1.2	0.9	5.3
ur	-0.00(1.0)	0.03(2.2)	-0.04(0.7)	24.2*	1.5	2.2	7.2
rw	0.02(0.1)	-0.00(0.0)	-0.03(0.3)	6.6	2.9	1.1	2.5
rs	-0.00(0.9)	0.06(2.6)	-0.04(0.8)	9.0	2.3	2.1	4.0
m1	0.25(3.6)	1.84(1.4)	-0.12(1.4)	5.1	11.7*	0.8	3.6
m2	0.20(2.9)	0.66(0.5)	-0.03(0.4)	3.7	8.9*	0.6	3.7
rm1	0.26(2.0)	-0.16(0.8)	-0.03(0.9)	5.2	9.3*	7.0*	6.8
vel1	-0.74(1.9)	-0.10(1.1)	-0.09(2.1)	4.1	7.4*	9.1*	3.1
cto	0.22(4.1)	0.02(2.6)	-0.10(2.2)	12.2	23.8*	14.0*	9.9
cps	0.31(3.4)	2.30(1.2)	-0.14(1.3)	5.6	10.6*	0.9	5.2
crto	0.28(0.9)	0.14(0.2)	-0.03(0.5)	4.9	5.0*	0.8	6.0
crps	0.17(1.0)	-0.68(2.2)	0.01(0.3)	9.2	4.8	5.1	8.8
rir	0.01(0.9)	0.01(0.2)	-0.37(2.7)	1.4	0.2	1.9	2.1

Notes: (a) Computed absolute t-statistic in paretheses besides the estimates Asterisk * means null hypothesis is rejected at 5% s.l.

(b) The parameters stability hypothesis was rejected for rs, m2, cps, crps. However investigation for unit root in the two subsamples did not alter the results for the whole sample.

TABLE 2

Optimal Lag Length for the Univariate Autoregressions

Series	opt. lag. length	FPE*10^{-3}	Q(χ^2_8)	CHOW74
Δra	1	1.767	6.17	0.4(14,17)
Δm1	1	1.867	1.48	0.3(14,17)
Δrs	1	0.163	2.74	4.8(14,17)
Δrs(1956-74)	2	0.062	1.77	
Δrs(1975-90)	1	0.307	2.61	
Δtr	1	47.403	3.54	0.4(14,17)
Δgq	3	1.440	2.47	0.6(12,15)
Δxq	2	7.098	0.60	1.0(13,16)
Δrw	1	1.387	2.00	1.8(14,17)
Δcto	2	2.707	8.54	2.7(13,16)
Δcto(1956-74)	2	1.469	5.41	
Δcto(1975-90)	1	3.644	10.10	
Δrm1	2	3.009	6.71	0.6(13,16)
Δrir	1	1.329	3.88	0.7(14,17)
Δcrto	1	5.125	7.58	1.9(14,17)
Δcps	2	5.346	3.54	2.9(13,16)
Δcps(1956-74)	2	2.707	4.54	
Δpcs(1975-90)	1	9.874	4.27	
Δcrps	1	8.792	8.70	1.6(14,17)

Note: CHOW74 is an F-type test. In paretheses the degrees of freedom.

Footnotes

1. The usual disclaimer applied.

2. However, the RBC point of view does not deny that there is any association between output and monetary magnitutes but it attributes the observed money-output correlation to the so-called 'reserve causation', i.e. responses of the money stock, via the monetary authorities and/or the banking sector, to variations in aggregate output (see e.g. King and Plosser, 1984).

3. In order to perform the tests the following regression have been used

$$\Delta y_t = \gamma \Delta y_{t-1} + u_t \tag{2a}$$

$$\Delta y_t = \alpha + \gamma \Delta y_{t-1} + u_t \tag{2b}$$

Thus, for the ADF model (SSR(i) is the estimated sum of squared residuals of the (i) equation)

$$\Phi_2 = \frac{SSR(2a) - SSR(2)}{SSR(2)} * \frac{N-4}{3}, \text{ and } \Phi_3 = \frac{SSR(2b) - SSR(2)}{SSR(2)} * \frac{N-4}{2}$$

4. The refered to previously results are available upon request by the author.

5. The examination of deflated monetary variables is coming along with the thesis that only real variables should be used in VAR systems. VAR systems, although they could be considered as reduced forms of a variety of structural models, are not immune to the Lucas-critique.

6. VAR models assume that stochastic processes are stationary. Consequently, first differences Δy have been used in the light of evidences coming out from the previous section. Real money supply and nominal total domestic credit have also been inserted as I(1) series since results in the previous section coming out from the two different of tests are not conclusive, in rejecting the unit root hypothesis.

