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Testing Money Supply Endogeneity: The Case of Greece (1975-1998)[1].

by Yannis Panagopoulos
Centre of Planning and Economic Research (K.E.Π.E.), Athens, Greece.
and
Aristotelis Spiliotis
Technological Educational Institute of Piraeus and Proton Bank S.A., Athens, Greece.

Abstract

The main purpose of this paper is to trace whether, for a prolonged period of time (1975-1998), money supply in Greece was endogenously or exogenously determined. In the theoretical part, we briefly report the Orthodox vis- a- vis the post Keynesian views on the issue. From the statistical evidence we conclude that : a) the deregulation process of the late 80's did not produce any structural break in the Greek monetary aggregates and b) under specific assumptions, money in Greece can be considered as endogenously determined. This implies that in the Greek monetary system the central bank behaves as a lender of last resort.

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Keywords :

Money supply, Bivariate VAR's, Cointegration.

1. Introduction

The main purpose of this paper is to examine whether money in Greece is endogenously determined. More analytically, this paper incorporates the following sections. Section 2 briefly presents the basic differences between the post Keynesian and the Orthodox school of thought, regarding the exogenous or endogenous nature of money. Section 3 gives us a brief historical review concerning the deregulation process of the Greek financial system.

[1] The authors would like to thank Hara Messini and Costas Papachristopoulos for reading and commenting this paper.

Section 4 presents the existing empirical evidence on the money endogeneity issue from the Greek as well as from the international literature.

In section 5, the variables and the data which will be used in the empirical part of this paper, are presented. Section 6 justifies the implementation of the selected econometric methodology -Lutkepohl and Reimers (1992) bivariate VAR causality approach- along with a brief discussion on the produced causality results. Finally, the concluding comments concerning the nature of money in Greece appear in section 7.

2. The theoretical debate regarding monetary policy

In the regulated financial environment of the 70's up to the 80's the confrontation of the high level of inflation was globally a priority. For the orthodox economists, the general idea was that because inflation is a monetary phenomenon (Freedman 1982) money growth controllability could be the only remedy for such a "decease". More specifically, the central bank, basically through its open market policy can affect commercial banks level of reserves and consequently control their credit expansion which is related with the monetary growth. For the effectiveness of such policy central bank will be assisted by its dominating role over the other main player of the financial macroeconomic environment (e.g. the commercial banks). In other words, the central bank through the open market policy and therefore reserve restraint, can exogenously control the high power money which consequently implies an effective control over monetary aggregates and inflation. This exogenous and effective usage of the high power money as well as the relative power of the central bank over commercial banks, was historically named *Monetarism*[2].

On the other hand, the theoretical counterargument was that no restriction on monetary aggregates by the central bank is possible because commercial banks can escape by following the principle "*loans make deposits and deposits make reserves*" (Lavoie, 1984). So, despite the central bank's dominating role, no reserve restrictions can be effective when economic agents need credit. Credit-money is not easily restricted because it is demand driven and therefore endogenous to the real economic world. The outcome of

[2] When Monetarism is implemented monetary authorities can restrict money supply by direct and / or indirect control on the quantity of money. In an extreme version of this approach, the quantity of money can be perfectly inelastic with respect to the interest rates and always independent of exogenous shift factors which are related to the demand for money. In statistical terms, any sort of money exogeneity will imply that the different monetary aggregates (e.g. M1, M3 and M4) "are caused by" and therefore restricted, when necessary, by monetary base.

such approach, paraphrasing Moore (1989), is the reversal of the orthodox theoretical causation between high power money and monetary aggregates we mention in advance. In a Post Keynesian world, the central bank, during the administrated period, assumes that it follows the *lender of last resort* attitude[3] which was named *Horizontialism* (see Moore, 1989).

However, from the late 80's onwards, this "tug of war" between central bank and the commercial banks was affected by the introduction of financial innovations especially in developed countries. In particular, the existing deregulated and liberalized financial environment substantially helped commercial banks to develop and use the new financial products (e.g. Repos, Certificate of Deposits, the Eurodollars etc) which could provide a much bigger liquidity to the commercial banks ability to deal with the existing demanded credit. This inevitably led to a greater ability to an easier "escape" from the central bank's restrictive policies (whenever these were applied). In other words, commercial banks became less controllable by the central bank. In the post-Keynesian literature (see Pollin 1991, Palley 1994, Vera 2001 etc), the phenomenon was named *liability management* policy on behalf of the commercial banks point of view.

