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Yannis Panagopoulos
Aristotelis Spiliotis

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Yannis Panagopoulos
Research Fellow
Centre of Planning and Economic Research, Athens, Greece
Aristotelis Spiliotis
AIAS Finance S.A., Omega Bank Group, Athens, Greece
e-mail of correspondence : ypanag@kepe.gr and
a.spiliotis@aiasfinance.gr

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ABSTRACT

The core issue of this paper is to present the way the different schools of economic thought are approaching the money-income relationship (a restricted quantity theory of money approach) as well as the money multiplier model. More analytically, in the theoretical part of our paper we briefly report the arguments between the different post Keynesians schools of thought upon these issues (Accommodationalism, Structuralism, Liquidity Preference and Circuit theory of Money) as well as Monetarism and the New Keynesian view. Then in the statistical part, with the help of advance econometric causality techniques, we are searching for the theory which better "fits the data" in the Greek economy from 1980 to 2000. The results favor the idea that although no particular school is totally prevailing in Greece, Circuitism seems to be the one that is closer to the Greek reality regarding money generation process.

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1. Introduction

The main purpose of this paper is to clarify the idiosygracies that are emerging from the different school of economic thought in explaining the money-income and the money multiplier relationships. A second aim is to implement advance econometric causality techniques upon these idiosygracies, for classifying if this is possible the Greek money generation process -for a prolonged period of time and at the eve of its entrance at E.M.U.- in some particular school.

More analytically, the paper incorporates the following sections : Section 2 briefly presents the basic differences between the post Keynesians school of thought on money (Accommodationalism, Structuralism, Circuit theory of Money and Liquidity Preference approach) as well as the Orthodox and the New Keynesian views[1]. In section 3 a brief historical presentation and evolution of the Greek financial system is presented. Section 4 presents the existing empirical evidence on the money endogeneity issue from the "Greek experience" as well as from the international literature. In section 5, the variables, the data and the sample that will be used in the empirical part of this paper, are presented. Section 6 justifies the implementation of the selected econometric methodology –the Lutkepohl and Reimers (1992) bivariate VAR causality approach- along with a brief discussion on the produced causality results. Finally, in section 7, the concluding comments concerning the nature of money in Greece are presented.

2. The theoretical debate regarding money

In the real world, we face interactions between the main "economic establishments" which are the *monetary authorities*, the *commercial banking industry* and the *households and firms*. These interactions are expressed through the money supply process and consequently affect the direction of causality and stability of the money-income relationship and the money multiplier model (e.g. M*V=P*Q and M=m*H respectively). Moreover, the money interconnection among the three "economic establishments" we mentioned in advance, is producing a continuous fight for dominance between them and consequently upon the overall economy. In simple words, we tend to believe that this "fight" for dominance in the economy is expressed

[1] For an extensive and analytical presentation regarding the different schools of monetary thought see Panagopoulos and Spiliotis (2005).

into the causality implications regarding the *money-income link* and the *multiplier model*.

In theoretical level, the dominant role of monetary authorities (central bank) is better represented through *Monetarism* and partly through New keynesianism. On the other hand, the dominant role of the commercial banking industry, through *New keynesianism,* and the dominant role of households and firms (aggregate demand and its needs) through the four alternative *post-Keynesian* monetary sub-schools of thought. Such diversified analysis is also related to the money endogeneity/ exogeneity issue of the literature. Lets now very briefly meet the schools commencing from the post-Keynesians.

2.1. Accommodatonism-(*ex ante*) Horizontialism

Accommodationalism is actually dealing with the attitude of both commercial and central bank towards the "protagonists" of the economy which are the economic agents and the firms in particular. In other words, Accommodationalism is the pure response of these institutions primarily towards the production needs. These needs are actually borrowing or aggregate demand needs proxied through demand for credit (loans). The emerging causalities regarding money-income link and money multipliers appeared in appendix 1.

2.2. Structuralism

Structuralism holds its roots back to the Minskyian (1957a,b) tradition. In this post keynesian approach, although economic agents and firms play the important role in the economic system, central bank (and auxiliary the commercial banks) is a significant player and has the privilege to accommodate reserve needs or not. This view implies the abandonment of passive accommodation [horizontal credit supply function and horizontialism] and the adaptation of resistance on credit expansion. This could lead to an upward sloping money supply curve (Spiliotis, 1992, Palley, 1996). Moreover, the classical view regarding the direction of the money–income relationship - from the left to the right - is not challenged by the Structuralists. The emerging causalities money-income link and money multipliers appeared in appendix 1.

2.3. Liquidity Preference[2] (L.P.)

In this approach, the problems for the bank credit expansion (and satisfaction of aggregate loan demand needs of agents and firms) are primarily raised by the role and the behavior of households/agents (their deposits which is accounted in the liability side of the banks) in connection with commercial banks' respond through their asset management policies. The emerging causalities money-income link and money multipliers appeared in appendix 1.

2.4. Circuit theory of money (C.T.M.) [3]

In contrast to the other post keynesian monetary theories, Circuit theory of money is a revolutionary view extended to the *money–income* and the multiplier model relationships[4]. Moreover, it is the result of the complexity and the links between three specific causal relationships: Banks and firms, firms and workers and banks and households. The first one is responsible for the *creation*, the second for the *circulation* and the third for the *destruction* of money[5]. The emerging causalities money-income link and money multipliers appeared in appendix 1.

2.5. Monetarism

We are departing now from the heterodox monetary theories and we move to the orthodox views[6]. Friedman, presenting his monetarist' view, underlined that: "*changes in the quantity of money as such in the long run have a negligible effect on real income so that non-monetary forces are 'all that matter' for changes in real income over decades and money 'does not matter' ... I regard the description as money is all that matters for changes in nominal income and for short - run changes*

[2] This section could be also called as *Structuralism* beyond the central bank's accommodation dilemma.

[3] Fontana (2004) makes an interesting attempt of incorporating the components of this monetary theory into the classical *Accommodatonism–Structuralism* debate. We however, prefer to treat it as a different school here.

[4] See Rochon (1999a) for more details. In *Circuitism* money is primarily a flow variable and not a stock one, although it manifest itself as a stock at the very end of the monetary circuit.

[5] See Rochon (1999).

[6] Friedman and the monetarists believed that exogenous increases in the money supply via open market operations may not only operate via the traditional Keynes interest rate mechanism on the marginal efficiency of capital, but it will also lead agents to increase, *pari passu*, the demand for producible household durables. Elaborating this we can end up to the view that *money-income* link runs from the left to the right and the stability of the multiplier model is not challenged.

in real income." (Friedman, 1974, p. 27). In simple words, according to monetarists, any exogenous money supply increase can produce, but only in the short run, an ouput effect. The emerging causalities money-income link and money multipliers appeared in appendix 1.