7. The final Prediction Error cretirion (FPE) is defined as

$$\frac{1}{N} * \frac{(N+\kappa)}{(N-\kappa)} * SSR,$$

where κ is the number of estimated coefficients. In other words the reduction of the estimated sum if squared residuals SSR has to be sufficiently large to outweight the "penalty" of an increase in κ by the addition of another lag.

8. Two series are defined as cointegrated when a linear combination of the two is stationary even though the series themselves are non-stationary. To illustrate the problem consider the simple model

$$y_{3t} = \delta y_{2t} + \varepsilon_t$$

where $\Delta\varepsilon_t = \rho\varepsilon_{t-1} + v_t$, v_t white noise and y_3, y_2 non-stationary series. The null hypothesis is taken to be non-cointegration $\rho=0$. Engle and Granger (1987) propose several tests of the null of non-cointegration against the alternative of cointegration.

9. All regressions analyses are available upon request by the author.

References

Ahmed E., RosserJ. B. Jr. and R. G. Sheehan (1989), "A Comparison of National and International Agreggate Supply and Demand VAR Models: The USA, Japan and the EEC", Weltwirtschaftliches Archiv., Vol. 2, pp. 252-72.

Alogoskoufis G. (1982), "Unanticipated Money, Output and Prices in Greece", European Economic Review, Vol. 19, pp. 289-303.

Alogoskoufis G. (1989), "Macroeconomic Policy and the External Constraint in the Dependent Economy. The Case of Greece", Birkbeck College Discussion Paper, No 89/3, London.

Arestis P. (1988), "The Demand for Money in Greece. An Application of the ECM", Greek Economic Review, Vol. 10, No 2, pp. 419-39.

Barro R. J. (1987), Macroeconomics, 2nd edition, New York.

BlanchardO. andL. Summers(1986), "Hysteresis in European Unemployment", NBER Annual Supplement 1987.

Demopoulos G. (1981), "Monetary Policy in the Open Economy of Greece" Centre of Planning and Economic Research of Greece Monograph Series Athens.

Dickey D. A. and W. A. Fuller (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", Journal of American Statistical Association, Vol. 74, pp. 427-31.

Dickey D. A. and W. A. Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", Econometrica, V 49:4 pp. 1057-72.

EngleR. and Granger C. (1987), "Co-integration and Error Correction: Representation Estimation and Testing", Econometrica, Vol. 55, pp. 251-76.

Fuckler J. S. (1985), "An Empirical Analysis of the Markets for Goods, Money and Credit", Journal of Money Credit and Business, Vol XVII, Nl, February.

Hsiao C. (1981), "Autoregressive Modelling and Money-Income Causality Detection", Journal of Monetary Economics, Vol 7, pp. 85-106.

Kaskarelisl. (1992), "Are there Real of Monetary Business Cycles in the UK Economy?", Rivista Internazionale di Scienze Economiche e Commerciali, Vol. 39, No 1, pp. 49-67.

KingR. G. and C. I. iVosser(1984), "Money, Credit and Prices in a Real Business Cycle", American Economic Review, Vol. 74, June, p. 363-80.

Litterman R. B. andL. W«ss(1985), "Money, Real Interest Rates, and Output: A Reinterpretation of Postwar US Data", Econometrica, Vol. 53, pp. 129-56.

Lucas R. E. Jr. (1977), "Understanding Business Cycles", in Brunner K. and A. Meltzer, Stabilization of the Domestic and International Economy, Carnegie-Rochester Conference Series, No 1.

Lucas R. E. Jr. (1987), Models of Business Cycles, Oxford: B. Blackwell.

McCallum B. T. (1986), "On 'Real' and 'Sticky-Price' Theories of the Busines Cycle", Journal of Money, Credit and Banking, Vol. 18:4, pp. 397-414.

*Nelson C. R. abd C. I. /*Yasser (1982), "Trends and Random Walks in Macroeconomic Time Series", Journal of Monetary Economics, Vol. 10, pp. 139-62.

Scheide J. (1989), "On Real and Monetary Explanations of Business Cycles in West Germany", presented at the 4rth Annual Conference of the EEA, Augsburg - W. Germany.

Sims C. A. (1980), "Comparison of Interwar and Postwar Business Cycles: Monetarism Reconsidered", American Economic Review, V 70, pp. 250-7.

Sims C. A. (1982), "Policy Analysis with Econometric Models", Brookings Papers in Economic Activity, Vol. 1,pp. 107-52.