According to the existing non-orthodox literature, one way we can trace the symptoms of such evolution in a financial system is by observing the commercial banks liquidity positions, regarding the loan/reserve and the loan/deposit ratios. If they are expanded irrespective of the monetary aggregates growth[4], then a *liability management* policy is applied from the commercial banks.

The new financial products that implemented progressively during the deregulation period initially helped commercial banks to accommodate demand for credit in an easier way than during the administrated period (reinforcing the endogenous nature of money) and consequently to gradually overturn the existing relative power between the central bank and the commercial banks. The new status quo of the 90's -concerning the relative power and its consequences for the endogeneity of money- was also underlined by Chick (1995) when she argued that "*Today, most central banks are experi-*

[3] This implies that policymakers set the interest rates at a level where reserve requirements are met and where the quantity of money is simultaneously determined by the portfolio preference of private sector banks and non-banks. Central bank plays the leading role and commercial banks follow the strategy of "price setters and quantity takers" (see Moore, 1989). Moreover, the Central bank had the leading obligation of preserving the solvency of the banking system (see Goodhart, 1994). In statistical terms, this will imply that monetary base "causes" the different monetary aggregates and this in empirical terms define money endogeneity.

[4] For instance, in econometric terms, they may have different unit root behaviour during the examined period from the other monetary aggregate variables.

encing greater difficulty controlling the banks, which have grown relatively to central banks. So the theory of the supply of money has been recasted by PKs, who play down the role of the central bank, emphasizing instead the demand for credit, which the (commercial) banks are assumed, one way or another, to accommodate. Modern money is endogenous[5]".

Elaborating this argument a bit further, in a deregulated financial environment central banks are expected to be very cautious imposing any quantitative restrictive measures for controlling monetary aggregates (e.g. by controlling reserves), not just because they do not want to jeopardize the solvency of the banking system but also due to the central bank's natural weakness in its relative power "battle" with commercial banks. This evolution reinforces the post-Keynesian view regarding the central bank's behaviour as a *lender of last resort*.

3. A brief review of the deregulation process of the Greek financial system

For the 70's and 80's the Greek financial system has been historically considered as a highly and strictly regulated one. In particular, as Eichengreen and Gibson (2001) report, in the 1980's the three bigger commercial banks of Greece owned more than 70% of the total assets of the banking sector. Moreover, as Garganas and Tavlas (2001) report, in 1985 these three larger commercial banks accounted for 64% of the total private deposits and 63% of the loans to the private sector. These three largest banks of the time were publicly controlled.

More specifically, the banking sector of that period was subject to extensive controls and regulations by the Central bank. Interest rates on all categories of bank deposits and loans were set administratively. Moreover, as Garganas and Tavlas (2001) underline, the allocation of financial resources, through the banking system, was determined according to a complex set of rules and regulations. The commercial banks general portfolio allocation requirements included a specific fractions of their deposits for the financing of the public sector and small and medium-sized firms as well as long term

5 In statistical terms, money endogeneity implies that the different monetary aggregates (e.g. M1, M2, M3) are either uncorrelated with monetary base or they "cause it". As an extension to this, it is expected that changes on the money supply will be either uncorrelated with or will be "caused by" changes in nominal income. On the other hand, if financial innovations assisted by the deregulated environment and the increase of the commercial banks' relative power, played no role on the effectiveness of monetary policy transmission mechanism, then the causality direction will be reversed and the mainstream school of money exogeneity will prevail.

loans to the industry. In addition, the quantity and terms of commercial bank lending to selected sectors or industries came under credit controls and regulations aimed at subsidizing certain sectors. Credit expansion was subject to quantitative ceilings heavily dependent on central bank funds. Therefore, the public character of the bigger market share of the commercial banks operated as a guarantee for their close cooperation with the central bank regarding credit and monetary growth.

Overall monetary policy was conducted through direct instruments of monetary control. For instance, by setting or limiting either prices (interest rates) or quantities (amounts of credit outstanding) through regulations.

Between 1980 and 1987 we have the first small steps towards the financial liberalization. However, the *Report of the Committee for the Reform and Modernization of the Greek financial system* (1987) was the one which actually accelerated the deregulation of the Greek financial system. According to that Report, in November 1987 interest rates on time deposits were deregulated and banks were allowed to offer new financial assets like Certificate of Deposits and Bank Bonds at market rates. Moreover, interest rates were deregulated on most categories of short-term and long-term loans, which accounted for over 80 percent of bank lending to the private sector. The reserve/rebate system used for allocating bank credit was abolished in December 1988. In 1989, the rates of savings deposit were liberalized, but although they were subject to a minimum rate, established by the Bank of Greece, during the early 90's even this was gradually abolished.