2.6. New Keynesianism

New Keynesianism money theory is rather operating supplementary to the Orthodox "money channel". As a theory is dealing with the development of "credit channel" focusing primarily on commercial banks' asset management and the substitutability between its elements. For the new Keynesians, the importance "credit channel" is a supply driven one. This "channel" is implemented primarily through the *Lending* channel[7] of the commercial banks but in link with the *Balance sheet* channel of the firms[8]. The general message of these two channels is the following : since other forms of credit satisfaction of firms are not perfect substitutes for bank loans, the loan supply curve will be shifted inwards. Therefore the loan *supply* channel is the dominant figure which is expected to affect investment and consequently the output oucome (e.g. $BC^{\text{supply-driven}} \Rightarrow GDP$)[9]. The emerging causalities money-income link and money multipliers appeared in appendix 1.

In Appendix 1 we summarize all the alternative money theories concerning the money multipliers and the money-output link. We next move to the presentation of the empirical evidence regarding the money multipler effect on the G7 economies as well on some other countries.

3. A brief review of the Greek financial system and monetary policy

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

[7] See Bernanke and Blinder (1988) on the *Lending* channel issue.
[8] See Bernanke and Gertler (1995) for an extensive discussion on the *Balance sheet* channel.
[9] In the New Keynesian literature, the way this channel appears to operate upon output is more highlighted through money or interest rates (or interest rate' spreads) shocks, engineered by the central bank's actions, than directly through a quantitative bank credit variable.

of the total private deposits and 63% of loans to the private sector. These three largest banks of the time were publicly controlled.

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. These included general portfolio allocation requirements on commercial banks to earmark specific fractions of their deposits for the financing of the public sector and small and medium-sized firms, and for long term loans to 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.

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

However, between 1980 and 1987, financial liberalization evolved gradually. The deregulation of the Greek financial system then accelerated, following the 1987 Report of the Committee for the Reform and Modernization 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 Certificate of Deposits and Bank Bonds at market rates. Interest rates were also deregulated on most categories of short-term and long-term loans, which accounted for over 80 percent of bank lending to the private sector (see Figure 2). 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 at the early 90's even this was gradually abolished.

According to Frangakis (1998), in the early 1990 another intervention related to 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, in May 1991 restrictions on long term capital movements with EU countries were also removed and they were completely deregulated at March 1993. At the same year 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) underlined, this "*financial liberalization allowed the creation of products called synthetic swaps*" in the Greek system [10].

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

4.1. The money-income (& endogeneity) issue in Greece

Although the international literature is full of empirical causality tests basically upon the money-income relationship, the Greek experience is rather limited in this issue. It commences with Sougiannis (1985) who made an effort to apply some causality tests (Sims test) for the case of Greece. In particular, testing the direction of causality between the money stock M1 and the Index of Industrial Production (IP), he found that the direction in the Greek economy is not quite clear. On the other hand, testing the causal relationship between M2 (broader definition of the money stock) and IP, he found that unidirectional causality runs from M2 to IP[11].

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. The produced long run causality results initially seems to favor the Monetarist view that money “causes” income. On the other hand, the short run causality results verified this outcome only between money and nominal income. Moreover, even the long run causality results do not lack autocorrelation problems, which make the “Monetarist long run verdict” dubious.

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

[11] 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 of the public debt. So, the degree of monetization of the public sector deficits varies from country to country, depending on the precise nature of the financial institutional arrangements.

Some more recent approaches concerning money endogeneity/exogeneity in Greece has been presented by Apergis and Tsoulfidis (1998) and Hayo (1998). More analytically, Hayo (1998) in his multi country approach incorporated Greece in his causality tests. His estimating period is from 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. The Hayo's results favor the assumptions that money causes income (though the lag specification in his VAR causality tests are given abstractly). On the other hand, Apergis and Tsoulfidis (1998) provide only short run causality results between M1 and real GDP. Their estimating period was 1975:1 to 1993:4. and the results support the feedback assumption between money and income. Finally, a strong debate upon the money (m1)-income causality direction has been recently presented between Karfakis (2002 & 2004) & Özmen (2003). This debate ended up on the importance of lag length specification of estimated VARs for reaching a verdict regarding money exogeneity or endogeneity in Greece.

4.2. The money multiplier (& endogeneity) issue in Greece

Away from the classical money-income causality issue, in Panagopoulos and Spiliotis (2004), it has been proven that in broader monetary aggregates (M3 and M4) money "Granger–cause" monetary base (MB) -under the assumption that there was *no deterministic trend* in the data. This was just an indication that money is endogenously determined and therefore the Greek monetary authorities could not quite effectively exercise some control over the real economy through the money supply process (using the monetary base variable as a policy 'tool')[12]. Finally, a drawback on all these studies was that whenever money endogeneity was proven there was not further discussion about its nature.

4.3. The international experience upon the money-income (& endogeneity) issue

The issue of the *money-income* link was basically discussed by Monetarists and the New Keynesians. It was actually part of the "money channel" analysis with its conequences on output. More analytically, most of the prominent economists of the orthodox school were standing irresolute between two views. That either, there is long

[12] The estimating period was 1975:1 to 1998:2. However, although money endogeneity was empirically revealed, no further analysis upon the "kind of endogeneity" was addressed.

run link between money and output, initiated by the monetary aggregate, or that we have a weakening or even breaking link among the two variables in favor of the interest rates explanatory role for output. For instance, Feldstein and Stock (1994) advocating for the first view in US economy, they support that "*..the Federal reserve could control quarterly M2 growth completely by extending reserve requirements to all of the components of M2.*" In addition they believe that by controlling and adjusting M2 we can restrict the GDP volatility[13]. Friedman and Kuttner (1992) on the other hand, seek the explanation of US future nominal income path, in a VAR approach *versus* monetary aggregates (like MB, M1, M2 and credit) as well as *versus* interest rates (like Treasury bills, Commercial papers and their spread). Their conclusion was that, regardless to the method of estimation, the selected time period affects the produced result. In other words, the pre-80's explanatory power of monetary aggregates is loosing ground as the sample time period is extended to the 90's. It is the spread between Treasury bills and Commercial papers who carry the explanatory role, according to the authors. In simple words, future nominal (and mainly real) output in nowadays is mainly determined by the different specification of interest rate' spreads and secondary by different specification of deposits (monetary aggregates). Bernanke and Blinder (1992, p.904), on the other hand, do not stand in the middle of the river : "*…money has far less predictive power for output than do interest rates* [and this] *is an important challenge to the traditional "money leads income" argument for monetary policy effectiveness.*" For the authors, it is the federal fund rates which perform better than monetary aggregates, treasury bills and bond rates in forecasting real variables (real output decompositions). Finally, Hufer and Kuttan (1997) suggest that the question of the money (M1 & M2)–(real) output long run relationship in USA apart from the sensitivity of time period selection is also affected by the type of stationarity imposed on the data (trend or difference one). [14]

[13] This view deviates from the Monetarists' "money channel" origin which they advocate in favour of a constant growth regarding the selected for policy monetary aggregate.