According to Frangakis (1998), in the early 1990 another intervention related to the distinction between special credit institutions and commercial banks was thoroughly dismantled. This actually released these institutions from the existing -during the administrated period- restrictions upon the types and terms of lending they were allowed to undertake.

Moreover, on May 1991 restrictions on long term capital movements with EU countries were also removed and they were completely deregulated on March 1993. At the same year the Bank of Greece introduced further credit facilities for the commercial banks like the Lombard facility for short term financing and the facility of rediscounting promissory notes and bills of exchange. Finally, as Ericsson and Sharma (1996) mention, the "*financial liberalization allowed the creation of products called synthetic swaps*" in the Greek financial system[6]. This was considered as a further tool for the com-

[6]For further information on the historical evolution of the Greek Financial system see Ericsson and Sharma (1996), Alogoskoufis (1995), Soumelis (1995) for recent overviews. However, two very good descriptions with chronological details upon the deregulation in Greece are given by Papaioannou & Gatzonas (1997) and by Garganas and Tavlas (2001).

mercial banks ability to apply an efficient *liability management* policy against central bank constraints.

In general, all the above changes were directly linked with the commercial banks' capabilities to "challenge" the ability of the central bank to control both their credit expansion as well as monetary aggregates' growth.

4. Some empirical evidence from the "Greek and the International experience"

In the empirical part of this paper, we will seek the existence of money endogeneity in the Greek economy (before and after deregulation) through the usage of causality tests. Although the international literature is full of empirical causality tests upon the money income and monetary aggregates' relationships[7], the Greek experience is rather limited in this issue. Sougiannis (1985) was the first to apply some causality tests (Sims test) for the case of Greece. In particular, he proxied money income with the Index of Industrial Production (IIP). Then by testing the direction of causality between the money stock M1 and the Index of Industrial Production (IIP), he found that the causal direction in the Greek economy is not quite clear. On the other hand, by testing the causal relationship between M2 (broader definition of the money stock) and IIP, he found that unidirectional causality runs from M2 to IIP[8]. The question with Sougiannis' results is basically the "soft" econometrics techniques applied in his study.

Furthermore, Spiliotis (1992, ch. 3), extended the examined time period up to 1988 and tested the causal relationship between different monetary aggregates (e.g. M1, M3) and nominal and real GDP, using the cointegration approach. Spiliotis' long run causality results initially seem to favor the Monetarist view that money "causes" income. On the other hand, the short run causality results verify this outcome only between money and nominal income but not the real one. Moreover, even his long run causality results do

[7] See, for instance, Stock & Watson (1989), Friedman & Kuttner (1993), Palley (1994), Hafer & Kutan (1997) for the U.S. case as well as Krol & Ohanian (1990), Hayo (1998), Hussein & Howells (1998) and Hafer & Kutan (1999) for some multi-country causality approaches on the money endogeneity issue.

[8] The above causality results are not irrelevant from the existing relationship between the money supply and the public deficit. This relationship is crucially related with the specific institutional framework under consideration and the way in which monetary authorities act in relation to the fiscal authorities, and, in a more general sense, how the monetary authorities react to changes in the public debt. In other words, the degree of monetization of the public sector deficit varies from country to country, depending on the precise nature of the financial institutional arrangements.

not lack autocorrelation problems, which make the "Monetarist long run verdict" dubious.

In addition, both articles "incorporate" the same problem : The causality results have been produced during the administrated time period of the Greek banking system. In other words, they do not actually enter into the period of real and accelerating deregulation.

Some more recent approaches concerning Greece on the money endogeneity/exogeneity question have been presented by Apergis and Tsoulfidis (1998) and Hayo (1998). More analytically, Hayo (1998) in his multi country approach included Greece in his causality tests. His estimating period is from the mid 60's to mid 90's. The causality tests were between output and narrow money (m1) and broad money (m3) for both levels and differences. Hayo's results favor the monetarists assumption that money causes income. Nevertheless, the problem with these results is that the lag specification of the VAR causality tests has been produced abstractly[9]. On the other hand, in Apergis and Tsoulfidis (1998) empirical approach, only short run causality results between M1 and real GDP, were presented. Their estimating period was 75:1 to 93:4. and the final outcome supported the feedback assumption between money and income.