[14] Note that, behind this disagreements upon the *effectiveness* of "money channel" variables for explaining output is actually hiding a "dispute", inside the two orthodox schools, regarding their prime explanatory role relative to the "credit channel" variables. In simple words, for more than two decades the loosening in the US (and the rest of the developed economies) monetary policy and the enlargement of the financial sector has actually shifted the policy variables inside the orthodox school from monetary aggregates to interest rate spreads in particular. In other words, from central bank controlled variables to commercial banks policy instruments. So, in causality terms, the "hard-liners" will insist that directly (through monetary aggregates and reserves) or indirectly (through federal fund rates), central

4.4. The international experience upon the money multiplier (& endogeneity) issue

Regarding the international literature the most recent characteristic examples of testing endogeneity through causality are the cases of Howells and Houssein (1998), Nell (2000-1), Vera (2001) and Shanmugam, Nair and Li (2003). In the case of Howells and Houssein, the causal relationship between bank lending (BL) and M3 was tested for the G7 countries. Their ECM outcome they produced showed that bank lending (BL) causes M3 in France, Italy, Japan, UK and US. This was considered as a strong indication for accepting money endogeneity especially in those countries. However, they supplement that "*our results seem to suggest that the ability of the demand for loans to cause deposits is constrained by the demand for those deposits.*" This is an indication to accept a strong flavor of liquidity preference view in their inferences.

Nell (2000-1), on the other hand, tested money endogeneity for South Africa (S.A.) by representing Accommodationalism, Structuralism and the Liquidity Preference view in the way Moore (1989b), Palley (1994) and Howells and Houssein (1998), did it respectively. His outcome was that loans cause deposits in S.A. and so endogeneity was verified. Moreover, apart of the clear endogeneity of money, evidence for Liquidity Preference exists in both his examined periods (1966-979 and 1980-1997). In the first subperiod, elements compatible with Accommodationalism and Structuralism were also present. In the second subperiod, Accommodationalism has still some explanatory power. Shanmugam, Nair and Li (2003), apply the same procedure for Malaysia. Their results were that Liquidity Preference view could be supported without however excluding Accommodationalistic influences.

Finally, Vera tested money endogeneity theory for Spain. He was actually tested the causality direction between bank lending (BL) monetary base (MB) and money Supply (MS). The verdict was that Bank lending causes MS, which causes

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bank will effect output. On the other hand, the "moderates" will say that, apart from the spreads, monetary aggregates may or may not affect output. (e.g. MA $\Rightarrow$ or $\neq$ GNP). This "dispute" is expected to have analogous consequences concerning the MB and M.A. long run relationships [e.g. optional MB $\Rightarrow$ MA]. Further empirical discussion on the money-income link can be sought in Stock & Watson (1989) and Swanson (1998) for the U.S. as well as in Krol & Ohanian (1990), Hayo (1998), and Hafer & Kutan (1999) for some multi-country causality approaches.

MB. This result was in favor of the money endogeneity assumption. Vera considers his results as compatible with both Accommodationalism and Structuralism. So, for clarifying the issue, he actually tried to implement the Pollin's "*Proportionality*" idea on liability management behavior as well as to test the variability of mark ups between prime lending and interbank rate. Unfortunately the results did not indicate any clear cut for favoring one of the two approaches.

Moving now to Greece and to the presentation of the empirical part of our study we will first present the data and the variables which will be used in the causality analysis.

5. The data

Our causality analysis covers the relationships that are presented in Appendix 1. The data used are quarterly and the examined period between 1980(1) and 2000(4). Finally, the variables to be implemented are : the gross domestic product in its nominal and real expressions (*GDP* and *RGDP* respectively), the monetary base, *(MB*), the narrow and broad money aggregates (*M1, M2 and M3*), the total bank credit *(BC)* and the credit multipliers *(MIER1=M1/MB, MIER2=M2/MB and MIER3=M3/MB).* All variables are expressed in logarithms (e.g. *LMB, LM1, LM2, LMIER1, LBC*). Figure 1 provides us a diagrammatic presentation of the main variables.

6. Econometric methodology and empirical results

6.1. Methodology

There different econometric "footpaths" someone can implement regarding causality techniques (from simple *E.C.* Models to *Auto Regressive Distributed Lag* procedures). Our empirical procedure was based on *Lutkepohl and Reimers* (1992) methodological approach of causality[15]. The reason (and the advantage) for this specific EC.VAR methodological selection is simple: It is not require an *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 (0),

[15] A brief presentation of the method is given at Appendix 2.

I(1) or I(2))[16]. This is quite helpful since disagreements sometimes exist between the different unit root test, on weather a variable is I (0) or I(1) for example. More analytically, this kind of causality follows the principles of co-integration in bivariate VAR systems, in a step by step basis. This methodology was also used in other empirical papers (see Alexakis, Panagopoulos, Spiliotis (2000)).

One crucial point on this methodology is that if the number of cointegrating vectors between the two examined variables are 1 or 0 (r=1or 0), the EC.VAR's are implemented at their 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. Another crucial point for all the bivariate VAR causality tests applied here (as well as Johansen's results and Wald's weak exogeneity short run causality tests), is the lag length selection procedure which has been implemented. It is now widely accepted that the causality results are very sensitive to the lag length VAR specification (see Karfakis, 2004). For that reason we have decided to apply five (5) different lag length selection criteria[17] for VARs in all our estimated causalities (see Appendix 1). It is important to mention that in many cases the five tests disagree about the optimal lag length (*k* in tables 1a-1f)). Then we choose sub optimal lag length following the majority of the criteria's decision and provided that the selected one had no normality problems (*Cholesky* normality test for VAR's implemented).[18]

6.2. The empirical results

In Table 1a-1f, we report the likelihood ratios [*Johansen's cointegration tests*] results concerning all the "*multiplier effect*" as well as the "*money-output effect*" the way these have been determined in Appendix 1 for each school of thought (assuming *deterministic trend* in the data). Then, we proceeded in the implementation of the *EC.VAR* test in order to derive the direction of causality between the examined bivariate set of variables. The second test was applied when the existence of one cointegrating vectors (r=1) permitted it.

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[16] However unit root test (*Augmented D.F.* as well as *Phillips–Perron*) have been implemented and are available upon request.

[17] These are: the sequential modified LR test statistic (*LR*), the Final prediction error test (*FPE*), the Akaike information criterion (*AIC*), the Schwarz information criterion (*SC*), the Hannan-Quinn information criterion (*HQ*).

[18] All tests results for the VAR's lag length selection of the causality tests have been produced with the help of EViews 4.1 and are available upon request.

*(*see Table 1a-1f)*

From the produced number of cointegrating vectors, r, it is obvious that almost all the expressions of the "*multiplier effect*" do not operate in the Greek economy[19]. In the only case we have some result regarding the *multiplier effect* is in Table 1d (testing the *Circuit Theory of Money*) where bank credit seems –in the *short run* only[20]- to affect money Mier2 and Mier3 respectively at 10% level. The termination of the *multiplier effect* is rather simple. Like in almost all the developed economies the Greece economy, in the last two decades, confronted a period of falling interest rates (see figures 2 and 3) and even reduction of reserve requirements. Moreover, the interest rate dynamic evolution was positively affecting the valuation of the non-loan financial assets of the commercial banks (e.g. Securities, Government bonds, Derivatives, Mutual funds etc). So, banks as profit maximizers used any excess reserves derived from the relaxing monetary policy more for buying these assets than for extending their loans policy. This way banks were in a position to record lots of profits at their income statement analysis, when capital gains from these financial activities will be liquidated. In other words, the profit maximizing ***asset*** function of commercial banks is such environment could be presented as :

Max [w (loans) + (1-w) (non-loan financial assets)]

with w : bank excess reserves.

Consequently (due to the falling interest rates), the prolonged deposit–loan relationship was broken with analogous results for the loan–multiplier relationship. This does not mean that the bank did not care about the expansion of their loans. It simply says that its importance varies (the w factor) with the financial environment and the evolution of interest rates in particular. Moreover, in such "environment" commercial banks care more for asset management and less for liabilities management. In an extreme case, a continuous 1-w increase, could lead to the lose of the central bank exogenous role, of safe-guarding money endogeneity, by allowing the abandonment of credit expansion for productive purposes in favour of destabilishing speculative purposes[21].

[19] We can claim more or less the same for the multipliers of G7 countries (with few but negligible exemptions) where the models have also been tested.
[20] For the methodology implemented for *short run* VAR tests see Appendix 2 as well.
[21] This argument comes from Dow (1989, p. 30) when he analysed the outside (exogenous) central bank role in the provision of credit for demand purposes. So an increasing of 1-w factor (at the expense of w) can even consequently brake the effective link between the bank

Regarding now the "*money – output effect*" the more economically completed results we can comment were produced in the *real* terms results of Table 1d (*Circuit Theory of Money*). More specifically, the results favor the idea that real income precedes ("causes") monetary aggregates M1 (in the short run[22]) and M2 and M3 (in the long run). This implies that real income realization precedes all money stocks and not the other way round. Regarding bank credit now we observe that "*bank credit is in feedback with (real) output*". So primarily we can accept that bank credit causes real income. On the other hand, the reverse causation needs further clarification in the sense that it is expected that bank credit precedes only (as a proxy of aggregate demand) the *realized* income if it is meant to be a proxy of the aggregate demand (e.g. B.C.$^{d} \Rightarrow$ output) and not the reverse as well[23].

Unidirectonally causality ("*Bank credit causes nominal output*") was actually traced in the results of the nominal terms of our study. However, despite the clear result regarding bank credit and nominal output hypothesis, the money-income link falls apart. In particular, nominal GDP is irrelevant to the M1 and M2 aggregates[24]. Despite this long run irrelevance between nominal money income and monetary aggregates we tend to believe that there is an economic explanation for it. The complete destruction of any long run causality in the money multiplier model – regardless of the direction- has its effects upon the money-income link at least in its nominal terms. However one thing is now prevailing: That bank credit (BC) is the policy variable which causes output in real and nominal terms of the economy. In addition, the existing results of the real output-money link advocates in "flavor" of a demand driven than a supply driven bank credit (according to the *Circuit theory of Money*). This will imply that aggregate demand factors seems to be in charge for the Greek economy.

7. Concluding comments

In this paper we presented the way the six different school of economic thought (two mainstream and four post-keynesians) are approaching the *money-income* link

credit and output. Similar result on the money-output link cannot be excluded.

[22] In the long run the real income is irrelevant to M1 (e.g. M1 ≠ RGDP)

[23] Note that no school supports the reverse causality assumption.

[24] M3 seems to cause nominal GDP. However the error correction coefficient of the EC causality VAR(5) was relatively small (-0,02). In overall, these are few and weak evidence to

as well as the *money multiplier* model. Moreover we tested their views upon the Greek economy from 1980 to 2000 with the implementation of advance econometric causality techniques (*Lutkepohl and Reimers (1992)* bivariate VAR causality approach). We can now summarize the main points of our research :

1. The "money multiplier effect" is seems that is not operative in the Greek economy[25] due to the prolonged loosening monetary policy (especially after 1990-figure 2 & 3) on behalf of central bank. This has turned the attention of commercial banks primarily in non-loan asset management policies. This seems to be a key point for breaking the traditional long run loan-deposit and loan-multiplier relationships. Put it another way, the liability management policies, especially in the last decade, were not so much related with economizing reserves for extending loans but with investing them to other asset management policies (we believe this touches all the developed economies-at least the G7[26]). The reason is simple: any prolonged period of falling interest rates simply leads to falling profit from loans but simultaneously leads to substantially higher valuation of other financial assets and therefore much bigger profits for the banks (due to the denominator role in their valuation). That is why the priority for the banks was the asset and not the liability management.
2. Regarding now the question of who holds the dominant role in the Geek economy[27] the answer is that the extensive loosening of monetary policy left Households/Firms and Commercial banks to "fight" for the prime role. Is like leaving aggregate demand and aggregate supply to decide who is the protagonist. To some extent the real "income causes (or precedes) money effect" gives us some reply to it. That aggregate demand is the protagonist (Households & firms) and commercial banks (Financial institutions) satisfy the expressed credit needs. However in nominal terms the "income causes money effect" is not repeated. The only thing that is clear in nominal terms is that *"Bank credit causes* (or precedes) *nominal output"*. But if we want to be severe this is not enough to "proclaim without hesitation victory of Circuitism upon New Keynesianism" in

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make us accept the existence of a New-Keynesianism in the Greek data.

[25] From our unpublished study in almost all G7 countries from 1980 up to almost nowadays.

[26] On this point see Panagopoulos and Spiliotis (2005).

[27] Aggregate demand (*Households & firms*), Commercial banks (*Financial institutions*) or Central bank (*Monetary authorities*).

the Greek economy. We say that because "moderate" New Keynesians could claim that from the moment "income does not causes money" in nominal terms – even though "money does not causes income"- the credit channel could be supply and not demand driven.

3. This last comment we believe that opens the way for future research regarding bank credit (BC) origins. In simple words, is it supply or demand driven? To answer this a decomposition of credit is required on its supply and the demand factors (similar for instance to Panagopoulos and Spiliotis, 1998, equation 3, p. 648). Such an approach can possibly clarify whether the origins of the prevailing *credit channel*. Finally, a second question for further research has to do with something which both schools -Circuitism and New Keynesianism- adopt, underline and discuss but with different consequences for the economy: The priorities and the role of banks' asset management. More analytically, whether asset management restrains bank loans or not. If *yes* then the two schools are rivals, if *no* then the two schools are close cousins.