Regarding the international literature, the most recent characteristic examples of endogeneity testing -with the usage of the Granger causality methodology- is linked with the relationship between credit and different monetary aggregates. In this kind of bivariate tests, endogeneity is accepted when credit «Granger-causes» monetary aggregates[10]. In other words, monetary authorities cannot effectively constraint any demand determined credit expansion. The causality approaches of Howells and Houssein (1998), Nell (2000) and Vera (2001) are the most characteristic cases. In Howells and Houssein's study, the causal relationship between bank lending (BL) and M3 was implemented for the G7 countries. The outcome was that bank lending (BL) causes M3 in France, Italy, Japan, UK and US, which is a cornerstone for accepting money endogeneity in these countries. Nell, on the other hand, tested money endogeneity for South Africa (S.A.) by running causality tests between loans (by credit worthy borrowers) and deposits. The outcome showed that loans cause deposits in S.A. and therefore endogeneity was in a sense verified. Finally, Vera's money endogeneity question for Spain was tested by determining the causality direction between bank lending (BL), monetary base (MB) and money Supply (MS). The outcome was that BL

[9] Not to mention the non reliable GNP Greek data which are frequently revised.

[10] In a broader explanation of the causality tests, even a non-causality result can be interpreted as non-orthodox outcome.

causes MB which causes MS. This result was in favor of the money endogeneity assumption[11].

Before the presentation of the empirical part of our study we will present the data and the variables which we will use in our causality approach.

5. The data

Our causality analysis covers the relationships between money supply and the index of industrial production as well as the relationships between the monetary base and different monetary aggregates, using monthly data from 1975(1) to 1998(2). In particular, the variables to be used are : the index of industrial production (*I.I.P.*), the high powered money *(monetary base, MB*), the narrow money (*M1*) and two broad money variables (*M3, M4*). The index of industrial production has been selected here as a proxy for GDP. This does not imply that there are no drawbacks for this selection[12].

6. Econometric methodology and empirical results

Our empirical procedure was based on Lutkepohl and Reimers (1992) methodological approach of causality. More specifically, this kind of causality follows the principles of co-integration in bivariate VAR systems, on a step by step basis. This methodology was also used in other empirical papers (see Alexakis, Panagopoulos, Spiliotis (2000)). The reason for this specific VAR methodological approach is simple : It does not require *ex ante* implementation of the unit root tests on the incorporated variables. In other words, it allows the implication of the Granger-causality approach without the pre determination of the degree of the variables integration (e.g. whether they are I(1) or I(2)).

The crucial point here is that if the number of cointegrating vectors between the two variables are 1 or 0 (r=1,0) then the EC.VAR's are implemented at the first differences. If, on the other hand, the number of cointegrating vectors are two (r=2) the EC.VAR's are implemented at the levels of

[11] All the previously mentioned international studies are linked not only with the assumption of money endogeneity testing but also with the idea of searching whether any possible money endogeneity follows the *Horizontialist* or the *Structuralist* or the *liquidity preference* School of post-Keynesian thought (see for example Nell 2000 and Vera 2001). In our study however we will be restricted on testing whether money supply in Greece is endogenously or exogenously determined. The kind of such possible endogeneity is beyond of our scope here.

[12] The basic drawback is that the importance of industrial production is persistently decreasing in the Greek GDP. On the other hand, GDP data are not available –for the examined time period- neither in quarterly nor in monthly basis.

the two variables. Finally, for all the bivariate VAR causality tests applied here (as well as Johansen results and Wald's short run causality tests), the LR test for the lag length selection has been implemented[13].

The empirical results

Our first priority here is to test whether a structural break exist in our causality tests due to the deregulation of the financial system. Table A presents the Chow tests for structural break in our data. Such evidence in our data seems to exist after 1994 between the index of industrial production and the different monetary aggregates (except M1) but not between the monetary base and the different monetary aggregates. From these results we cannot actually accept a structural break in our system due to the deregulation of the financial system. Therefore, any attempt to break the sample in two periods – before and after deregulation– is not actually supported by the data.

In Table 1a, we report the likelihood ratio [Johansen] results concerning all the examined bivariate sets of variables between monetary aggregates and the index of industrial production (with and without deterministic trend in the data).