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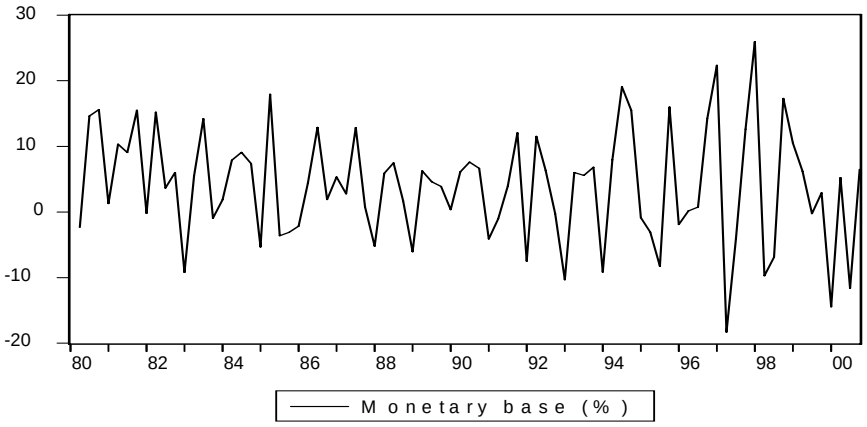
FIGURE 1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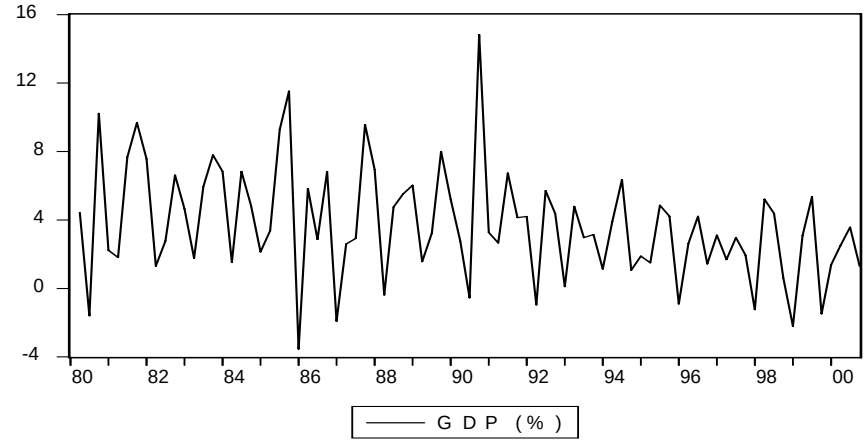
Monetary base (%)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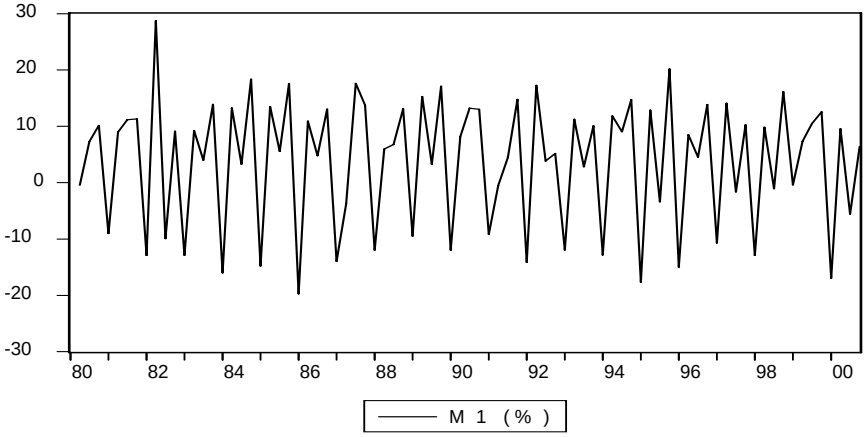
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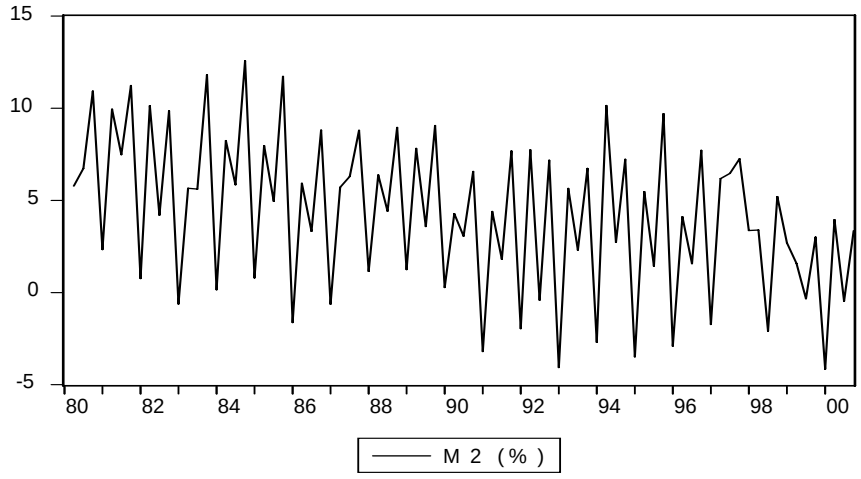
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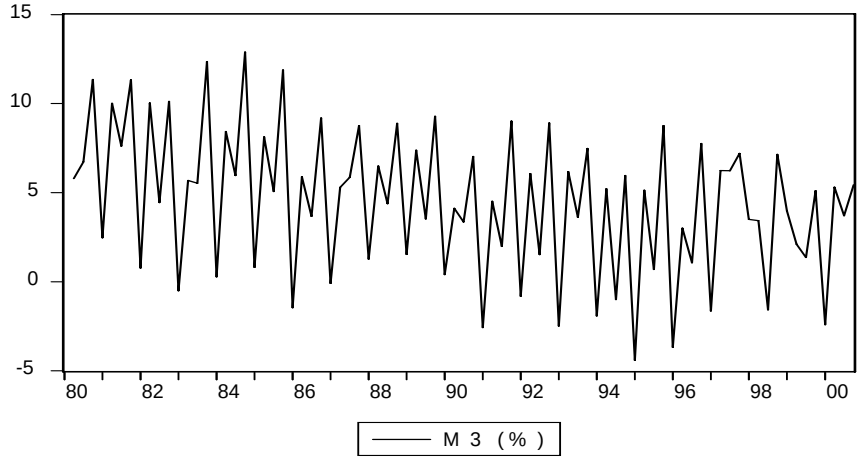
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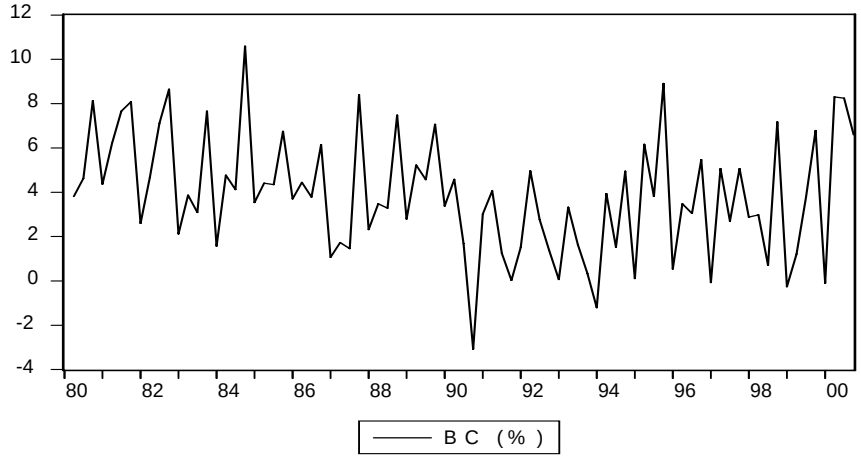
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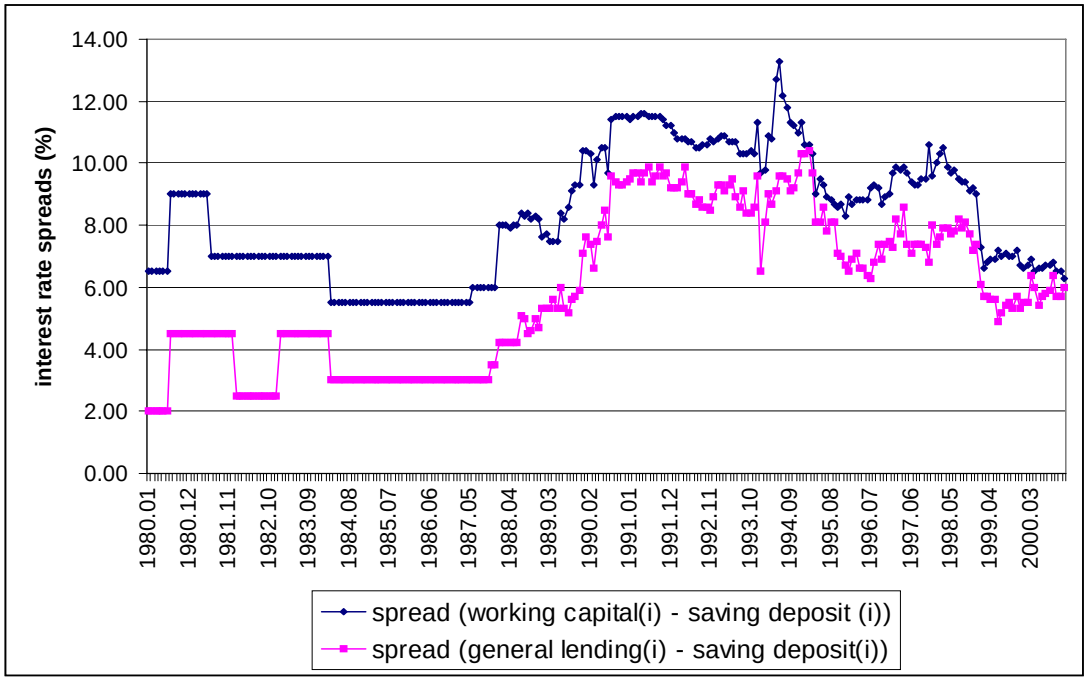
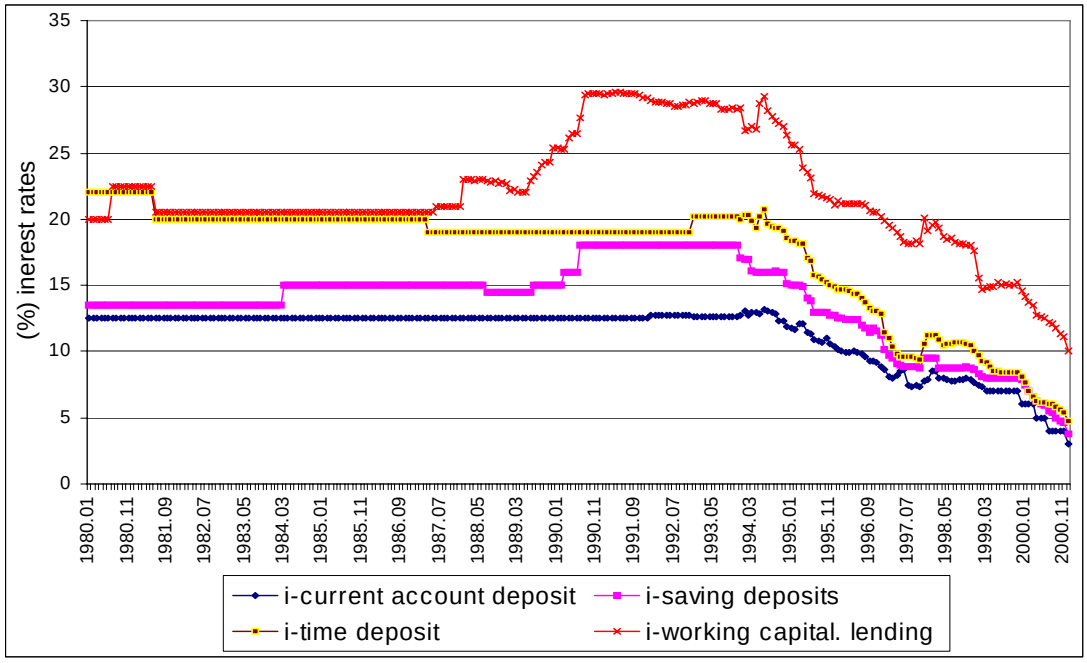
FIGURE 2



w.c.(i) : stands for lending interest rates for working capital needs

i – general : stands for long term lending interest rates

FIGURE 3



i- T.B. : stands for treasury bills rate (proxy for deposit rates)

Table 1a
Testing ***Accommodationalism-Horizontialism***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
BC on MB	10,89	12,55	0	7	BC ≠ MB
&					
BC on Mier1	10,30	11,35	0	6	BC ≠ Mier1
BC on Mier2	8,86	9,64	0	6	BC ≠ Mier2
BC on Mier3	8,86	8,87	0	6	BC ≠ Mier3
"The money -output effect"					
GDP on M1	16,77	19,26	1^{∂}	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
&/or					
RGDP on M1	6,14	6,14	0	5	RGDP ≠ M1
RGDP on M2	15,51	16,12	1^{∂}	5	
RGDP on M3	21,17	21,30	1^{Ψ}	5	

Table 1a (continued)

The EC.VAR tests	the error-correction term (*t-statistic*)	κ *(lag selection)*	the *long run* causality result
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
ΔGDP, expl.^{f} ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3 , expl. ΔGDP	2,46	5	M3 ⇒ GDP
&/or			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2 , expl. ΔRGDP	-3,30	5	M2 ⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3 , expl. ΔRGDP	-3,30	5	M3 ⇐ RGDP

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.
f : expl. stands for explanatory variable.

Table 1b
Testing ***Structuralism***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
BC on MB	10,89	12,55	0	7	BC ≠ MB
&					
BC on Mier1	10,30	11,35	0	6	BC ≠ Mier1
BC on Mier2	8,86	9,64	0	6	BC ≠ Mier2
BC on Mier3	8,86	8,87	0	6	BC ≠ Mier3
"The money -output effect"					
GDP on M1	16,77	19,26	1^{∂}	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
&/or					
RGDP on M1	6,14	6,14	0	5	RGDP ≠ M1
RGDP on M2	15,51	16,12	1^{∂}	5	
RGDP on M3	21,17	21,30	1^{Ψ}	5	

Table 1b (*continued*)

The EC.VAR tests result	**the error-correction term (*t-statistic*)**	**κ *(lag selection)***	**the *long run* causality**
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
ΔGDP, expl. ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3, expl. ΔGDP	2,46	5	M3 ⇒ GDP
&/or			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2, expl. ΔRGDP	-3,30	5	M2 ⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3 , expl. ΔRGDP	-3,30	5	M3 ⇐ RGDP

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.