Table 1a: The Johansen Results (Monetary Aggregates vs. Industrial Production) Monthly data (*1975Q1 - 1998Q2*)

Hypothesis			***Likelihood***	***5%***	***Numb. Of***	***No. of***
H_0	***H_1***	***Eigenvalues***	***Ratio***	***Critical Value***	***C.E(s)***	***lags***
(Assuming deterministic trend in the data)						
LMB & **LIIP** variables						
r = 0	r = 1	0.07	28.1	15.41		
r ≤ 1	r = 2	0.02	7.5	3.76	r = 2	14
LM1 & **LIIP** variables						
r = 0	r = 1	0.06	21.23	15.41		
r ≤ 1	r = 2	0.01	3.08	3.76	r = 1	14
LM3 & **LIIP** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.10	28.49	15.41		
r ≤ 1	r = 2	0.02	5.38	3.76	r = 2	14
LM4 & **LIIP** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.03	12.76	15.41		
r ≤ 1	r = 2	0.02	5.29	3.76	r = 0	16

[13] All LR tests results for lag length selection of the causality tests have been produced with the help of Microfit 3.0 and are available upon request.

(Assuming no deterministic trend in the data)						
LMB & **LIIP** variables						
r = 0	r = 1	0.09	47,16	19.96		
r ≤ 1	r = 2	0.07	20,53	9.24	r = 2	14
LM1 & **LIIP** variables						
r = 0	r = 1	0.10	48,97	19.96		
r ≤ 1	r = 2	0.06	18,10	9.24	r = 1	14
LM3 & **LIIP** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.11	30,15	19.96		
r ≤ 1	r = 2	0.02	5.43	9.24	r = 2	14
LM4 & **LIIP** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.03	13,21	19.96		
r ≤ 1	r = 2	0.02	5.35	9.24	r = 0	16

From the produced results it appears that there is no long run relationship between the different monetary aggregates and the index of industrial production (I.I.P.) with the exception of the narrow money (M1) variable. In Table 1b, we report the likelihood ratio [Johansen] results between the monetary base and the alternative monetary aggregates (with and without deterministic trend in the data).

Table 1b: The Johansen Results (Monetary Base vs. Monetary Aggregates)) Monthly data (*1975Q1 - 1998Q2*)

Hypothesis			***Likelihood***	***5%***	***Numb. Of***	***No. of***
H_0	***H_1***	***Eigenvalues***	***Ratio***	***Critical Value***	***C.E(s)***	***lags***
(Assuming deterministic trend in the data)						
LMB & **LMI** variables						
r = 0	r = 1	0.02	8.92	15.41		
r ≤ 1	r = 2	0.003	0.88	3.76	r = 0	12
LMB & **LM3** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.17	45.10	15.41		
r ≤ 1	r = 2	0.02	5.09	3.76	r = 2	11
LMB & **LM4** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.05	13,92	15.41		
r ≤ 1	r = 2	0.007	1.54	3.76	r = 0	11

(Assuming no deterministic trend in the data)						
LMB & **LM1** variables						
r = 0	r = 1	0.11	41,44	19.96		
r ≤ 1	r = 2	0.02	7,85	9.24	r = 1	12
LMB & **LM3** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.23	64,15	19.96		
r ≤ 1	r = 2	0.04	9,40	9.24	r = 2	11
LMB & **LM4** variables (1980Q1 - 1998Q2)						
r = 0	r = 1	0.08	23,23	19.96		
r ≤ 1	r = 2	0.01	3.93	9.24	r = 1	11

***** At 1% we accept that r =1 between the two variables

Provided that no deterministic trend in the data is assumed, Monetary Base (MB) is cointegrated, at a 5% critical value, with all the other monetary aggregates, with the exception of the narrow definition of the money stock (M1) variable. However, the LR ratio for MB and M1 is very close to the critical value and at a 1% level we can consider that they are co-integrated. In other words, Monetary Base (MB) can be considered been cointegrated with all the other monetary aggregates.

Our next step will be a brief presentation and implementation of the Wald tests for defining the direction of short - run causality between the previously examined sets of variables.

The Wald - test for short - run causality definition

As we have already mentioned, the number of the existing co-integrating vectors (e.g. r = 0, 1, 2), will accordingly transform the nature of our Granger - causality bivariate error-correction tests. Wald tests will then be applied (in order to define the direction of causality in all pairs of variables).