Table 1c
Testing ***Liquidity Preference***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
BC on M1	4,76	6,13	0	5	BC ≠ M1
BC on M2	9,70	9,96	0	6	BC≠ $M2^{\propto}$
BC on M3	15,28	15,28	0	6	BC≠ $M3^{\propto}$
&					
BC on Mier1	10,30	11,35	0	6	BC ≠ Mier1
BC on Mier2	8,86	9,64	0	6	BC ≠ Mier2
BC on Mier3	8,86	8,87	0	6	BC ≠ Mier3
&					
BC on MB	10,89	12,55	0	7	BC ≠ MB
"The money -output effect"					
GDP on M1	16,77	19,26	1^{∂}	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
&/or					
RGDP on M1	6,14	6,14	0	5	RGDP ≠ M1
RGDP on M2	15,51	16,12	1^{∂}	5	
RGDP on M3	21,17	21,30	1^{Ψ}	5	

Table 1c (*continued*)

The EC.VAR tests result	**the error-correction term (*t-statistic*)**	**κ *(lag selection)***	**the *long run* causality**
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
ΔGDP, expl. ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3, expl. ΔGDP	2,46	5	M3 ⇒ GDP
&/or			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2 , expl. ΔRGDP	-3,30	5	M2 ⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3 , expl. ΔRGDP	-3,30	5	M3 ⇐ RGDP

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.
∝ Some problems of Normality at 5% but not at 1%.

Table 1d
Testing ***Circuit Theory of Money***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
BC on M1	4,76	6,13	0	5	BC ≠ M1
BC on M2	9,70	9,96	0	6	BC≠ M2$^{\propto}$
BC on M3	15,28	15,28	0	6	BC≠ M3$^{\propto}$
&					
BC on Mier1	10,30	11,35	0	6	BC ≠ Mier1
BC on Mier2	8,86	9,64	0	6	BC ≠ Mier2
BC on Mier3	8,86	8,87	0	6	BC ≠ Mier3
"The money -output effect"					
GDP on B.C.	16,28	16,34	1	5	
plus					
GDP on M1	16,77	19,26	1$^{\partial}$	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
alternatively					
RGDP on B.C.	21,18	21,32	1	7	
&					
RGDP on M1	6,14	6,14	0	5	RGDP ≠ M1
RGDP on M2	15,51	16,12	1$^{\partial}$	5	
RGDP on M3	21,17	21,30	1$^{\Psi}$	5	

Table 1d (*continued*)

The EC.VAR *run* tests result	**the error-correction term (*t-statistic*)**	**κ *(lag selection)***	**the *long* causality**
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
ΔBC, expl. ΔGDP	1,00	5	
ΔGDP, expl. ΔBC	-3,57	5	BC ⇒ GDP
plus			
ΔGDP, expl. ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3 , expl. ΔGDP	2,46	5	M3 ⇒ GDP
alternativly			
ΔBC, expl. ΔRGDP	-2,97	5	
ΔRGDP, expl. ΔBC	-2,59	5	BC ⇔ RGDP
&			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2 , expl. ΔRGDP	-3,30	5	M2 ⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3 , expl. ΔRGDP	-3,30	5	M3 ⇐ RGDP

Table 1d (*continued*)

The EC.VAR Short –run tests	**Wald test –Block Exogeneity (X^2 -*statistic*)**	**κ (*lag selection)***	**the *short run* causality result**
"The multiplier effect"			
ΔMIER2 , expl. ΔBC	11,78	6	
ΔBC, expl. ΔMIER2	9,17	6	BC ⇒ Mier2∗
ΔMIER3 , expl. ΔBC	11,39	6	
ΔBC , expl. ΔMIER3	7,97	6	BC ⇒ Mier3*
"The money -output effect"			
ΔRGDP, expl. ΔM1	8,25	5	
ΔM1 , expl. ΔRGDP	10,37	5	RGDP ⇒ M1*

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.
∝ Some problems of Normality at 5% but not at 1%.
* Significant at 10%.

Table 1e
Testing ***Monetarism***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
M1 on M.B.	9,00	9,97	0	5	MB ≠ M1
M2 on M.B.	11,89	11,89	0	9	MB ≠ M2
M3 on M.B.	12,29	15,15	0	5	MB ≠ M3
&					
M1 on Mier1	9,00	9,97	0	5	Mier1≠ M1
M2 on Mier2	14,37	15,15	0	7	Mier2≠ M2
M3 on Mier3	12,29	15,15	0	5	Mier3≠ M3
&					
BC on M1	4,76	6,13	0	5	BC ≠ M1
BC on M2	9,70	9,96	0	6	BC≠ $M2^{\propto}$
BC on M3	15,28	15,28	0	6	BC≠ $M3^{\propto}$
"The money -output effect"					
GDP on M1	16,77	19,26	1^{∂}	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
&					
RGDP on M1	6,14	6,14	0	5	RGDP≠ M1
RGDP on M2	15,51	16,12	1^{∂}	5	
RGDP on M3	21,17	21,30	1^{Ψ}	5	

Table 1e (*continued*)

The EC.VAR tests	**the error-correction term (*t-statistic*)**	**κ *(lag selection)***	**the *long run* causality result**
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
ΔGDP, expl. ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3 , expl. ΔGDP	2,46	5	M3⇒ GDP
&			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2, expl. ΔRGDP	-3,30	5	M2⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3, expl. ΔRGDP	-3,30	5	M3⇐ RGDP

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.

Table 1f

Testing ***New Keynesanism***

Quarterly data (*1980Q1 - 2000Q4***)**

Hypothesis Johansen's Co-integration tests	**λ Max-eigenvalue**	**λ trace**	**Numb. of *C.E.(s)***	**No. of *lags* *(lag selection- k)***	***long-run effect***
"The multiplier effect"					
M1 on M.B.	9,00	9,97	0	5	MB ≠ M1
M2 on M.B .	11,89	11,89	0	9	MB ≠ M2
M3 on M.B.	12,29	15,15	0	5	MB ≠ M3
&					
BC on Mier1	10,30	11,35	0	6	BC ≠ Mier1
BC on Mier2	8,86	9,64	0	6	BC ≠ Mier2
BC on Mier3	8,86	8,87	0	6	BC ≠ Mier3
"The money -output effect"					
the money channel					
GDP on M1	16,77	19,26	1 ∂	5	
GDP on M2	13,84	17,80	0	5	GDP ≠ M2
GDP on M3	15,19	17,74	1	5	
&					
RGDP on M1	06,14	6,14	0	5	RGDP ≠ M1
RGDP on M2	15,51	16,12	1∂	5	
RGDP on M3	21,17	21,30	1Ψ	5	
and					
the credit channel					
GDP on B.C.	16,28	16,34	1	5	
RGDP on B.C.	21,18	21,32	1	7	

Table 1f (*continued*)

The EC.VAR tests *run*	**the error-correction term (*t-statistic*)**	**κ *(lag selection)***	**the *long* causality result**
"The multiplier effect"			
-	-	-	-
"The money -output effect"			
the money channel			
ΔGDP, expl. ΔM1	3,95	5	
ΔM1, expl. ΔGDP	-0,65	5	GDP ≠ M1
ΔGDP, expl. ΔM3	-2,64	5	
ΔM3, expl. ΔGDP	2,46	5	M3 ⇒ GDP
&			
ΔRGDP, expl. ΔM2	1,64	5	
ΔM2, expl. ΔRGDP	-3,30	5	M2 ⇐ RGDP
ΔRGDP, expl. ΔM3	1,57	5	
ΔM3, expl. ΔRGDP	-3,30	5	M3 ⇐ RGDP
The credit channel			
ΔBC, expl. ΔGDP	1,00	5	
ΔGDP, expl. ΔBC	-3,57	5	BC ⇒ GDP
&			
ΔBC, expl. ΔRGDP	-2,97	7	
ΔRGDP, expl. ΔBC	-2,59	7	BC ⇔ RGDP

∂ the Johansen's Co-integration tests provide different number of cointegrated vectors at 1% and 5% level (e.g. 1 at 5% and 0 at 1%).
Ψ The two Co-integration tests disagree upon the number of cointegrated vectors at 5% (1 or 0). We choose to accept the 1 vector and to "solve the difference" at the ECVAR level.

APPENDIX 1

Hypotheses testing for the nature of money

Money theories (*School of thought*)	"**Multiplier effect"**	**"Money - Output effect"** (nominal output)	(real output)
Accommodationalism -Horizontialism	BC⇒ MB[¶] & BC ≠ MIER	GDP ⇔ M.A.	RGDP ⇔ M.A.
Structuralism	BC ⇔ MB[ℜ] & BC⇔ MIER	GDP ⇔ M.A.	RGDP ⇔ M.A.
Liquidity Preference	MIER⇔ BC & BC ⇔ M.A. [optional $BC \neq MB$]	GDP ⇔ M.A.	RGDP ⇔ M.A.
Circuist theory of money	BC ⇒ M.A. & BC ⇒ MIER	BC^d ⇒ GDP & GDP ⇒ M.A.	BC^d ⇒ RGDP & RGDP ⇒ M.A.
Monetarism	MB ⇒ M.A., M.A. ⇒ BC & MIER⇒ M.A.	M.A. ⇒ GDP	M.A. ≠ RGDP
New Keynesianism (*) (***** "*hard-liners"*)	MIER⇒ BC & [$MB \Rightarrow M.A.$]	BC^s ⇒ GDP (*credit channel*) M.A.⇒ GDP (*money channel*)	BC^s ⇒ RGDP (*credit channel*) M.A.⇒ RGDP (*money channel*)
New Keynesianism (•) (•*" moderates"*)	MIER⇒ BC & [optional $MB \neq M.A.$]	BC^s ⇒ GDP (*credit channel*) M.A. ≠ GDP (*money channel*)	BC^s ⇒ RGDP (*credit channel*) M.A.≠ RGDP (*money channel*)

¶ because : BC⇒ MA ⇒ MB (endogeneity effect)

ℜ because : BC⇒ MA ⇒ MB (endogeneity effect) and BC⇐ MA ⇐ MB (non accommodative active *quantitative* Central Bank effect or "exogeneity effect").

BC : stands for total bank credit, MB : stands for monetary base, M.A.: stands for M1 or M2, MIER : stands for money multiplier, RGDP : stands fror real GDP.

APPENDIX 2

The *Lutkepohl and Reimers* Bivariate VAR approach

The Lutkepohl and Reimers (1992) methodological approach of causality follows the principles of co-integration in bivariate VAR systems, in a step by step basis. In the first step, we reparametrize two bivariate vector autoreggresive processes of order p [VAR (p)] to get the corresponding Johansen's (1988) error-correction (EC) forms. Then, with the help of the Johansen tests, the number of the existing co-integrating vectors (e.g. r = 0, 1, 2) will be defined. Moreover, the number of the existing co-integrating vectors will also transform our initial bivariate error-correction systems accordingly. To these reparametrized and transformed Granger - causality bivariate VAR systems, *long run* as well as *short run* tests will be implemented in order to define the direction of possible causality[28].

The Bivariate VAR System

According to the Lutkepohl and Reimers (1992) theoretical presentation, we assume the existence of the following bivariate vector autoreggresive process of order p [VAR(p)] :

$$\begin{bmatrix} Z_t \\ X_t \end{bmatrix} = \sum_{i=1}^{p} \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,i} \end{bmatrix} \begin{bmatrix} Z_{t-i} \\ X_{t-i} \end{bmatrix} + u_t \qquad (1)$$

where Z_t and X_t are the two time series variables and $u_t = (u_{1t}, u_{2t})'$ is the bivariate white noise process with zero mean and nonsingular covariance matrix $\sum_u$.

Reparametrasing (1), by subtracting $(Z_{t-1}, X_{t-1})'$ from both sides of the system and by rearranging the variables , we can get the Johansen's (1988) error-correction (EC) form of the process :

$$\begin{bmatrix} \Delta Z_t \\ \Delta X_t \end{bmatrix} = \sum_{i=1}^{p-1} \Gamma_i \begin{bmatrix} \Delta Z_{t-i} \\ \Delta X_{t-i} \end{bmatrix} - \Pi \begin{bmatrix} Z_{t-p} \\ X_{t-p} \end{bmatrix} + u_t \qquad (2)$$

where

[28] It is importance to underline that we are only consider VAR processes as a good approximation of the unknown process. In other words, if the true process has a VARMA presentation then the whole analysis is under question.

$$\Gamma_i = -(I_k - A_1 - A_2 - ..... A_i),\ i = 1, ..., p-1$$

and $$\Pi = I_k - A_1 - A_2 - ..... A_p$$

Here $$A_i = \begin{bmatrix} \alpha_{11,i} & \alpha_{12,i} \\ \alpha_{21,i} & \alpha_{22,I} \end{bmatrix} \quad i = 1, ..., p.$$

The rank of the matrix Π, say r, will transform process (2) accordingly. More analytically, as Lutkepohl and Reimers (1992) say, *" for r = 1 the two variables Z_t , X_t are co-integrated in the sense of Engle and Granger (1987)*[29] *. If r = 0 then Π = 0 and the system is stationary in first differences. At the other extreme end, if r = 2, Π is nonsingular and the system is stationary in levels (without taking differences)".*

The two likelihood ratio tests (the *Trace* and *Maximal Eigenvalue* tests), from the Johansen's (1988) methodology, can be implemented next for defining the co-integrated rank of the matrix Π of process (2) and therefore the nature of our causality tests. Then *long run* as well as *short run* tests will be implemented in order to define the direction of possible causality. The *long run* test is basically related to the Jenkinson (1986) methodology, where 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 E.C.T. in ECM/Causality model 3 [30]. In other words, the statistical significance of this term/variable (*γ*-coefficient) will show us the direction of the *long-run* causality.

The Wald –weak exogeneity test for short - run VAR's causality

Our next step will be to trace for the existence of any *short - run relationship* [effects] between the bivariate systems with the help of Wald - Likelihood ratio test (λ_w) which has an asymptotic $X^2(p)$ distribution (see Toda and Phillips 1991, *Collorary 1.1 and*

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

[30] The ECM/Causality model applied here will have the following structure :

$$\Delta y_t = const. + \sum_{i=1}^{n} \alpha \Delta y_{t-1} + \sum_{j=1}^{n} \beta \Delta x_{t-1} - \gamma ECT_{-1} + e_t \qquad (3)$$

In all examined cases the Sims' test for the optimal lag length selection, has been implemented.

Theorem 2) [31]. This distribution will be followed if the co - integration rank of matrix Π is equal to one or two (e.g. *r = 1 or 2*). Otherwise, 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"*.

[31]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)].

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