According to Toda and Phillips (1991, *Collorary 1.1 and Theorem 2*) the Wald Likelihood ratio test (λ_w) has an asymptotic $X^2(p)$ distribution[14] if the co - integration rank of matrix Π is equal to one or two (e.g. r = 1 or 2). Furthermore, as Lutkepohl and Reimers (1992) say, *"if r = 0 , the VAR coefficients may be estimated in first differences and the resulting Wald statistic for testing Granger - causality has an asymptotic X^2 (p-1) distribution"*.

[14]P is the number of restrictions which are tested when a Wald test is applied. It is also the lag length of the corresponding bivariate VAR system [e.g. VAR (p)] we mentioned and specified with the help of LR test.

As we mentioned in section 6, when r = 0 our Granger - causality bivariate tests will have no error-correction term (as Π = 0). Moreover, if r = 2 then Π is nonsingular and then the bivariate system is stationary in levels (without taking differences)[15].

The empirical results

Table 2(a) presents the results from the implementation of the Wald test between monetary aggregates and the index of industrial production (I.I.P.).

Table 2a : Wald - tests for short run Granger - Causality
Monthly data (1975Q1 - 1998Q2)
(Monetary Aggregates vs. Industrial Production)

Hypothesis	***Co-integration rank*** *(r = 2)*		***no. of***
H_0	X^2 *– test*	*F- test*	***lags***
LMB does not cause **LIIP**	55,2	3,94	14
LIIP does not cause **LMB**	132,2	9,44	
(1980Q1 - 1998Q2)			
LM3 does not cause **LIIP**	69,9	4,99	14
LIIP does not cause **LM3**	28,75	2,05	
Hypothesis	***Co-integration rank*** *(r = 1)*		
H_0	X^2 *- test*	*F- test*	
ΔLM1 does not cause **ΔLIIP**	43,4	3,10	14
ΔLIIP does not cause **ΔLM1**	85,3	6,09	
Hypothesis	***Co-integration rank*** *(r = 0)*		
H_0	X^2 *– test*	*F- test*	
ΔLM4 does not cause **ΔLIIP**	50,73	3,17	16
ΔLIIP does not cause **ΔLM4**	34,28	2,14	

Note : The critical values for the tests are :

X^2 (14) = 26,12 when ***r = 0*** *and X^2 (15) = 23,34 when* ***r = 1,2*** *for 0.025 level of significance.*

F (14,278) = 1,74 when ***r = 0*** *and F (12,278) = 1,80 when* ***r= 1,2*** *for 5% level of significance.*

From the above results we can easily infer that *feedback* results are produced for all the examined cases.

[15] On the other hand, when r = 1 the corresponding Granger - causality bivariate error-correction tests will have an error-correction term (as Π ≠ 0 and singular). In other words, our causality bivariate error-correction tests will follow the classical Granger and Engle (1987) two - step procedure.

Table 2b now presents the short run causality results between Monetary Base (MB) and the alternative monetary aggregates.

Table 2b : Wald - tests for short run Granger - Causality
Monthly data (1975Q1 - 1998Q2)
(Monetary Base vs. Monetary Aggregates)

Hypothesis	***Co-integration rank*** *(r = 1*,0**)*		***no. of***
H_0	X^2 *– test*	*F- test*	***lags***
ΔLMB does not cause **ΔLM1**	49,3	4,11	12
ΔLM1 does not cause **ΔLMB**	33,2	2,77	
(1980Q1 - 1998Q2)			
ΔLMB does not cause **ΔLM4**	98,4	8,94	11
ΔLM4 does not cause **ΔLMB**	91,8	8,35	
Hypothesis	***Co-integration rank*** *(r = 2)*		
H_0	X^2 *- test*	*F- test*	
(1980Q1 - 1998Q2)			
LMB does not cause **LM3**	83,3	3,94	11
LM3 does not cause **LMB**	149,0	13,5	

Note : The critical values for the tests are :

*X^2 (11) = 21,92 when **r = 0** and X^2 (12) = 23,34 when **r = 1,2** for 0.025 level of significance.*

*F (11,278) = 1,83 when **r = 0** and F (12,278) = 1,80 when **r= 1,2** for 5% level of significance.*

*Assuming no deterministic trend in the data, **Assuming deterministic trend in the data

As in the case of Table 1a we can infer that *feedback* results are also produced in all the examined cases.

The EC.VAR/Causality test for the long - run causality definition

Following Jenkinson's (1986) methodology, the direction of the long-run causality among two variables will be basically revealed from their long run relationship incorporated as an explanatory variable – defined as ECT term in Table 3- inside a two step ECM/Causality test approach[16]. In other words, the statistical significance of this term/variable will show us the direction of the long-run causality. These tests are the most crucial of all because they can guide us to theoretical answers regarding the exogenous or endogenous nature of money.

[16] The ECM/Causality methodology applied here is under the constraint that it is only a test and not a model.

The empirical results

Table 3 presents the results from the implementation of the ECVAR tests.

Table 3 : The EC.VAR tests (*1975-1998*)

$$\Delta y_t = const. + \sum_{i=1}^{n} \alpha \Delta y_{t-1} + \sum_{j=1}^{n} \beta \Delta x_{t-1} - \gamma\, ECT_{-1} + e_t$$

Variables	γ - coefficient & (t- ratio)	Long - run causality direction	No of lags
(assuming deterministic trend in the data)			
ΔLM1 vs ΔLIIP	-0,0004 (-0,53)	LM1 causes LIIP	14
ΔLIIP vs ΔLM1	-0,003 (-4,02)		
(assuming no deterministic trend in the data)			
ΔLM1 vs ΔLIIP	-0,006 (-5,40)	LIIP causes LM1	14
ΔLIIP vs ΔLM1	0,0004 (0,39)		
ΔLMB vs ΔLM1	0,03 (3,96)	LMB causes LM1	12
ΔLM1 vs ΔLMB	-0,04 (-5,60)		
ΔLMB vs ΔLM3	0,03 (-2,05)	LM3 causes LMB	11
ΔLM3 vs ΔLMB	-0,04 (5,85)		
ΔLMB vs ΔLM4	-0,08 (-3,15)	LM4 causes LMB	11
ΔLM4 vs ΔLMB	0,04 (4,02)		

From the above results we can infer the following : Assuming the existence of a deterministic trend in the data, narrow money (M1) seems to "Granger-cause" the index of industrial production (I.I.P). On the other hand, if we assume no deterministic trend in the data, we have many more long run causality results available we can comment upon. More analytically, the index of industrial production « Granger-causes» M1 and monetary aggregates M3 and M4 « Granger-cause» Monetary base (MB). On the other hand, Monetary base (MB) seems to «cause» M1. This last point however can be

justified if we consider that, as Zis and Papadopoulos (1997) noted, the demand for M1 in Greece is unstable.

7. Concluding comments

The basic aim of this paper was the clarification of the way the nature of money has evolved during the last 23 years in the Greek Monetary System. Based on the Lutkepohl and Reimers (1992) causality methodology that was implemented, we can now infer that the empirical evidence showed the following results :

First of all, the statistical evidence does not support the assumption of a structural break in a particular year regarding the monetary aggregates as a consequence of the gradual deregulation process of the late 80's.

Moreover, all data used are very sensitive to the existence of a *deterministic trend*. More analytically, if we assume such existence the only long run causality result is that the index of industrial production «Granger-causes» M1. Although this is a post Keynesian outcome it is not sufficient to reach a verdict concerning the nature of money in Greece. Moreover, in the short run we have clear feedback results which also leave little room for any clear decision regarding the nature of money in Greece.

If we now assume that there is *no deterministic trend* in the data we can reach the verdict that money in Greece is endogenously determined. This is advocated from the direction of the long run causalities between the monetary base (MB) and the two broader definition of the monetary aggregates, M3 and M4. More specifically M3 and M4 "Granger–cause" MB which is an indication that money is endogenously determined and therefore the Greek monetary authorities cannot quite effectively exercise some control over the real economy through the money supply process (using the monetary base variable as a policy 'tool'). In this case we can accept the Post Keynesian view regarding central bank's behaviour as a lender of last resort.

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Table A: Chow test for structural break (*1975Q1 - 1998Q2*)

Variables	X^2 (1)			
Monetary aggregates vs. Industrial production				
LM4 vs LIIP	5,07	(1996:5)	2,4	(1996:6)
LM3 vs LIIP	6,55	(1994:1)	3,7	(1994:2)
LM1 vs LIIP	-	-	-	-
LMB vs LIIP	7,49	(1994:1)	4,04	(1994:2)
Monetary base vs. Monetary aggregates				
LMB vs LM1	-	-	-	-
LMB vs LM3	-	-	-	-
LMB vs LM4	-	-	-	-